AMALGAMATED TRANSIT UNION
LOCAL 998 • AFFILIATED WITH AFL-CIO
734 North 26th Street Milwaukee, WI 53233 (414) 342-4300 Fax: (414) 342-1998

August 10, 2015

[illegible]
President

[illegible]
Vice President

[illegible]
Financial Secretary-Treasurer

CASSANDRA [illegible]
Recording Secretary

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734 North 26th Street Milwaukee, WI 53233 (414) 342-4300 Fax: (414) 342-1998

JAMES MACON
President
RICK BASSLER
Vice President
JOHN GROH
Financial Secretary-Treasurer
CASSANDRA COBB
Recording Secretary

April 22, 2015

Dear County Supervisor:

On Tuesday, April 21st a violent incident occurred on a Milwaukee County Transit bus. Unfortunately, the company has made no comment about it. In the past, I have requested M.C.T.S. Contract Security to be allowed to carry Tasers. Currently, they are carrying pepper spray, which is no match to a knife, gun or other weapons being brought on the buses, as noted in Tuesday's incident that involved a passenger being stabbed. Right now, our security for the buses are not able to do their jobs, due to the company's policies, which serve no justice for the safety of employees of M.C.T.S. or the riding public. I want M.C.T.S. Contract Security to have more input on security issues, because they are out there every day.
It is my understanding, Supervisor Michael Mayo has formed a task force, which is on paper, but has not been enforced.

I would like to suggest having the county implement a task force combination of Milwaukee County Transit Contract Security, Milwaukee Police Department and the Milwaukee County Sheriff's Department. It is my understanding the Sheriff wants more money for security. Milwaukee County pays the bills for the transit system, which makes them responsible. Also four out of five members of the board of directors of Milwaukee Transport Services are county employees.

Therefore, there is no reason for the Sheriff to be paid more money for security, because he is responsible for the security of the county. All ordinances posted on the bus are county ordinances.

Sincerely,

James Macon, President
Amalgamated Transit Union, Local 998

JM:vc:opeiu9aflcio

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August 10, 2015

JAMES MACON
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MICHAEL BALTON
Vice President
JOHN BRO
Financial Secretary-Treasurer
CASSANDRA COBB
Recording Secretary

To whom it may concern:

I have expressed my concerns about security issues on Milwaukee County Transit System's buses on many occasions. It is my understanding, the company utilizes G4S, formerly known as Wackenhut, as their bus security.

Ms. Schneider, Manager of Security and Street Operations, apparently seems to be unable to do her job and seems to handcuff others from doing their job as well. It is also my understanding that Ms. Schneider does not send for the police when they are needed. Instead, she sends for G4S to respond to the dispatcher on a security issue. Apparently, Ms. Schneider makes all the decisions on a police call security issue. Could it possibly be that she does not want certain security reports to become public knowledge? Why is it unnecessary to file a security report when a supervisor responds to a security issue? At times, supervisors file incident reports, which are received by the company, but never in receipt of the Union. Why? Drivers are expected to fill out security reports, but are not given a copy of the report. Why? This seems to be another way for the company to keep the public ignorant concerning security issues on the buses.

There is a possibility of G4S losing the contract with M.C.T.S. This is a concern of the union and should be for the public. It is my understanding, another company will replace G4S. They will not be allowed to touch a perpetrator, but can only talk to him/her. Yet, the new company is expected to remove a perpetrator from the bus without force. I do not believe the drivers, nor the riding public, will feel safe with this type of security on the buses.

The union has questions and concerns regarding the new company's procedures. We do not want to go backwards. We need to move forward.

At this time, ATU Local 998 would like to have this matter investigated for the safety of our drivers and the riding public. This is a major concern that needs to be addressed for the benefit of the drivers, the riding public, M.C.T.S. and the county.

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September 3, 2015

Dear County Board Supervisor:

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ATU Local 998 is concerned about the process of how the RFP contracting is being done in-house. It is the Local's understanding that M.C.T.S. awarded the contract to L.A. Barton Firm. It is also our understanding that the Appeals Committee is comprised of four individuals and two of them are employed by Milwaukee County Transit System. Obviously, this is a conflict of interest. You are aware that GS4 Security, formerly Wackenhut, has appealed the RFP process. ATU Local 998 believes the appeal is biased in having two of Milwaukee County Transit System's employees sit on the Appeals Committee.

ATU Local 998 is concerned about the handling of the RFP process in obtaining bus security for M.C.T.S. and requests that the County Board of Supervisors conduct a thorough investigation regarding this matter.

ATU Local 998 is also concerned about whomever is awarded the bus security contract, would not be handcuffed by M.C.T.S. from doing their job, as they have done others in the past, through their off-hand procedures.

In closing, ATU Local 998 has submitted numerous requests to have bus security equipped with Tasers. Please review the enclosed information on "*The Effectiveness of Tasers*."

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Enclosure:

Cc: Brian Dranzik

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Enclosure:

Cc: Brian Dranzik

High Incident Routes July 2015

ROUTE 80

	#	% of Rt.
Low Severity	9	47%
Moderate Severity	10	53%
High Severity	0	0%
Total Number of incidents	**19**	

Fare disputes	4	21%
Sleepers	4	21%
Vandalism/Graffiti	3	16%
Intoxicated passengers	2	11%
Objects thrown at bus	2	11%
Other Ordinance violations	2	11%
Fights	1	5%
Off bus incidents	1	5%
Any assault on operator	0	0%
Any assault on psngr on bus	0	0%
Counterfeit passes	0	0%
Lewd conduct	0	0%
Music or loud students	0	0%
Operator Threatened	0	0%
Passenger security issues	0	0%
Police stop bus	0	0%
Suspicious Activity	0	0%
Theft (not counterfeit)	0	0%
Vulgar Language	0	0%
Weapon	0	0%

MCTS High Severity Security Calls for Service JULY 2015

Date	Time	Code	Route	Bus	Badge	Location	Heading	Narrative
07/04/15	11:11 AM	355	23	5316		4901 W Washington Dr	South	Passenger believed that another passenger that was sitting behind him picked his pocket and left the bus. the victim was unable to give a description of thief. WestAllis police requested Transit 4 sent. After interview with police the crime happend on another unknown bus.
07/06/15	10:28 PM	353	22	5310		489 E Center St	East	Operator reported two females approached bus @ Holton and stated they had just been robbed at gunpoint. MPD called CPOs and Transit 9 dispatched to bus . Parties were interviewed by MPD and transported to their destinations by MPD or Family.
07/07/15	9:39 PM	353	19	4822		4144 N Teutonia Ave	North	before boarding the bus a pass had her purse snatched did not want pd involvement at this time
07/09/15	4:26 PM	352	PUR	4819		6202 N Baker Rd	North	operator claiming his keys were stolen told to file report with local pd station
07/09/15	11:59 PM	466	30	5509		1892 N 40th St	West	male passenger boarded stating he had a gun was going to commit suicide & sat down in back of bus mpd sq's3231 3235 transit 9 cpo#36 case#1817 subject conveyed to mental health by mpd sq# 3235.
07/14/15	11:54 AM	342	19	5431		141 W Wisconsin Ave	North	A female passenger was punced in the face by another male passenger.Cpo requested Transit 6 sent. Bell Amb 401 treated on the scene
07/17/15	10:37 PM	342	GOL	5512		3109 N Sherman Blvd	East	Male passenger assaulted transit 9 Mfd eng# 13 mpd sq#7272 cpo#3 case#1888 all 3 actors were GOA transit 9 conveyed victim to residence delay 10:37pm- 11:16pm sent nis to UWM for in service w.b. @ 11:22pm
07/19/15	5:54 PM	355	61	5509		3803 N Sherman Blvd	West	pass claiming that another pass stole things out of her wallet. mpd notified. cpos and supervisor sent. cpos got everything in order pd disregarded. case 1904
07/20/15	11:46 AM	342	28	5513		5529 N 107th St	South	A female passenger was struck in the face by another female passenger Mpd & CPO'S requested.Transit 5 sent. Both females involved left prior to Police and Cpo arrival. No citations issued. Case#1909 Cpo#8
07/20/15	2:37 PM	466	62	4817		4220 W Capitol Dr	West	pass had a knife on the bus cpos sent. subject found knife taken from subject warned and released. case 1911
07/26/15	12:00 PM	466	GRE	5161		186 N Water St	North	Operator reported a passenger had a gun on the bus. MPD sent. Bus was intercepted at Water/Pleasant. The passenger was arrested for DC due to gun being a toy. Sup 3 & 5 CPO 5 and MPD Sq. 1121
07/26/15	8:38 PM	353	30	5333		4058 N Sherman Blvd	West	cell phone taken off bus. MPD called instructed that female would have to call the non-emergency # to file a report.bus

MCTS High Severity Security Calls for Service JULY 2015

Date	Time	Code	Route	Bus	Badge	Location	Heading	Narrative
07/28/15	5:46 PM	355	53	5419		2389 S Bay St	East	Operator stated passengers reported a male stole a womans computer from the bus. Instructed to fill out an incident report
07/28/15	8:13 PM	466	27	5202		4704 US 241	North	passenger claiming to have a knife operator does not see anything at this time. cpos sent. No knife. Subject seemed cognitively challenged and removed from the bus allowed to ride next bus to final destination with cpo ride follow. case 1978
07/31/15	12:16 PM	345	31	5316		Mayfair	West	A passenger was assaulted while attempting to board the bus.The passenger did not want Police Security or Medical. no injury reported. supervisor to intercept bus when available.

ROUTE	# OF INC.
6	0
12	0
14	0
15	0
19	2
21	0
22	1
23	1
27	1
28	1
30	2
30X	0
31	1
33	0
35	0
51	0
52	0
53	1
54	0
55	0
56	0
57	0
60	0
61	1
62	1
63	0
64	0
67	0
76	0
79	0
80	0
RED	0

GRN	1
BLU	0
PUR	1
GOL	1
Other	0
Total	**15**

Type	Number	% of Total
Any assault on operator	0	0.00%
Thefts	4	26.67%
Any assault on Passenger (on bus)	3	20.00%
Off bus incidents	4	26.67%
Weapons (on and off bus)	4	26.67%
Total	**15**	

Transfer thefts	0

MCTS TRANSPORTATION SECURITY COMMITTEE
MAJOR INCIDENT UPDATES

August 19, 2015

OPEN CASES

Matthew Jones – 2015CM001405 & 2015CM001670 – OUT OF CUSTODY
$11,000 bail reduced to $350 on 6/12/15

Disorderly Conduct – Spitting on an Operator 4-23-15
Disorderly Conduct – on Bus - 4-19-15
Disorderly Conduct – Assault on Passenger 5-15-15
Bail Jumping – and Repeat Offender charge modifier
Next Court Date: September 15, 8:30 a.m. Sentencing hearing

Corian Morgan – 2013CF002081– IN CUSTODY – Mendota

- Substantial Battery and Battery to a Transit Operator – 05-08-13
- Sent to Mental Health facility for treatment.
- **Next Court Date: 9-1-15, 8:30 a.m. for another competency report**

Burgess Jr., Edward, B. – 2015CF002462 – IN CUSTODY

- Battery to a transit Operator 06-01-2015 Route 12/213 11:50 a.m.
- Cash bail set at $2500.00 - TURNED OVER to JUSTICE Point for Supervision.
- Absolute sobriety. No possession of dangerous weapons or firearms.
- Defendant to have no CONTACT WITH OPERATOR
- Next Court Date: **AUG 31st, 2015 at 8:30 am.** For Plea and Sentencing

CLOSED CASES

Welch, Hoover, R. – 2015CF000757 – IN CUSTODY MCSDF

- Battery to a transit Operator 02-15-2015 Route 12/202 6:00 p.m.
- Found Guilty on 8-4-15 to serve 6 months in HOC – Anticipated Release: 2-4-16

Repeat Offenders Status

- **Xavier Over – Active Community Supervision**
- **Kenyan Brown (A.K.A.Tupac)– Supervised Living Facility**
- **Paul Fox (A.K.A.Pee Wee)– Active Community Supervision**
- **Steven Reasby — Active Community Supervision**
- **Robert Hayes – HOC for non-transit-related offense**

Milwaukee County Transit System

SECURITY BULLETIN

For Employees - Transportation Department

CONTINUOUS POSTING

WEAPONS ON BUSES

Passengers are allowed to open and conceal carry weapons on buses. MCTS cannot deny a ride to anyone carrying a handgun or electronic weapon legally, but we can contact the police in the following circumstances:

If the person with the weapon:

- Appears under the influence of drugs or alcohol
- Is acting in a threatening or disorderly manner
- Is carrying the weapon in his or her hand without it being in a case or protective covering
- Is pointing the weapon at any person

What do you do if a person with a weapon is disorderly?

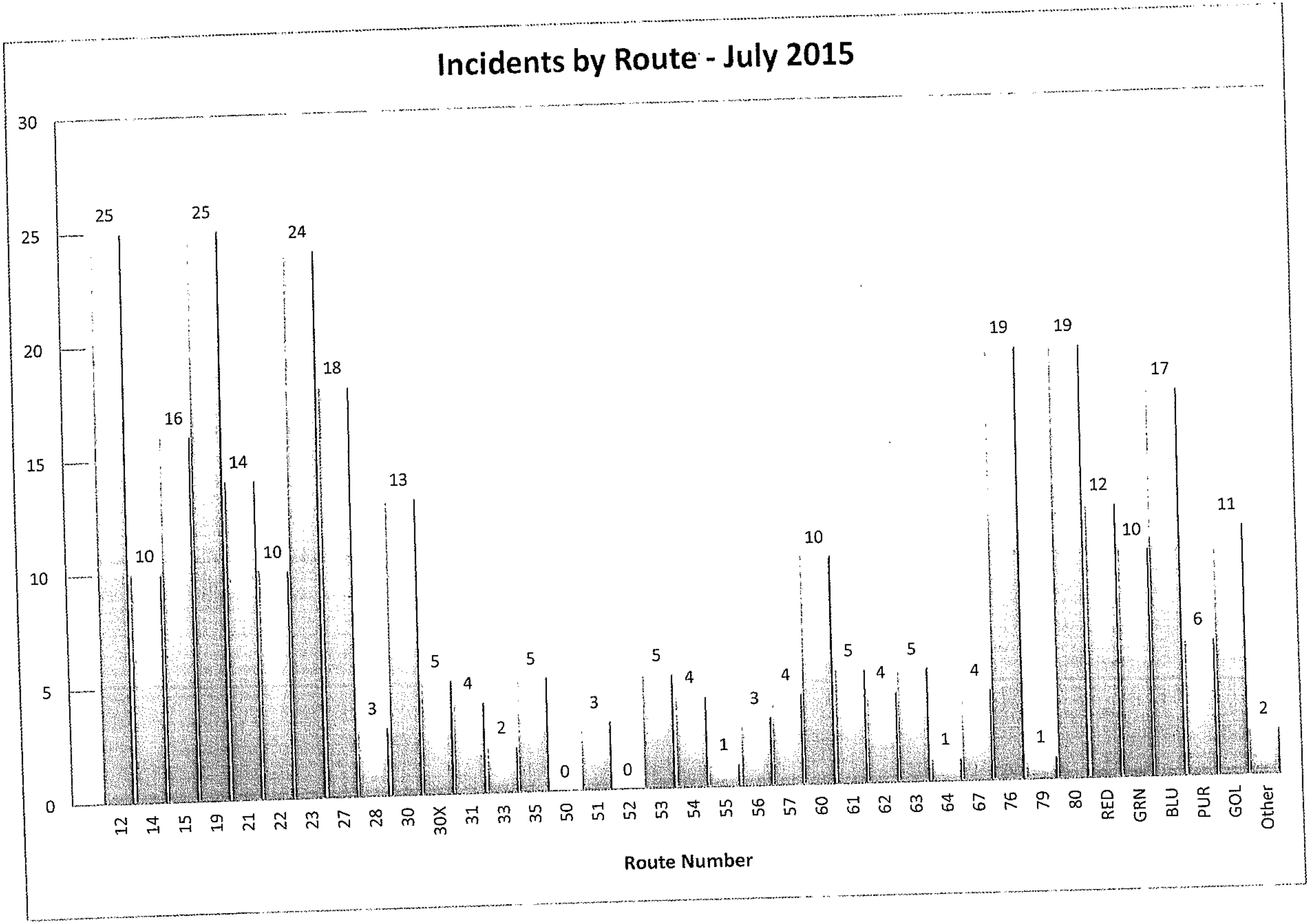
- Immediately pull the bus over, allowing you and passengers to leave the bus if needed
- Contact the dispatcher via PRTT, or from a safe location and give them detailed information about behavior of the passenger and the weapon.
- Only use the silent alarm if you feel that direct communication with dispatcher would cause you harm.

If a person is disorderly and a weapon is visible, Dispatch will call the police immediately.

If a person is disorderly and threats are made or weapons are implied but not seen, Security and MCTS route supervision will be dispatched.

Always contact the dispatcher again if a situation changes or your safety is compromised.

Questions can be directed to Julie Schneider at 937-3228 or jschneider@mcts.org



Incidents by Route - July 2015
30
25
20
15
10
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0
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10
16
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30X
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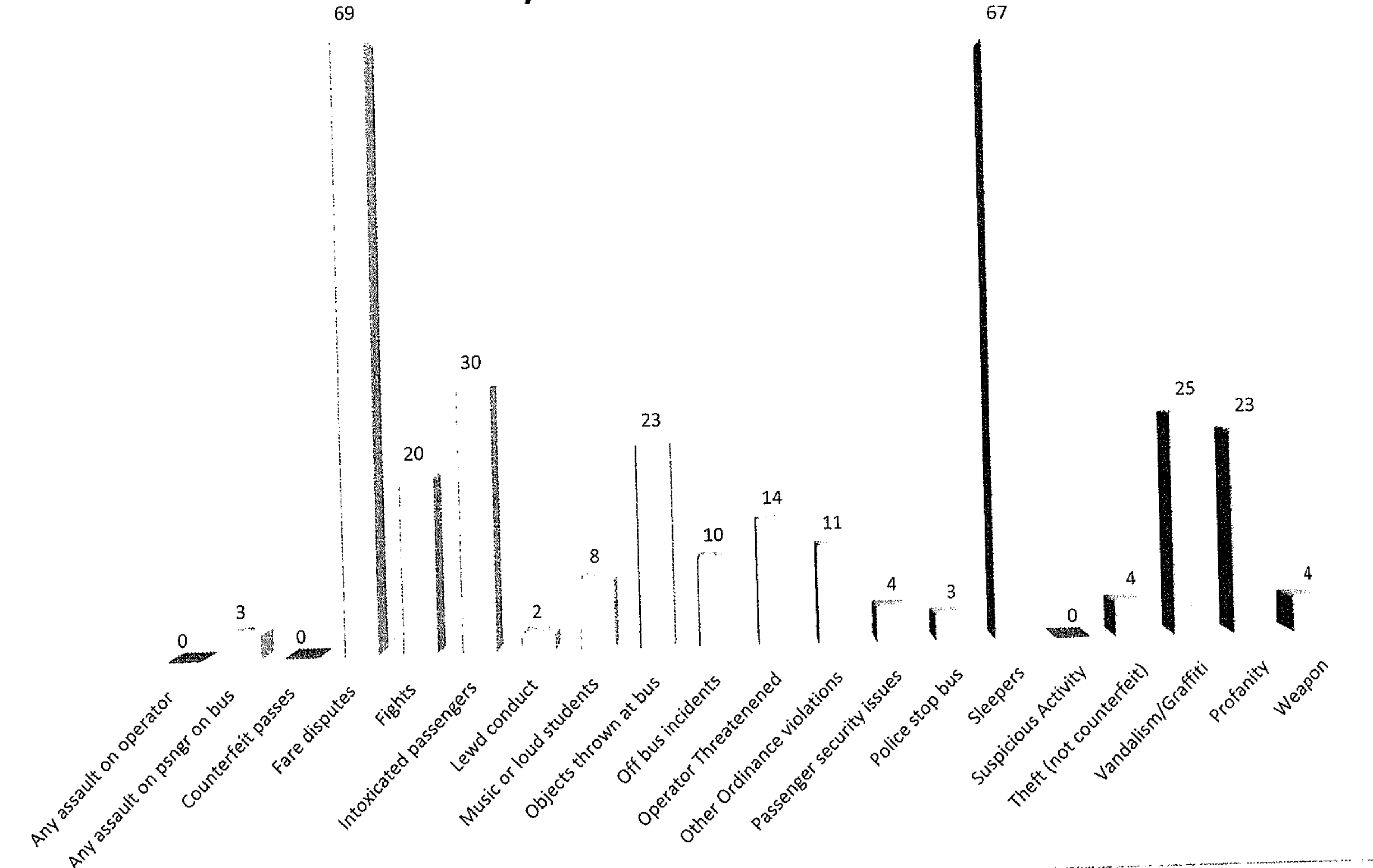
63
64
67
76
79
80
RED
GRN
BLU
PUR
GOL
Other
Route Number

July 2015 Calls by Type



Security Committee Meeting – August 20, 2015

Agenda:

- Reports and Incidents Overview
- Schools and Operator Security Reports
- Transit Security Task Force.
- Security Project Updates
  - Grants
  - Security camera update
- Station Updates

Date for Next meeting is
Thursday, **September 17th, 2015**

9:00 a.m. in the Transportation Training Room

Oleoresin Capsicum Spray and Tasers: A Comparison of Factors Predicting Use and Effectiveness

Steven G. Brandl and Meghan S. Stroshine

******SUMMARY REVIEW ONLY*****

In a study performed by TASER International (2002), the effectiveness of the OC Spray and the Taser were compared, but only when both were used in the same incident. In these encounters, OC Spray was effective 33% of the time while the Taser was effective in 83% of cases.

The study by Brandl and Stroshine examines the factors that predict the use and effectiveness of OC Spray (N=259) and Tasers (N=245) in a single large municipal police department (**Milwaukee PD**). Data were obtained from official use-of-force reports of the police department on incidents that occurred in 2010 and 2011.

OC Spray and Tasers

Oleoresin capsicum (OC) spray, otherwise known as pepper spray is an inflammatory agent naturally found in cayenne peppers. When a person is sprayed with OC spray, the effects are immediate: the respiratory tract becomes inflamed, the individual experiences an intense burning sensation and swelling around the eyes, and the subject's eyes close involuntarily (Lumb & Friday, 1997). Although the subject may be in extreme discomfort, he or she may be able to resist. OC spray was less likely to cause injury than bodily force, batons, and flashlights (Lumb & Friday, 1997).

The **Taser** delivers and electrical current which overrides the central nervous system, causing involuntary muscle contractions and incapacitation (Alpert et al, 2011; Means and Edwards, 2005). The Taser has advantages over other less-lethal alternatives including their greater reliability at longer distances, the relatively quick recovery time involved, and their perceived effectiveness in inducing suspect compliance (White & Ready 2010). In addition, because **Tasers do not rely on pain to induce compliance, ideally they should be more effective on persons who have a higher tolerance of pain, such as people under the influence of drugs or alcohol or who have a mental illness (Means & Edwards, 2005).**

With regard to Tasers, it has been demonstrated that the risk of death when a Taser is used is less than 0.25 percent (NIJ, 2011), and in those situations the death is likely to be a result of drug intoxication, preexisting heart conditions, and exposure to other forms of nonlethal police force (White & Ready, 2007). White and Ready (2010) found an effectiveness rate of 85% for the Taser.

The Effectiveness of Tasers

In the study conducted on the Milwaukee PD by Brandl and Stroshine (2011) the Taser was considered to be effective if it led to the "successful incapacitation" of the subject. Brandl and Stroshine **found that after deploying a Taser "85% of subjects were subdued by the Taser and taken into custody." Analyses performed revealed that the Taser was the most effective in the "highest risk" situations.**

In a study conducted of the NYC Police Dept by White and Ready (2010) suspect resistance situations where the Taser temporarily resulted in incapacitation of the suspect, found that the suspect subsequently resisted prior to the conclusion of the incident approximately 11% of the time. White and Ready found the Taser to be less effective on heavier subjects (i.e. over 200 lbs), subjects who were under the influence of drugs or alcohol, subjects who were violent, when another less lethal weapon was used, when one or both prongs missed the subject, and when the Taser was fired from farther away (i.e. greater than 3 feet). When effectiveness was based on officer satisfaction, the Taser was also perceived to be more effective when the suspect was armed with a knife or gun.

Conclusions

Effectiveness of the Taser has been found to range from 66% to 89% (White & Ready 2010). Despite the variation in effectiveness estimates, it appears that most studies confirm the Taser to be more effective than OC spray. Milwaukee employed approximately 1,200 patrol officers during the time of the study, serving a population of approximately 600,000 citizens; 40% of whom were African American and 10% Latino. Officer who were selected to be Taser trained participated in 16 hours of "new user" training and an additional 8 hours of refresher training every 2 years. *The only training required by Taser international is the 8 hours of "new user" training.*

Results

OC spray and a Taser were equally likely to be used regardless of subject age, sex, weight, or height (Brandl and Stroshine, 2011). A Taser was significantly more likely to be used than OC when the subject appeared to be mentally disturbed, was believed to be aremed with a weapon, when the subject was actually armed with a weapon, and when the subject fled the police on foot. ***OC*** *was more likely to be used than a Taser when more than one subject had force used upon them in the incident;* **a Taser was more likely to be used than OC when more officer used force in the incident.** When the subject was believed to be mentally disturbed, a Taser was more than two times more likely to be used than OC spray. Second, when the subject was ***believed to be armed, a Taser was significantly more likely to be used than OC spray.*** Finally, when there were more subjects involved, OC spray was nearly 80% more likely to be used than a Taser.

Of the 245 incidents where a Taser was used, in 85 of them, only a Taser was used. In the other 160 incidents, a Taser and some other force were used. ***In 136 of the 160, a Taser was the last type of force used.***

To calculate an effectiveness rate of Tasers, the 85 incidents that only involved a Taser and the 136 incidents where a Taser was used last are combined (85+136) and divided by the total number of incidents in which a Taser was used (245). This calculation results in a 90.2% effectiveness rate. It is clear that Tasers demonstrate a substantially higher effectiveness rate than OC.

Based on the multivariate analyses, only on factor increased the odds of OC spray being used: when there were more subjects involved, OC spray was significantly more likely to be used than a Taser. This finding speaks directly to an advantage of OC spray over the Taser; ***it can be used on more than one subject at a time.***

The best predictor of Taser use was whether the subject was mentally disturbed. No previous studies of Taser use have included this variable. Brandl and Stroshine found the Taser was more than two time more likely than OC spray to be used on mentally disturbed subjects (23% of the time). This finding was attributed to several factors. The officer may perceive the Taser to be particularly appropriate and effective with potentially volatile and unpredictable subjects. Officer may be reluctant to get to close to such subjects because of their concern of unpredictable behavior or reaction.

When the subject was ***believed*** to be armed with a weapon, a Taser was also significantly more likely to be used than OC spray. A Taser allows officer to keep their distance from such a subject but still deal with the uncertain threat posed by him or her, possibly preventing injury to both. None of the multivariate analyes conducted by Brandl and Stroshine found subject rage, age, or sex to exert a significant influence on OC spray and Taser use.

The only significant predictor of OC spray ineffectiveness was subject resistance. ***The more a subject resisted the police, the less likely QC spray was to be effective.*** When OC spray was used in situations where the subject resisted, it was likely that OC was not the last type of force used. It is safe to say that Tasers have inherent advantages over OC spray in their ability to incapacitate subjects. It is important not to lose sight of the fact that OC spray and Tasers are simply tools; decision making is an important factor of effectiveness.

Follow Up Considerations:

1. Is OC spray used at a lower rate if more officers are equipped with Tasers?
2. Does the amount, type, and quality of training received by officers on OC spray and Tasers impact their use and effectiveness?
3. To what extent does organizational policy regarding the use of OC spray and Tasers affect their use and effectiveness?

Most use-of-force incidents begin with bodily force and most injuries to officers are as a result of bodily force (Adams, 1999). There are situations where bodily force (or certain types of bodily force) should be avoided and OC spray and Tasers used instead.

Oleoresin Capsicum Spray and Tasers: A Comparison of Factors Predicting Use and Effectiveness

Steven G. Brandl and Meghan S. Stroshine

******SUMMARY REVIEW ONLY*****

In a study performed by TASER International (2002), the effectiveness of the OC Spray and the Taser were compared, but only when both were used in the same incident. In these encounters, OC Spray was effective 33% of the time while the Taser was effective in 83% of cases.

The study by Brandl and Stroshine examines the factors that predict the use and effectiveness of OC Spray (N=259) and Tasers (N=245) in a single large municipal police department (**Milwaukee PD**). Data were obtained from official use-of-force reports of the police department on incidents that occurred in 2010 and 2011.

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The **Taser** delivers and electrical current which overrides the central nervous system, causing involuntary muscle contractions and incapacitation (Alpert et al, 2011; Means and Edwards, 2005). The Taser has advantages over other less-lethal alternatives including their greater reliability at longer distances, the relatively quick recovery time involved, and their perceived effectiveness in inducing suspect compliance (White & Ready 2010). In addition, because **Tasers do not rely on pain to induce compliance, ideally they should be more effective on persons who have a higher tolerance of pain, such as people under the influence of drugs or alcohol or who have a mental illness (Means & Edwards, 2005).**

With regard to Tasers, it has been demonstrated that the risk of death when a Taser is used is less than 0.25 percent (NIJ, 2011), and in those situations the death is likely to be a result of drug intoxication, preexisting heart conditions, and exposure to other forms of nonlethal police force (White & Ready, 2007). White and Ready (2010) found an effectiveness rate of 85% for the Taser.

The Effectiveness of Tasers

In the study conducted on the Milwaukee PD by Brandl and Stroshine (2011) the Taser was considered to be effective if it led to the "successful incapacitation" of the subject. Brandl and Stroshine **found that after deploying a Taser "85% of subjects were subdued by the Taser and taken into custody." Analyses performed revealed that the Taser was the most effective in the "highest risk" situations.**

In a study conducted of the NYC Police Dept by White and Ready (2010) suspect resistance situations where the Taser temporarily resulted in incapacitation of the suspect, found that the suspect subsequently resisted prior to the conclusion of the incident approximately 11% of the time. White and Ready found the Taser to be less effective on heavier subjects (i.e. over 200 lbs), subjects who were under the influence of drugs or alcohol, subjects who were violent, when another less lethal weapon was used, when one or both prongs missed the subject, and when the Taser was fired from farther away (i.e. greater than 3 feet). When effectiveness was based on officer satisfaction, the Taser was also perceived to be more effective when the suspect was armed with a knife or gun.

Conclusions

Effectiveness of the Taser has been found to range from 66% to 89% (White & Ready 2010). Despite the variation in effectiveness estimates, it appears that most studies confirm the Taser to be more effective than OC spray. Milwaukee employed approximately 1,200 patrol officers during the time of the study, serving a population of approximately 600,000 citizens; 40% of whom were African American and 10% Latino. Officer who were selected to be Taser trained participated in 16 hours of "new user" training and an additional 8 hours of refresher training every 2 years. *The only training required by Taser international is the 8 hours of "new user" training.*

Results

OC spray and a Taser were equally likely to be used regardless of subject age, sex, weight, or height (Brandl and Stroshine, 2011). A Taser was significantly more likely to be used than OC when the subject appeared to be mentally disturbed, was believed to be aremed with a weapon, when the subject was actually armed with a weapon, and when the subject fled the police on foot. ***OC** was more likely to be used than a Taser when more than one subject had force used upon them in the incident;* **a Taser was more likely to be used than OC when more officer used force in the incident.** When the subject was believed to be mentally disturbed, a Taser was more than two times more likely to be used than OC spray. Second, when the subject was ***believed to be armed, a Taser was significantly more likely to be used than OC spray.*** Finally, when there were more subjects involved, OC spray was nearly 80% more likely to be used than a Taser.

Of the 245 incidents where a Taser was used, in 85 of them, only a Taser was used. In the other 160 incidents, a Taser and some other force were used. ***In 136 of the 160, a Taser was the last type of force used.***

To calculate an effectiveness rate of Tasers, the 85 incidents that only involved a Taser and the 136 incidents where a Taser was used last are combined (85+136) and divided by the total number of incidents in which a Taser was used (245). This calculation results in a 90.2% effectiveness rate. It is clear that Tasers demonstrate a substantially higher effectiveness rate than OC.

Based on the multivariate analyses, only on factor increased the odds of OC spray being used: when there were more subjects involved, OC spray was significantly more likely to be used than a Taser. This finding speaks directly to an advantage of OC spray over the Taser; ***it can be used on more than one subject at a time.***

The best predictor of Taser use was whether the subject was mentally disturbed. No previous studies of Taser use have included this variable. Brandl and Stroshine found the Taser was more than two time more likely than OC spray to be used on mentally disturbed subjects (23% of the time). This finding was attributed to several factors. The officer may perceive the Taser to be particularly appropriate and effective with potentially volatile and unpredictable subjects. Officer may be reluctant to get to close to such subjects because of their concern of unpredictable behavior or reaction.

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Follow Up Considerations:

1. Is OC spray used at a lower rate if more officers are equipped with Tasers?
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In a study conducted of the NYC Police Dept by White and Ready (2010) suspect resistance situations where the Taser temporarily resulted in incapacitation of the suspect, found that the suspect subsequently resisted prior to the conclusion of the incident approximately 11% of the time. White and Ready found the Taser to be less effective on heavier subjects (i.e. over 200 lbs), subjects who were under the influence of drugs or alcohol, subjects who were violent, when another less lethal weapon was used, when one or both prongs missed the subject, and when the Taser was fired from farther away (i.e. greater than 3 feet). When effectiveness was based on officer satisfaction, the Taser was also perceived to be more effective when the suspect was armed with a knife or gun.

Conclusions

Effectiveness of the Taser has been found to range from 66% to 89% (White & Ready 2010). Despite the variation in effectiveness estimates, it appears that most studies confirm the Taser to be more effective than OC spray. Milwaukee employed approximately 1,200 patrol officers during the time of the study, serving a population of approximately 600,000 citizens; 40% of whom were African American and 10% Latino. Officer who were selected to be Taser trained participated in 16 hours of "new user" training and an additional 8 hours of refresher training every 2 years. *The only training required by Taser international is the 8 hours of "new user" training.*

Results

OC spray and a Taser were equally likely to be used regardless of subject age, sex, weight, or height (Brandl and Stroshine, 2011). A Taser was significantly more likely to be used than OC when the subject appeared to be mentally disturbed, was believed to be aremed with a weapon, when the subject was actually armed with a weapon, and when the subject fled the police on foot. ***OC** was more likely to be used than a Taser when more than one subject had force used upon them in the incident;* **a Taser was more likely to be used than OC when more officer used force in the incident.** When the subject was believed to be mentally disturbed, a Taser was more than two times more likely to be used than OC spray. Second, when the subject was ***believed to be armed, a Taser was significantly more likely to be used than OC spray.*** Finally, when there were more subjects involved, OC spray was nearly 80% more likely to be used than a Taser.

Of the 245 incidents where a Taser was used, in 85 of them, only a Taser was used. In the other 160 incidents, a Taser and some other force were used. ***In 136 of the 160, a Taser was the last type of force used.***

To calculate an effectiveness rate of Tasers, the 85 incidents that only involved a Taser and the 136 incidents where a Taser was used last are combined (85+136) and divided by the total number of incidents in which a Taser was used (245). This calculation results in a 90.2% effectiveness rate. It is clear that Tasers demonstrate a substantially higher effectiveness rate than OC.

Based on the multivariate analyses, only on factor increased the odds of OC spray being used: when there were more subjects involved, OC spray was significantly more likely to be used than a Taser. This finding speaks directly to an advantage of OC spray over the Taser; ***it can be used on more than one subject at a time.***

The best predictor of Taser use was whether the subject was mentally disturbed. No previous studies of Taser use have included this variable. Brandl and Stroshine found the Taser was more than two time more likely than OC spray to be used on mentally disturbed subjects (23% of the time). This finding was attributed to several factors. The officer may perceive the Taser to be particularly appropriate and effective with potentially volatile and unpredictable subjects. Officer may be reluctant to get to close to such subjects because of their concern of unpredictable behavior or reaction.

When the subject was ***believed*** to be armed with a weapon, a Taser was also significantly more likely to be used than OC spray. A Taser allows officer to keep their distance from such a subject but still deal with the uncertain threat posed by him or her, possibly preventing injury to both. None of the multivariate analyes conducted by Brandl and Stroshine found subject rage, age, or sex to exert a significant influence on OC spray and Taser use.

The only significant predictor of OC spray ineffectiveness was subject resistance. ***The more a subject resisted the police, the less likely QC spray was to be effective.*** When OC spray was used in situations where the subject resisted, it was likely that OC was not the last type of force used. It is safe to say that Tasers have inherent advantages over OC spray in their ability to incapacitate subjects. It is important not to lose sight of the fact that OC spray and Tasers are simply tools; decision making is an important factor of effectiveness.

Follow Up Considerations:

1. Is OC spray used at a lower rate if more officers are equipped with Tasers?
2. Does the amount, type, and quality of training received by officers on OC spray and Tasers impact their use and effectiveness?
3. To what extent does organizational policy regarding the use of OC spray and Tasers affect their use and effectiveness?

Most use-of-force incidents begin with bodily force and most injuries to officers are as a result of bodily force (Adams, 1999). There are situations where bodily force (or certain types of bodily force) should be avoided and OC spray and Tasers used instead.

High Incident Routes July 2015

ROUTE 80

	#	% of Rt.
Low Severity	9	47%
Moderate Severity	10	53%
High Severity	0	0%
Total Number of incidents	**19**	

Fare disputes	4	21%
Sleepers	4	21%
Vandalism/Graffiti	3	16%
Intoxicated passengers	2	11%
Objects thrown at bus	2	11%
Other Ordinance violations	2	11%
Fights	1	5%
Off bus incidents	1	5%
Any assault on operator	0	0%
Any assault on psngr on bus	0	0%
Counterfeit passes	0	0%
Lewd conduct	0	0%
Music or loud students	0	0%
Operator Threatened	0	0%
Passenger security issues	0	0%
Police stop bus	0	0%
Suspicious Activity	0	0%
Theft (not counterfeit)	0	0%
Vulgar Language	0	0%
Weapon	0	0%

MCTS High Severity Security Calls for Service JULY 2015

Date	Time	Code	Route	Bus	Badge	Location	Heading	Narrative
07/04/15	11:11 AM	355	23	5316		4901 W Washington Dr	South	Passenger believed that another passenger that was sitting behind him picked his pocket and left the bus. the victim was unable to give a description of thief. WestAllis police requested Transit 4 sent. After interview with police the crime happend on another unknown bus.
07/06/15	10:28 PM	353	22	5310		489 E Center St	East	Operator reported two females approached bus @ Holton and stated they had just been robbed at gunpoint. MPD called CPOs and Transit 9 dispatched to bus . Parties were interviewed by MPD and transported to their destinations by MPD or Family.
07/07/15	9:39 PM	353	19	4822		4144 N Teutonia Ave	North	before boarding the bus a pass had her purse snatched did not want pd involvement at this time
07/09/15	4:26 PM	352	PUR	4819		6202 N Baker Rd	North	operator claiming his keys were stolen told to file report with local pd station
07/09/15	11:59 PM	466	30	5509		1892 N 40th St	West	male passenger boarded stating he had a gun was going to commit suicide & sat down in back of bus mpd sq's3231 3235 transit 9 cpo#36 case#1817 subject conveyed to mental health by mpd sq# 3235.
07/14/15	11:54 AM	342	19	5431		141 W Wisconsin Ave	North	A female passenger was punced in the face by another male passenger.Cpo requested Transit 6 sent. Bell Amb 401 treated on the scene
07/17/15	10:37 PM	342	GOL	5512		3109 N Sherman Blvd	East	Male passenger assaulted transit 9 Mfd eng# 13 mpd sq#7272 cpo#3 case#1888 all 3 actors were GOA transit 9 conveyed victim to residence delay 10:37pm- 11:16pm sent nis to UWM for in service w.b. @ 11:22pm
07/19/15	5:54 PM	355	61	5509		3803 N Sherman Blvd	West	pass claiming that another pass stole things out of her wallet. mpd notified. cpos and supervisor sent. cpos got everything in order pd disregarded. case 1904
07/20/15	11:46 AM	342	28	5513		5529 N 107th St	South	A female passenger was struck in the face by another female passenger Mpd & CPO'S requested.Transit 5 sent. Both females involved left prior to Police and Cpo arrival. No citations issued. Case#1909 Cpo#8
07/20/15	2:37 PM	466	62	4817		4220 W Capitol Dr	West	pass had a knife on the bus cpos sent. subject found knife taken from subject warned and released. case 1911
07/26/15	12:00 PM	466	GRE	5161		186 N Water St	North	Operator reported a passenger had a gun on the bus. MPD sent. Bus was intercepted at Water/Pleasant. The passenger was arrested for DC due to gun being a toy. Sup 3 & 5 CPO 5 and MPD Sq. 1121
07/26/15	8:38 PM	353	30	5333		4058 N Sherman Blvd	West	cell phone taken off bus. MPD called instructed that female would have to call the non-emergency # to file a report.bus

MCTS High Severity Security Calls for Service JULY 2015

Date	Time	Code	Route	Bus	Badge	Location	Heading	Narrative
07/28/15	5:46 PM	355	53	5419		2389 S Bay St	East	Operator stated passengers reported a male stole a womans computer from the bus. Instructed to fill out an incident report
07/28/15	8:13 PM	466	27	5202		4704 US 241	North	passenger claiming to have a knife operator does not see anything at this time. cpos sent. No knife. Subject seemed cognitively challenged and removed from the bus allowed to ride next bus to final destination with cpo ride follow. case 1978
07/31/15	12:16 PM	345	31	5316		Mayfair	West	A passenger was assaulted while attempting to board the bus.The passenger did not want Police Security or Medical. no injury reported. supervisor to intercept bus when available.

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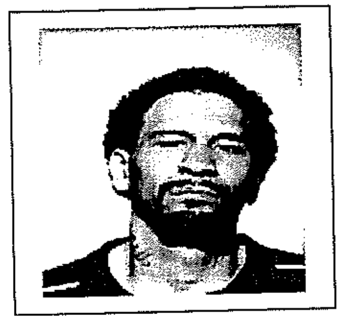
6	0
12	0
14	0
15	0
19	2
21	0
22	1
23	1
27	1
28	1
30	2
30X	0
31	1
33	0
35	0
51	0
52	0
53	1
54	0
55	0
56	0
57	0
60	0
61	1
62	1
63	0
64	0
67	0
76	0
79	0
80	0
RED	0

GRN	1
BLU	0
PUR	1
GOL	1
Other	0
Total	**15**

Type	Number	% of Total
Any assault on operator	0	0.00%
Thefts	4	26.67%
Any assault on Passenger (on bus)	3	20.00%
Off bus incidents	4	26.67%
Weapons (on and off bus)	4	26.67%
Total	**15**	
Transfer thefts	0	

MCTS TRANSPORTATION SECURITY COMMITTEE
MAJOR INCIDENT UPDATES

August 19, 2015



OPEN CASES

Matthew Jones – 2015CM001405 & 2015CM001670 – OUT OF CUSTODY
$11,000 bail reduced to $350 on 6/12/15

Disorderly Conduct – Spitting on an Operator 4-23-15
Disorderly Conduct – on Bus - 4-19-15
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Bail Jumping – and Repeat Offender charge modifier
Next Court Date: September 15, 8:30 a.m. Sentencing hearing

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- Substantial Battery and Battery to a Transit Operator – 05-08-13
- Sent to Mental Health facility for treatment.
- **Next Court Date: 9-1-15, 8:30 a.m. for another competency report**

Burgess Jr., Edward, B. – 2015CF002462 – IN CUSTODY

- Battery to a transit Operator 06-01-2015 Route 12/213 11:50 a.m.
- Cash bail set at $2500.00 - TURNED OVER to JUSTICE Point for Supervision.
- Absolute sobriety. No possession of dangerous weapons or firearms.
- Defendant to have no CONTACT WITH OPERATOR
- Next Court Date: **AUG 31st, 2015 at 8:30 am.** For Plea and Sentencing

CLOSED CASES

Welch, Hoover, R. – 2015CF000757 – IN CUSTODY MCSDF

- Battery to a transit Operator 02-15-2015 Route 12/202 6:00 p.m.
- Found Guilty on 8-4-15 to serve 6 months in HOC – Anticipated Release: 2-4-16

Repeat Offenders Status

- **Xavier Over – Active Community Supervision**
- **Kenyan Brown (A.K.A.Tupac)– Supervised Living Facility**
- **Paul Fox (A.K.A.Pee Wee)– Active Community Supervision**
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Milwaukee County Transit System

SECURITY BULLETIN

For Employees - Transportation Department

CONTINUOUS POSTING

WEAPONS ON BUSES

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If the person with the weapon:

- Appears under the influence of drugs or alcohol
- Is acting in a threatening or disorderly manner
- Is carrying the weapon in his or her hand without it being in a case or protective covering
- Is pointing the weapon at any person

What do you do if a person with a weapon is disorderly?

- Immediately pull the bus over, allowing you and passengers to leave the bus if needed

- Contact the dispatcher via PRTT, or from a safe location and give them detailed information about behavior of the passenger and the weapon.

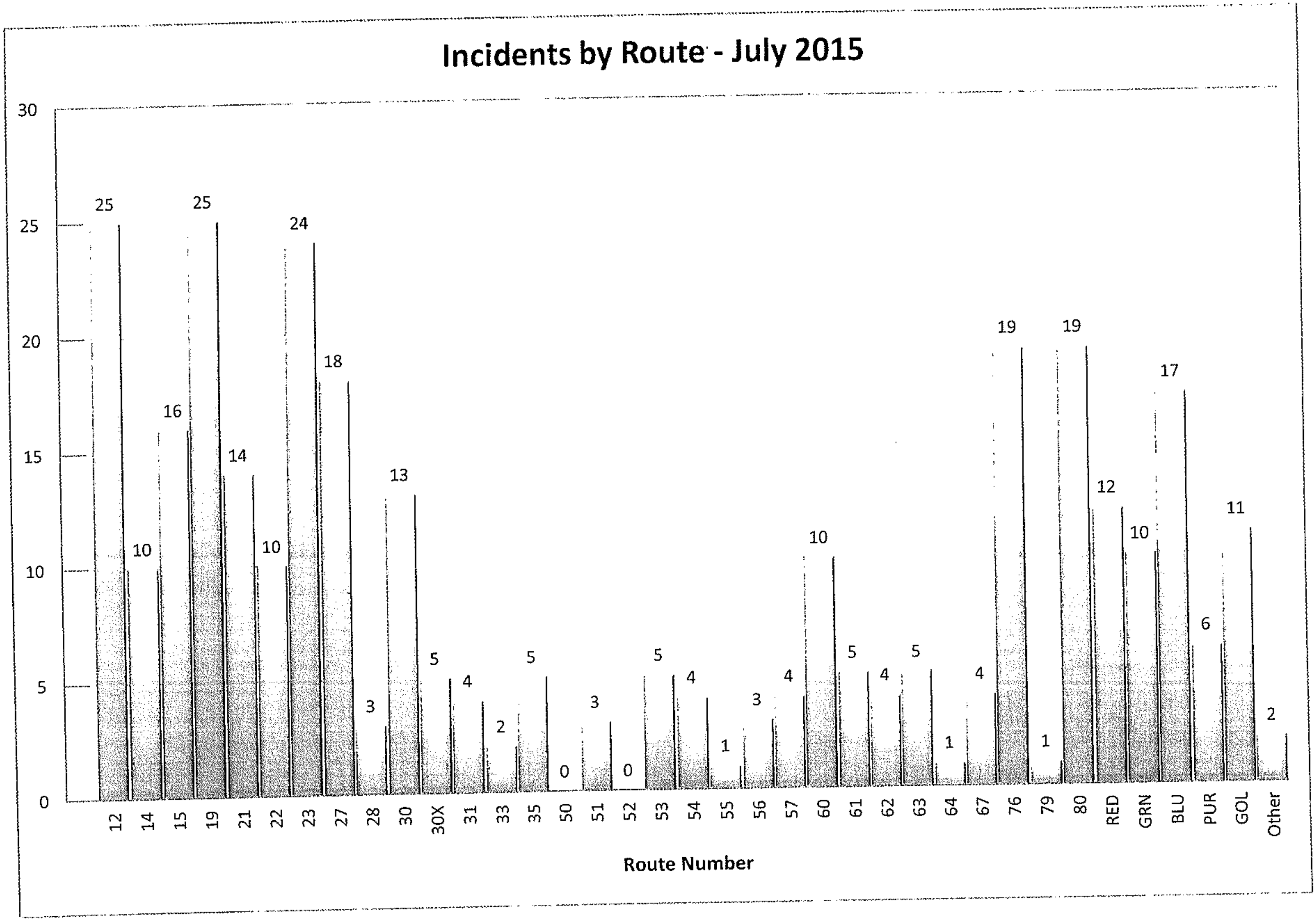
- Only use the silent alarm if you feel that direct communication with dispatcher would cause you harm.

If a person is disorderly and a weapon is visible, Dispatch will call the police immediately.

If a person is disorderly and threats are made or weapons are implied but not seen, Security and MCTS route supervision will be dispatched.

Always contact the dispatcher again if a situation changes or your safety is compromised.

Questions can be directed to Julie Schneider at 937-3228 or jschneider@mcts.org


Incidents by Route - July 2015
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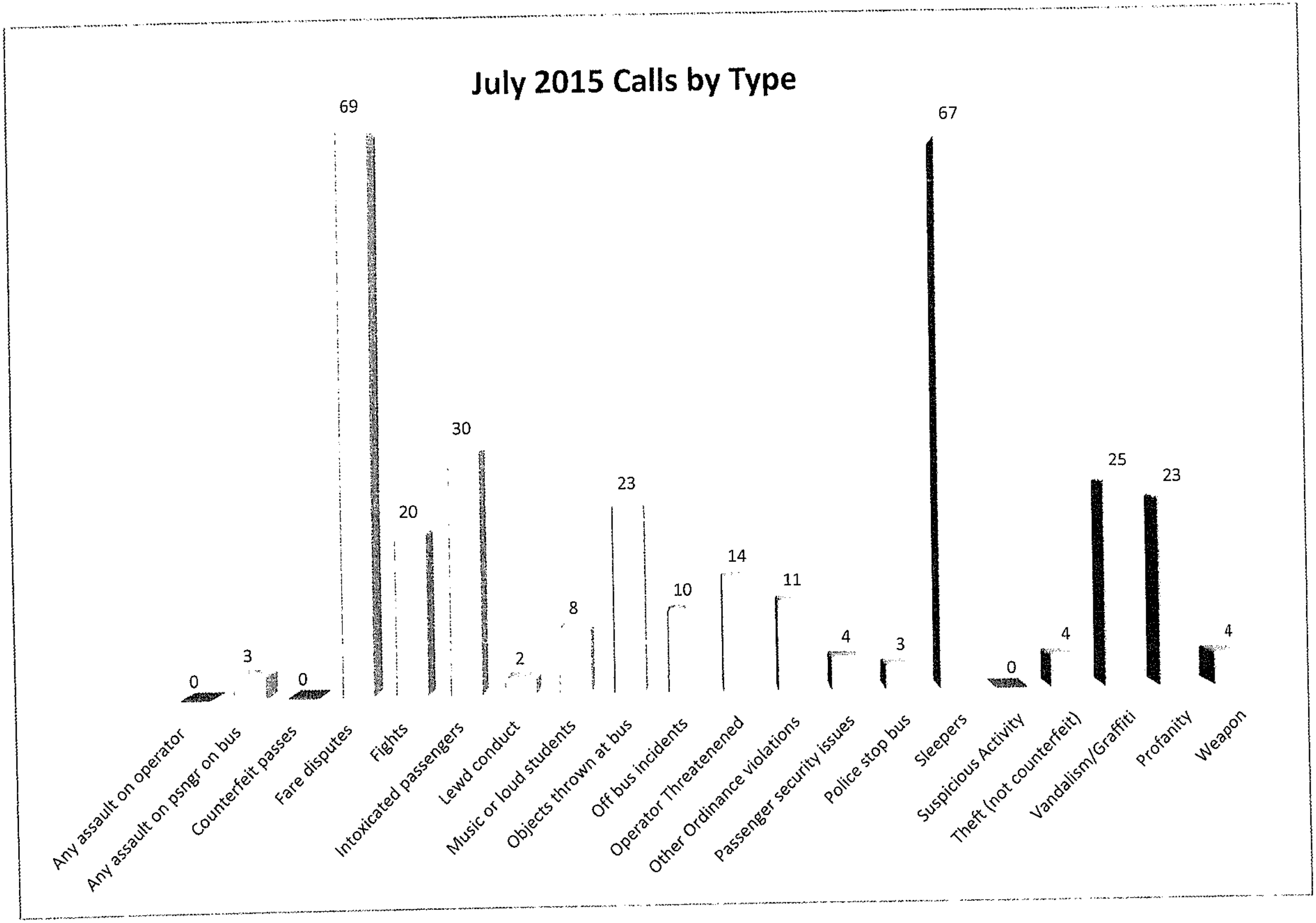
Route Number


July 2015 Calls by Type
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Any assault on operator
Any assault on psngr on bus
Counterfeit passes
Fare disputes
Fights
Intoxicated passengers
Lewd conduct
Music or loud students
Objects thrown at bus
Off bus incidents
Operator Threatenened
Other Ordinance violations
Passenger security issues
Police stop bus
Sleepers
Suspicious Activity
Theft (not counterfeit)
Vandalism/Graffiti
Profanity
Weapon

Security Committee Meeting – August 20, 2015

Agenda:

- Reports and Incidents Overview
- Schools and Operator Security Reports

- Transit Security Task Force.

- Security Project Updates
    - Grants
    - Security camera update

- Station Updates

Date for Next meeting is
Thursday, **September 17th, 2015**

9:00 a.m. in the Transportation Training Room

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21	0
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30X	0
31	1
33	0
35	0
51	0
52	0
53	1
54	0
55	0
56	0
57	0
60	0
61	1
62	1
63	0
64	0
67	0
76	0
79	0
80	0
RED	0

GRN	1
BLU	0
PUR	1
GOL	1
Other	0
Total	**15**

Type	Number	% of Total
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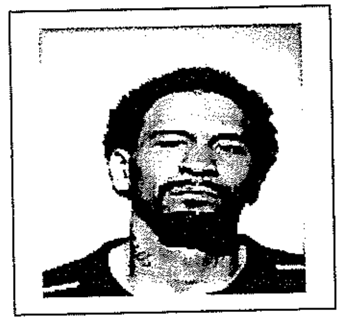
MCTS TRANSPORTATION SECURITY COMMITTEE
MAJOR INCIDENT UPDATES

August 19, 2015

OPEN CASES



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- Absolute sobriety. No possession of dangerous weapons or firearms.
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Milwaukee County Transit System

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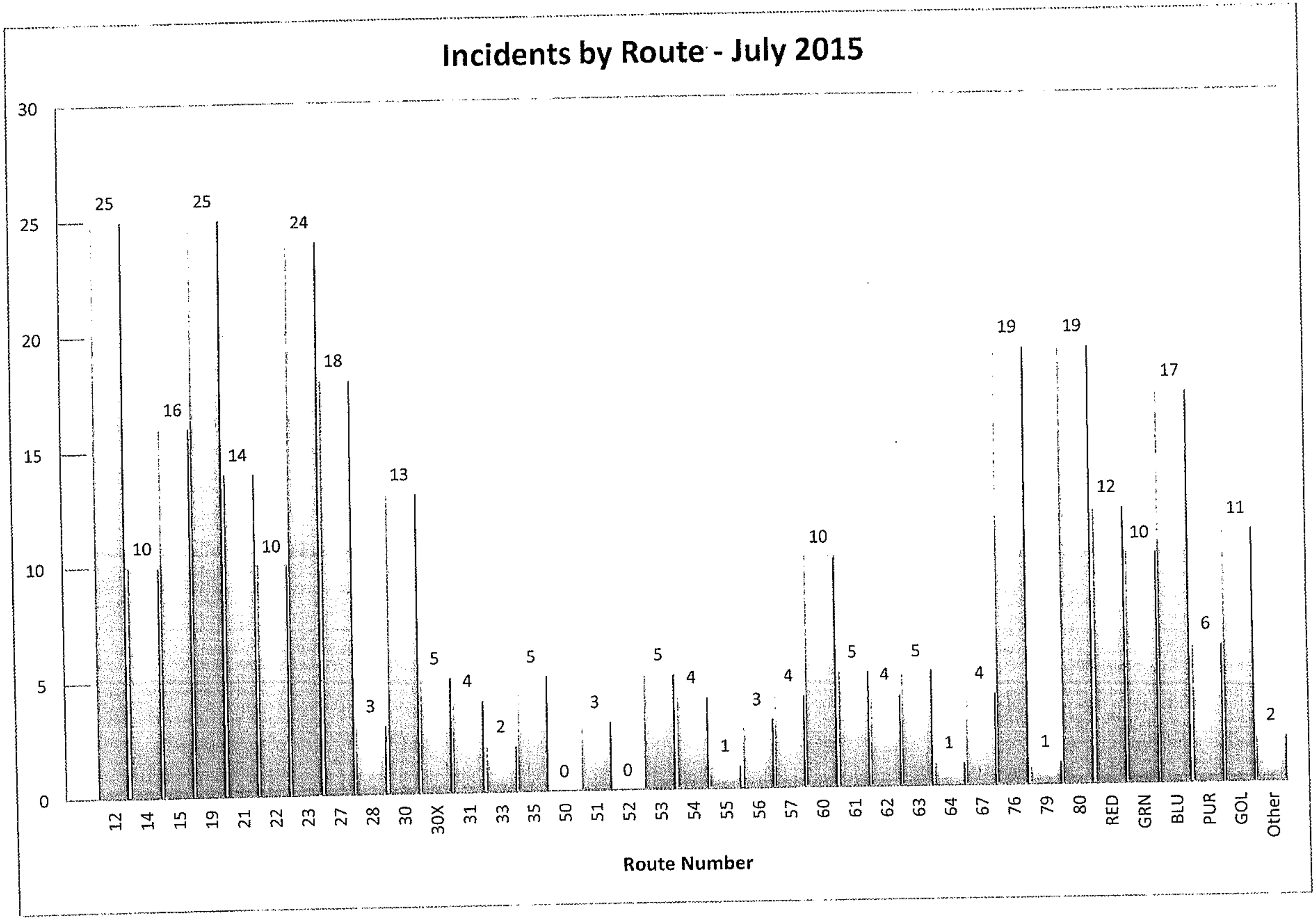

Incidents by Route - July 2015
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25
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RED
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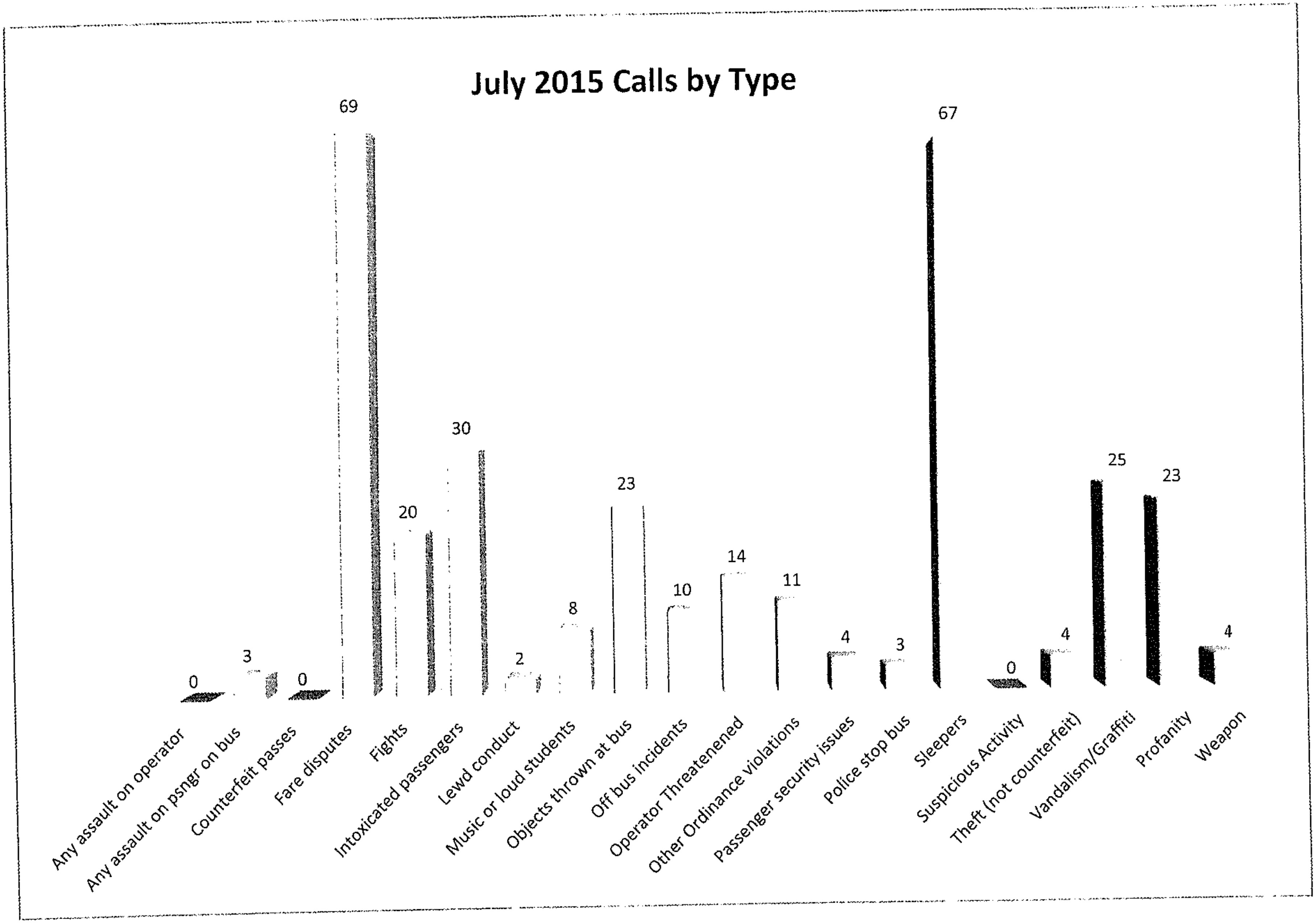
PUR
GOL
Other
Route Number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0
69
20
30
2
8
23
10
14
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4
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67
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4
25
23
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Other Ordinance violations	2	11%
Fights	1	5%
Off bus incidents	1	5%
Any assault on operator	0	0%
Any assault on psngr on bus	0	0%
Counterfeit passes	0	0%
Lewd conduct	0	0%
Music or loud students	0	0%
Operator Threatened	0	0%
Passenger security issues	0	0%
Police stop bus	0	0%
Suspicious Activity	0	0%
Theft (not counterfeit)	0	0%
Vulgar Language	0	0%
Weapon	0	0%

MCTS High Severity Security Calls for Service JULY 2015

Date	Time	Code	Route	Bus	Badge	Location	Heading	Narrative
07/04/15	11:11 AM	355	23	5316		4901 W Washington Dr	South	Passenger believed that another passenger that was sitting behind him picked his pocket and left the bus. the victim was unable to give a description of thief. WestAllis police requested Transit 4 sent. After interview with police the crime happend on another unknown bus.
07/06/15	10:28 PM	353	22	5310		489 E Center St	East	Operator reported two females approached bus @ Holton and stated they had just been robbed at gunpoint. MPD called CPOs and Transit 9 dispatched to bus . Parties were interviewed by MPD and transported to their destinations by MPD or Family.
07/07/15	9:39 PM	353	19	4822		4144 N Teutonia Ave	North	before boarding the bus a pass had her purse snatched did not want pd involvement at this time
07/09/15	4:26 PM	352	PUR	4819		6202 N Baker Rd	North	operator claiming his keys were stolen told to file report with local pd station
07/09/15	11:59 PM	466	30	5509		1892 N 40th St	West	male passenger boarded stating he had a gun was going to commit suicide & sat down in back of bus mpd sq's3231 3235 transit 9 cpo#36 case#1817 subject conveyed to mental health by mpd sq# 3235.
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6	0
12	0
14	0
15	0
19	2
21	0
22	1
23	1
27	1
28	1
30	2
30X	0
31	1
33	0
35	0
51	0
52	0
53	1
54	0
55	0
56	0
57	0
60	0
61	1
62	1
63	0
64	0
67	0
76	0
79	0
80	0
RED	0

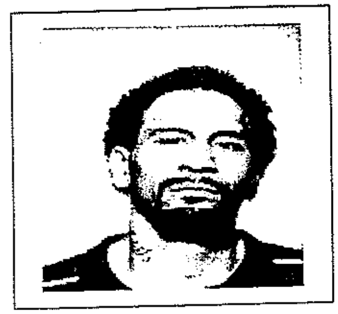
GRN	1
BLU	0
PUR	1
GOL	1
Other	0
Total	**15**

Type	Number	% of Total
Any assault on operator	0	0.00%
Thefts	4	26.67%
Any assault on Passenger (on bus)	3	20.00%
Off bus incidents	4	26.67%
Weapons (on and off bus)	4	26.67%
Total	**15**	

Transfer thefts	0

MCTS TRANSPORTATION SECURITY COMMITTEE
MAJOR INCIDENT UPDATES August 19, 2015

OPEN CASES



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Disorderly Conduct – on Bus - 4-19-15
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Bail Jumping – and Repeat Offender charge modifier
Next Court Date: September 15, 8:30 a.m. Sentencing hearing

Corian Morgan – 2013CF002081– IN CUSTODY – Mendota

- Substantial Battery and Battery to a Transit Operator – 05-08-13
- Sent to Mental Health facility for treatment.
- **Next Court Date: 9-1-15, 8:30 a.m. for another competency report**

Burgess Jr., Edward, B. – 2015CF002462 – IN CUSTODY

- Battery to a transit Operator 06-01-2015 Route 12/213 11:50 a.m.
- Cash bail set at $2500.00 - TURNED OVER to JUSTICE Point for Supervision.
- Absolute sobriety. No possession of dangerous weapons or firearms.
- Defendant to have no CONTACT WITH OPERATOR
- Next Court Date: **AUG 31st, 2015 at 8:30 am.** For Plea and Sentencing

CLOSED CASES

Welch, Hoover, R. – 2015CF000757 – IN CUSTODY MCSDF

- Battery to a transit Operator 02-15-2015 Route 12/202 6:00 p.m.
- Found Guilty on 8-4-15 to serve 6 months in HOC – Anticipated Release: 2-4-16

Repeat Offenders Status

- **Xavier Over – Active Community Supervision**
- **Kenyan Brown (A.K.A.Tupac)– Supervised Living Facility**
- **Paul Fox (A.K.A.Pee Wee)– Active Community Supervision**
- **Steven Reasby — Active Community Supervision**
- **Robert Hayes – HOC for non-transit-related offense**

Milwaukee County Transit System

SECURITY BULLETIN

For Employees - Transportation Department

CONTINUOUS POSTING

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If the person with the weapon:

- Appears under the influence of drugs or alcohol
- Is acting in a threatening or disorderly manner
- Is carrying the weapon in his or her hand without it being in a case or protective covering
- Is pointing the weapon at any person

What do you do if a person with a weapon is disorderly?

- Immediately pull the bus over, allowing you and passengers to leave the bus if needed

- Contact the dispatcher via PRTT, or from a safe location and give them detailed information about behavior of the passenger and the weapon.

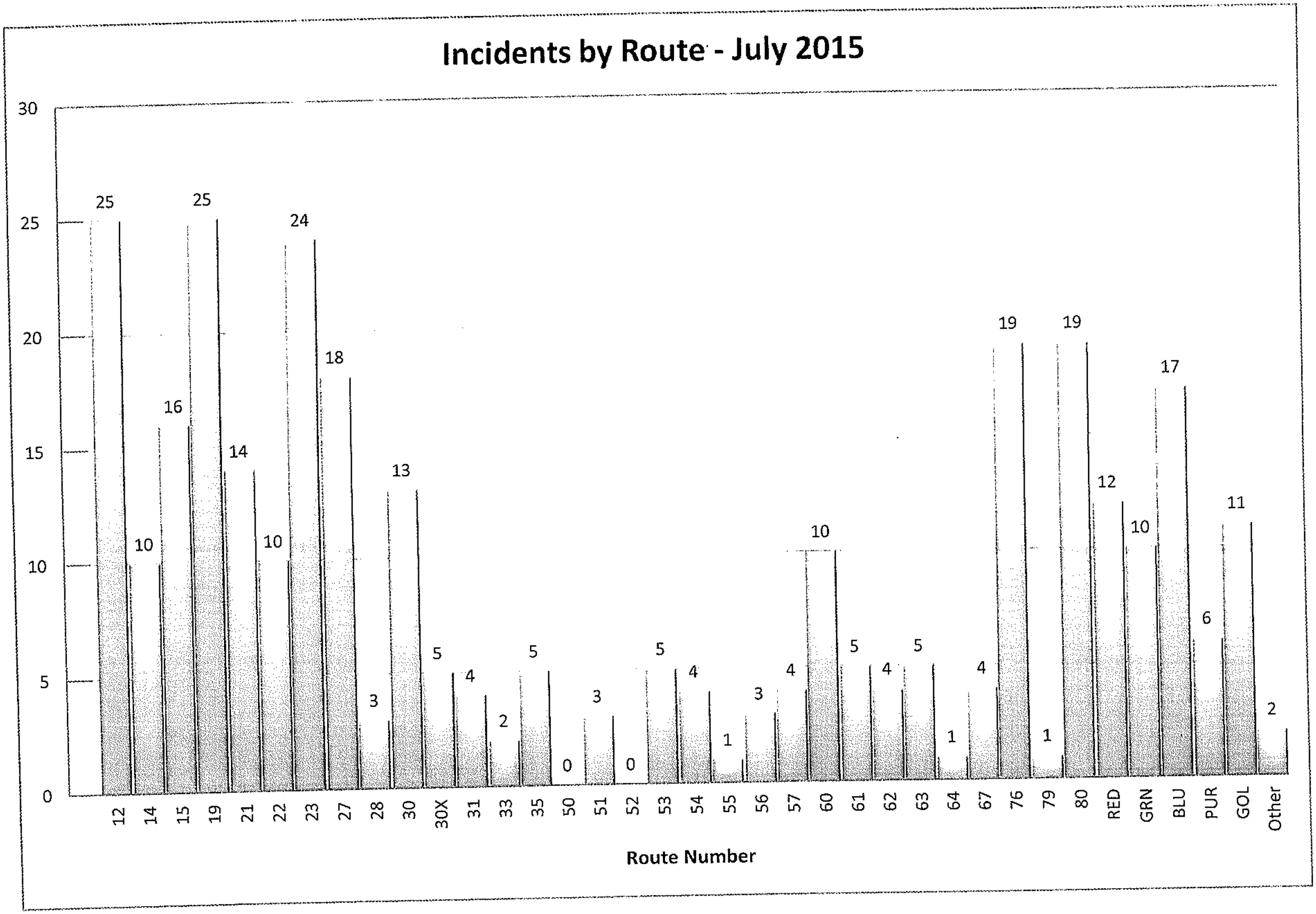
- <u>Only use the silent alarm if you feel that direct communication with dispatcher would cause you harm.</u>

If a person is disorderly <u>and</u> a weapon is visible, Dispatch will call the police immediately.

If a person is disorderly and threats are made or weapons are implied but not seen, Security and MCTS route supervision will be dispatched.

Always contact the dispatcher again if a situation changes or your safety is compromised.

Questions can be directed to Julie Schneider at 937-3228 or jschneider@mcts.org



Incidents by Route - July 2015
30
25
20
15
10
5
0
25
10
16
25
14
10
24
18
3
13
5
4
2
5
0
3
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5
4
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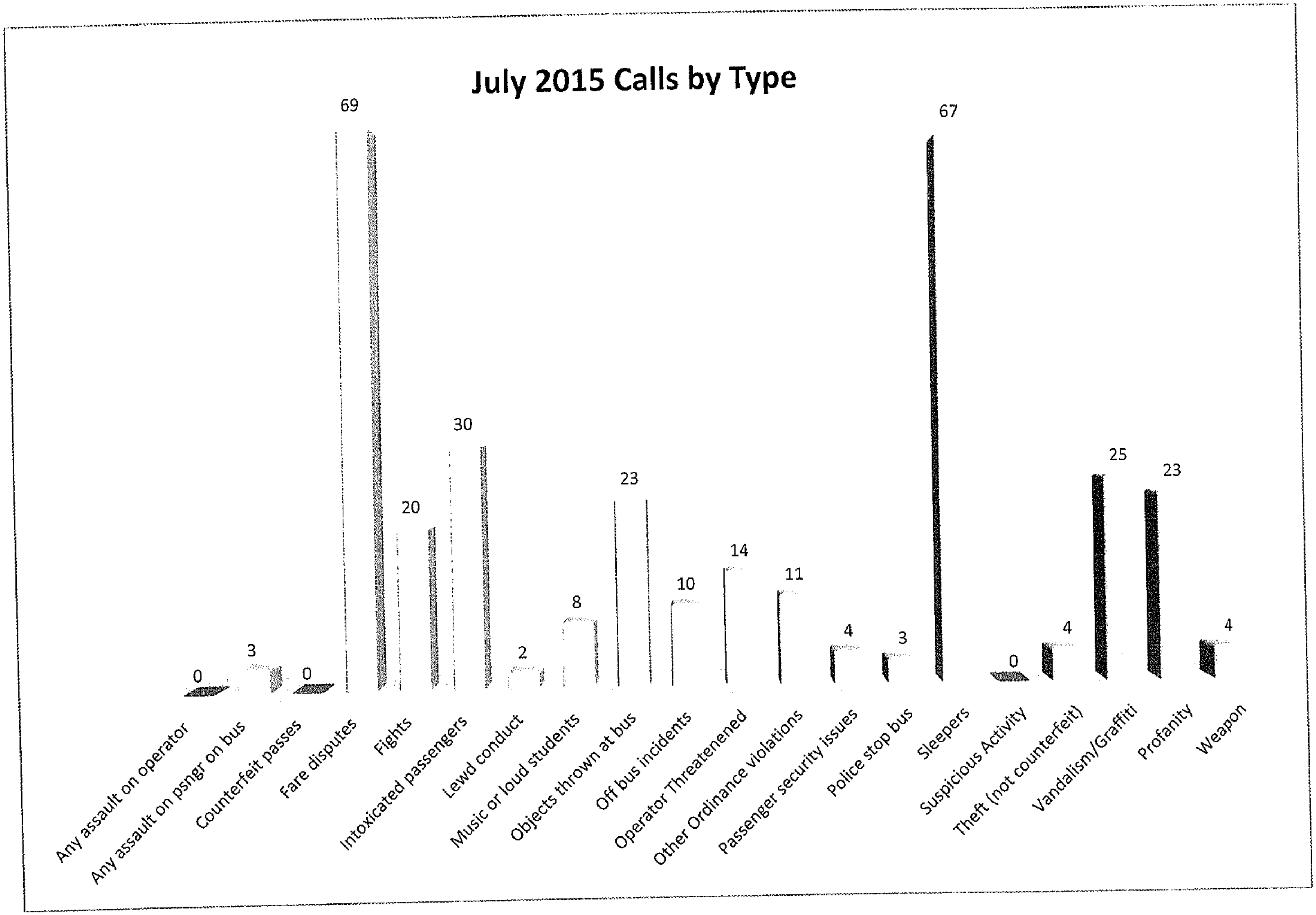
76
79
80
RED
GRN
BLU
PUR
GOL
Other
Route Number



July 2015 Calls by Type
0
3
0
69
20
30
2
8
23
10
14
11
4
3
67
0
4
25
23
4
Any assault on operator
Any assault on psngr on bus
Counterfeit passes
Fare disputes
Fights
Intoxicated passengers
Lewd conduct
Music or loud students
Objects thrown at bus
Off bus incidents
Operator Threatenened
Other Ordinance violations
Passenger security issues
Police stop bus
Sleepers
Suspicious Activity
Theft (not counterfeit)
Vandalism/Graffiti
Profanity
Weapon

Security Committee Meeting – August 20, 2015

Agenda:

- Reports and Incidents Overview
- Schools and Operator Security Reports
- Transit Security Task Force.
- Security Project Updates
  - Grants
  - Security camera update
- Station Updates

Date for Next meeting is
Thursday, **September 17th, 2015**

9:00 a.m. in the Transportation Training Room

High Incident Routes July 2015

ROUTE 80

	#	% of Rt.
Low Severity	9	47%
Moderate Severity	10	53%
High Severity	0	0%
Total Number of incidents	**19**	

Fare disputes	4	21%
Sleepers	4	21%
Vandalism/Graffiti	3	16%
Intoxicated passengers	2	11%
Objects thrown at bus	2	11%
Other Ordinance violations	2	11%
Fights	1	5%
Off bus incidents	1	5%
Any assault on operator	0	0%
Any assault on psngr on bus	0	0%
Counterfeit passes	0	0%
Lewd conduct	0	0%
Music or loud students	0	0%
Operator Threatened	0	0%
Passenger security issues	0	0%
Police stop bus	0	0%
Suspicious Activity	0	0%
Theft (not counterfeit)	0	0%
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Weapon	0	0%

MCTS High Severity Security Calls for Service JULY 2015

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6	0
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14	0
15	0
19	2
21	0
22	1
23	1
27	1
28	1
30	2
30X	0
31	1
33	0
35	0
51	0
52	0
53	1
54	0
55	0
56	0
57	0
60	0
61	1
62	1
63	0
64	0
67	0
76	0
79	0
80	0
RED	0

GRN	1
BLU	0
PUR	1
GOL	1
Other	0
Total	**15**

Type	Number	% of Total
Any assault on operator	0	0.00%
Thefts	4	26.67%
Any assault on Passenger (on bus)	3	20.00%
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Weapons (on and off bus)	4	26.67%
Total	**15**	

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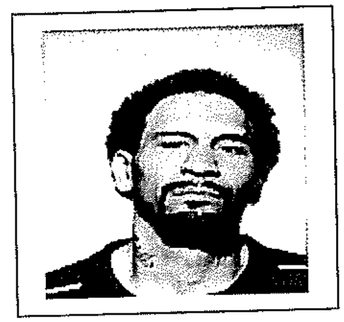
MCTS TRANSPORTATION SECURITY COMMITTEE
MAJOR INCIDENT UPDATES

August 19, 2015

OPEN CASES



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Milwaukee County Transit System

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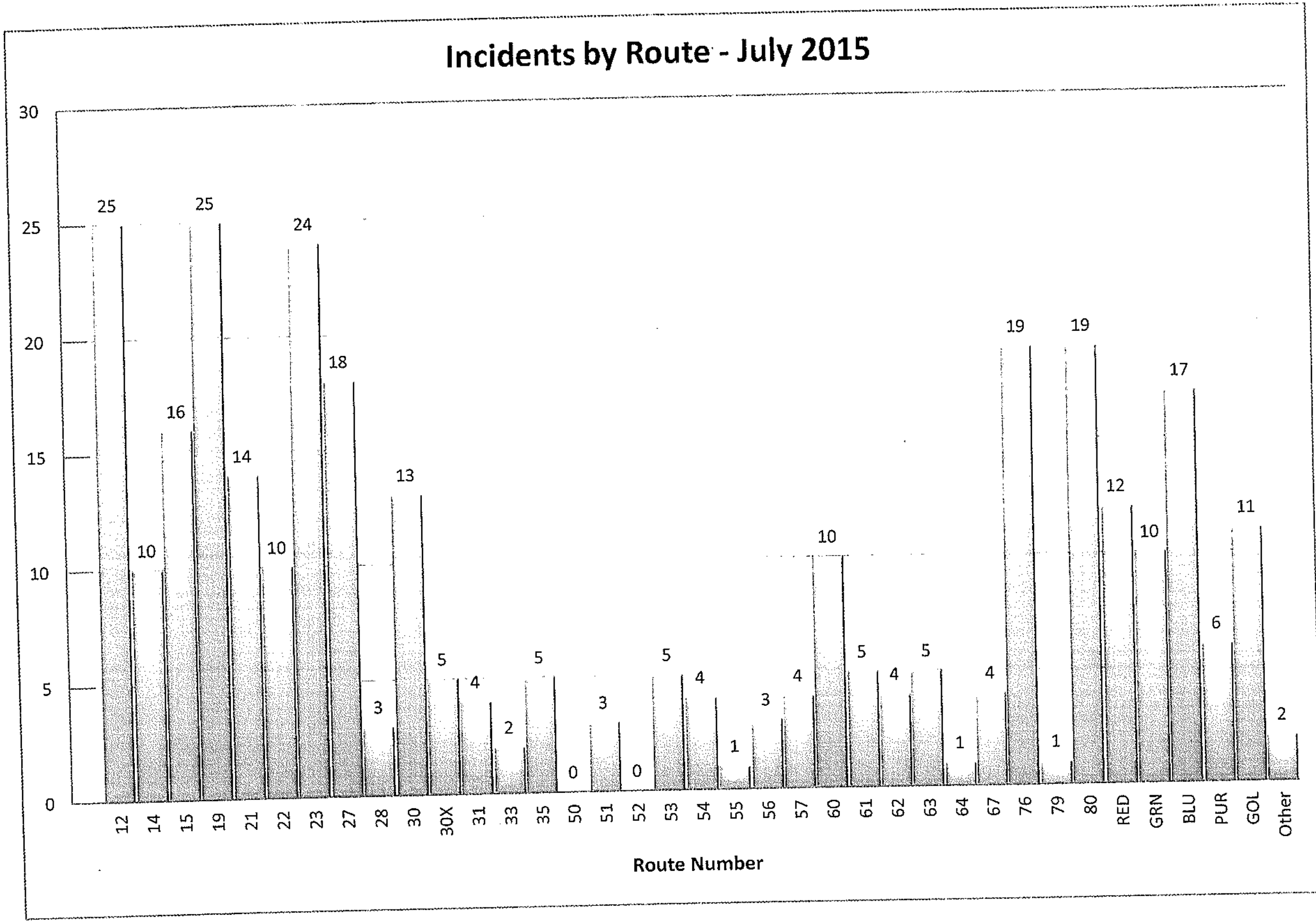
Incidents by Route - July 2015
30
25
20
15
10
5
0
25
10
16
25
14
10
24
18
3
13
5
4
2
5
0
3
0
5
4
1
3
4
10
5
4
5
1
4
19
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19
12
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17
6
11
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12
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19
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22
23
27
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30X
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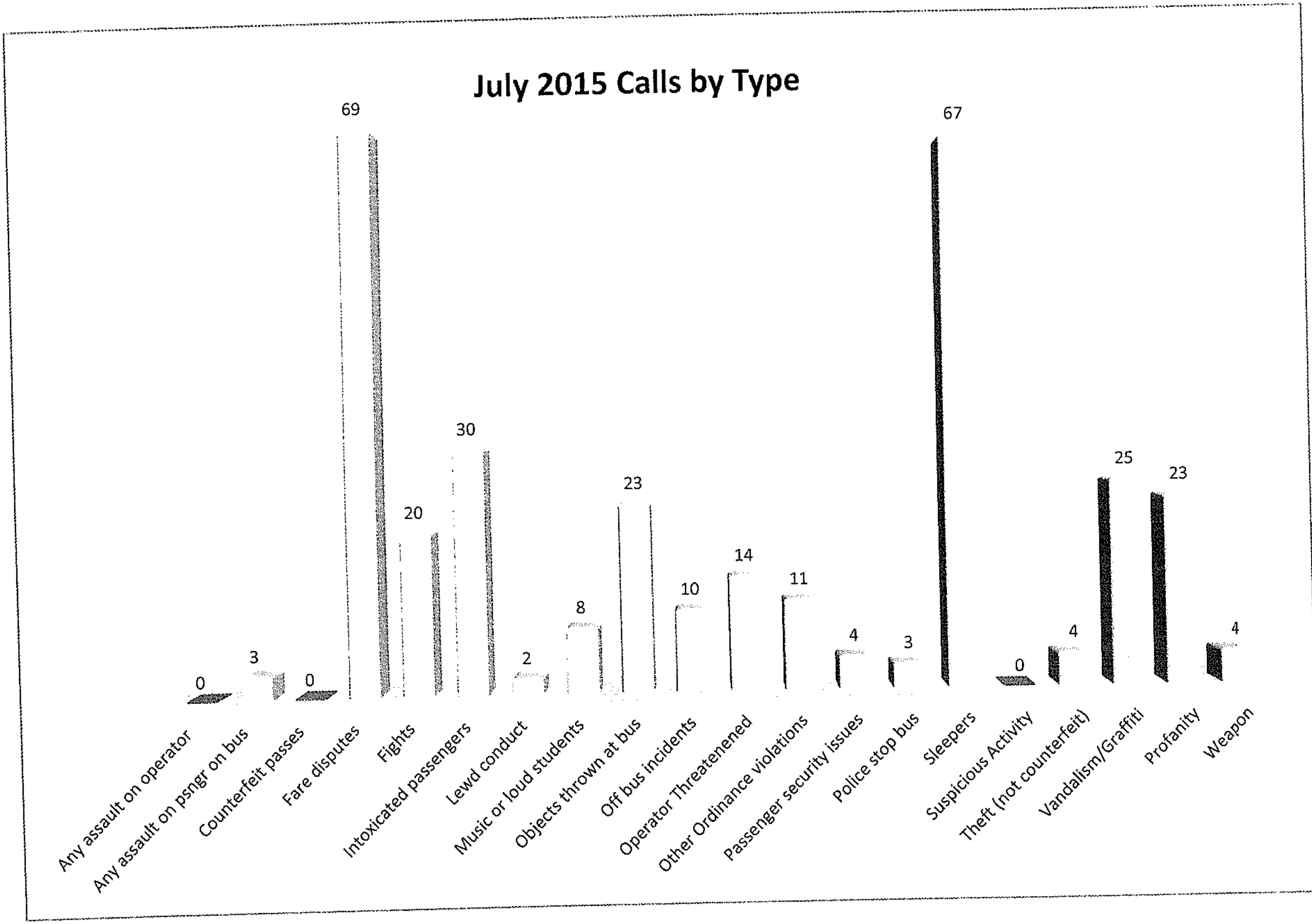
76
79
80
RED
GRN
BLU
PUR
GOL
Other
Route Number


July 2015 Calls by Type
0
3
0
69
20
30
2
8
23
10
14
11
4
3
67
0
4
25
23
4
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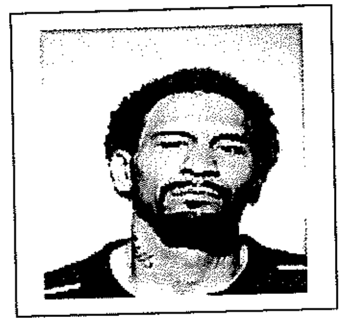
12	0
14	0
15	0
19	2
21	0
22	1
23	1
27	1
28	1
30	2
30X	0
31	1
33	0
35	0
51	0
52	0
53	1
54	0
55	0
56	0
57	0
60	0
61	1
62	1
63	0
64	0
67	0
76	0
79	0
80	0
RED	0

GRN	1
BLU	0
PUR	1
GOL	1
Other	0
Total	**15**

Type	Number	% of Total
Any assault on operator	0	0.00%
Thefts	4	26.67%
Any assault on Passenger (on bus)	3	20.00%
Off bus incidents	4	26.67%
Weapons (on and off bus)	4	26.67%
Total	**15**	
Transfer thefts	0	

MCTS TRANSPORTATION SECURITY COMMITTEE
MAJOR INCIDENT UPDATES August 19, 2015

OPEN CASES



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Milwaukee County Transit System

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For Employees - Transportation Department

CONTINUOUS POSTING

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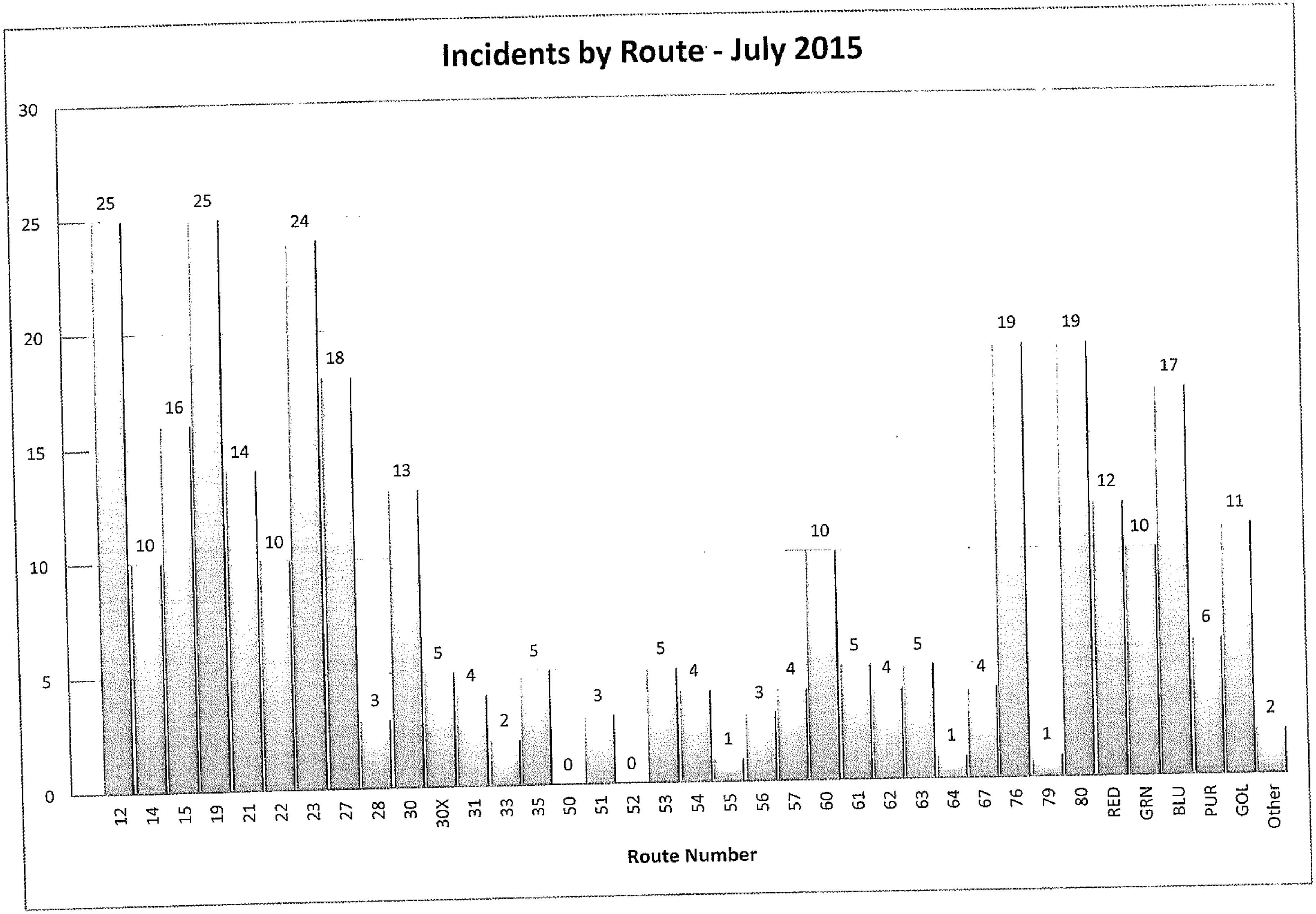

Incidents by Route - July 2015
30
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RED
GRN
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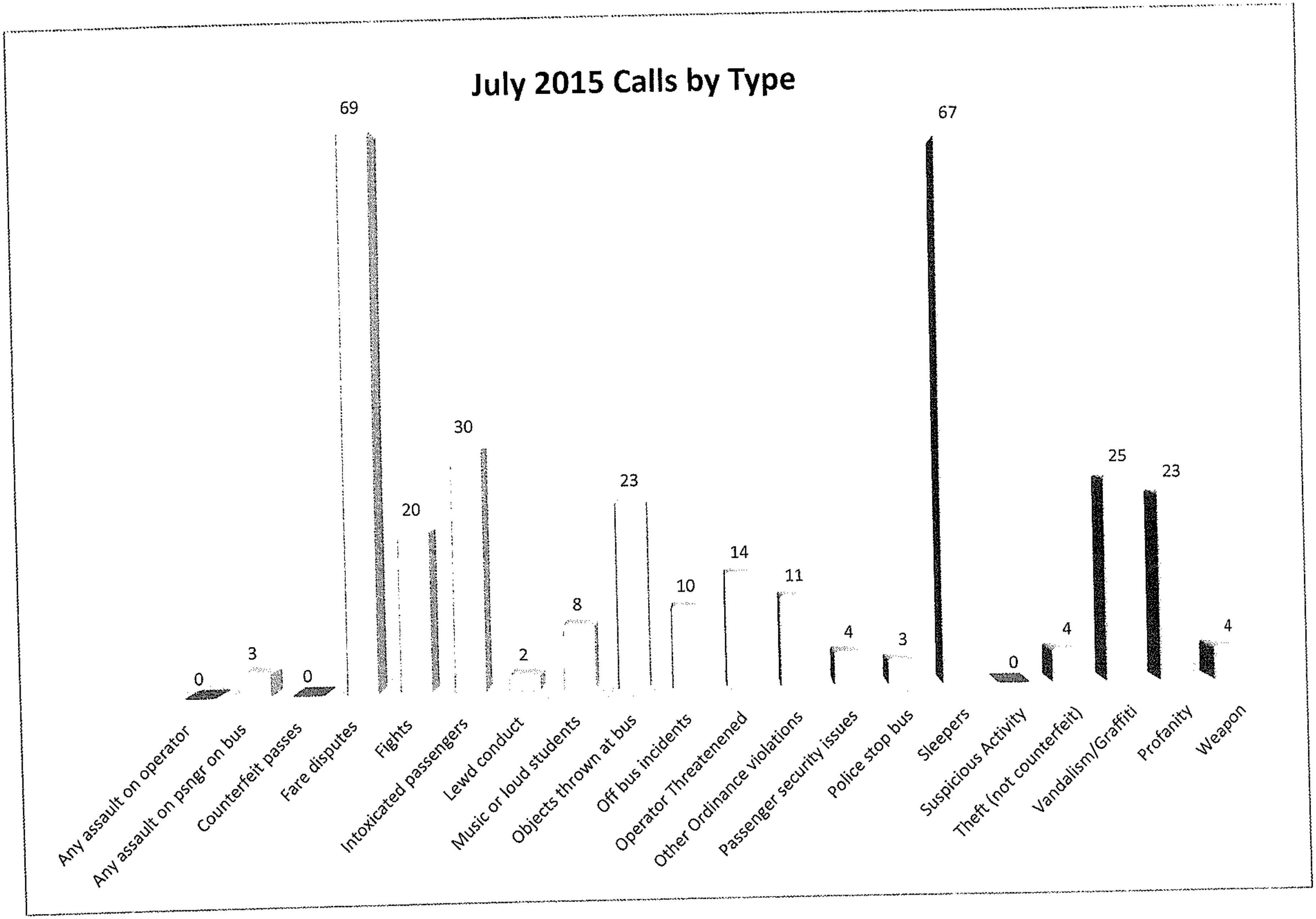
PUR
GOL
Other
Route Number



July 2015 Calls by Type
0
3
0
69
20
30
2
8
23
10
14
11
4
3
67
0
4
25
23
4
Any assault on operator
Any assault on psngr on bus
Counterfeit passes
Fare disputes
Fights
Intoxicated passengers
Lewd conduct
Music or loud students
Objects thrown at bus
Off bus incidents
Operator Threatenened
Other Ordinance violations
Passenger security issues
Police stop bus
Sleepers
Suspicious Activity
Theft (not counterfeit)
Vandalism/Graffiti
Profanity
Weapon

Security Committee Meeting – August 20, 2015

Agenda:

- Reports and Incidents Overview
- Schools and Operator Security Reports
- Transit Security Task Force.
- Security Project Updates
  - Grants
  - Security camera update
- Station Updates

Date for Next meeting is
Thursday, **September 17th, 2015**

9:00 a.m. in the Transportation Training Room

High Incident Routes July 2015

ROUTE 80

	#	% of Rt.
Low Severity	9	47%
Moderate Severity	10	53%
High Severity	0	0%
Total Number of incidents	**19**	

Fare disputes	4	21%
Sleepers	4	21%
Vandalism/Graffiti	3	16%
Intoxicated passengers	2	11%
Objects thrown at bus	2	11%
Other Ordinance violations	2	11%
Fights	1	5%
Off bus incidents	1	5%
Any assault on operator	0	0%
Any assault on psngr on bus	0	0%
Counterfeit passes	0	0%
Lewd conduct	0	0%
Music or loud students	0	0%
Operator Threatened	0	0%
Passenger security issues	0	0%
Police stop bus	0	0%
Suspicious Activity	0	0%
Theft (not counterfeit)	0	0%
Vulgar Language	0	0%
Weapon	0	0%

MCTS High Severity Security Calls for Service JULY 2015

Date	Time	Code	Route	Bus	Badge	Location	Heading	Narrative
07/04/15	11:11 AM	355	23	5316		4901 W Washington Dr	South	Passenger believed that another passenger that was sitting behind him picked his pocket and left the bus. the victim was unable to give a description of thief. WestAllis police requested Transit 4 sent. After interview with police the crime happend on another unknown bus.
07/06/15	10:28 PM	353	22	5310		489 E Center St	East	Operator reported two females approached bus @ Holton and stated they had just been robbed at gunpoint. MPD called CPOs and Transit 9 dispatched to bus . Parties were interviewed by MPD and transported to their destinations by MPD or Family.
07/07/15	9:39 PM	353	19	4822		4144 N Teutonia Ave	North	before boarding the bus a pass had her purse snatched did not want pd involvement at this time
07/09/15	4:26 PM	352	PUR	4819		6202 N Baker Rd	North	operator claiming his keys were stolen told to file report with local pd station
07/09/15	11:59 PM	466	30	5509		1892 N 40th St	West	male passenger boarded stating he had a gun was going to commit suicide & sat down in back of bus mpd sq's3231 3235 transit 9 cpo#36 case#1817 subject conveyed to mental health by mpd sq# 3235.
07/14/15	11:54 AM	342	19	5431		141 W Wisconsin Ave	North	A female passenger was punced in the face by another male passenger.Cpo requested Transit 6 sent. Bell Amb 401 treated on the scene
07/17/15	10:37 PM	342	GOL	5512		3109 N Sherman Blvd	East	Male passenger assaulted transit 9 Mfd eng# 13 mpd sq#7272 cpo#3 case#1888 all 3 actors were GOA transit 9 conveyed victim to residence delay 10:37pm- 11:16pm sent nis to UWM for in service w.b. @ 11:22pm
07/19/15	5:54 PM	355	61	5509		3803 N Sherman Blvd	West	pass claiming that another pass stole things out of her wallet. mpd notified. cpos and supervisor sent. cpos got everything in order pd disregarded. case 1904
07/20/15	11:46 AM	342	28	5513		5529 N 107th St	South	A female passenger was struck in the face by another female passenger Mpd & CPO'S requested.Transit 5 sent. Both females involved left prior to Police and Cpo arrival. No citations issued. Case#1909 Cpo#8
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07/26/15	8:38 PM	353	30	5333		4058 N Sherman Blvd	West	cell phone taken off bus. MPD called instructed that female would have to call the non-emergency # to file a report.bus

MCTS High Severity Security Calls for Service JULY 2015

Date	Time	Code	Route	Bus	Badge	Location	Heading	Narrative
07/28/15	5:46 PM	355	53	5419		2389 S Bay St	East	Operator stated passengers reported a male stole a womans computer from the bus. Instructed to fill out an incident report
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07/31/15	12:16 PM	345	31	5316		Mayfair	West	A passenger was assaulted while attempting to board the bus.The passenger did not want Police Security or Medical. no injury reported. supervisor to intercept bus when available.

ROUTE	# OF INC.
6	0
12	0
14	0
15	0
19	2
21	0
22	1
23	1
27	1
28	1
30	2
30X	0
31	1
33	0
35	0
51	0
52	0
53	1
54	0
55	0
56	0
57	0
60	0
61	1
62	1
63	0
64	0
67	0
76	0
79	0
80	0
RED	0

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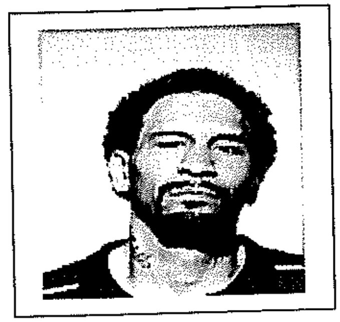
MCTS TRANSPORTATION SECURITY COMMITTEE
MAJOR INCIDENT UPDATES

August 19, 2015

OPEN CASES



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Milwaukee County Transit System

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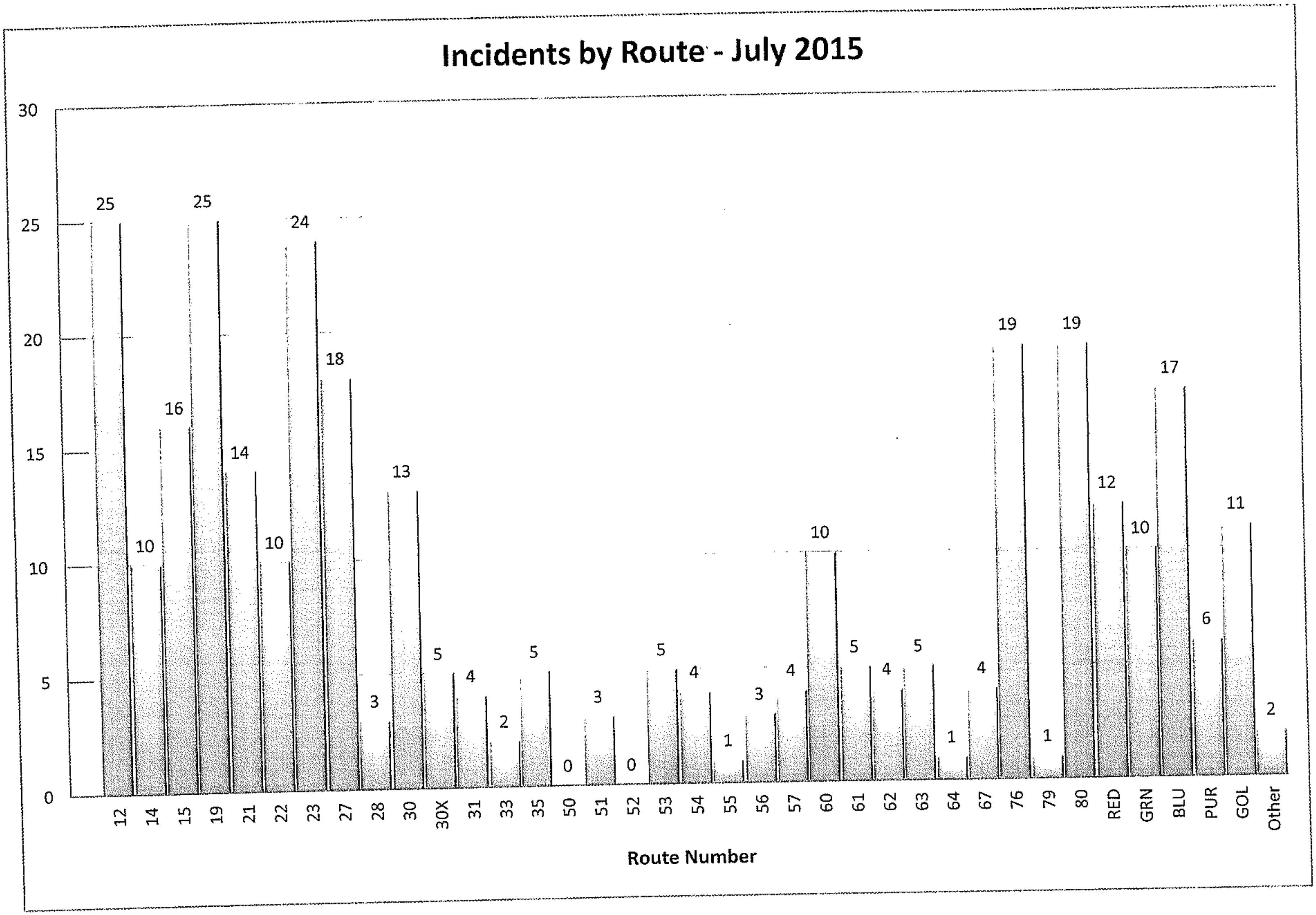

Incidents by Route - July 2015
30
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RED
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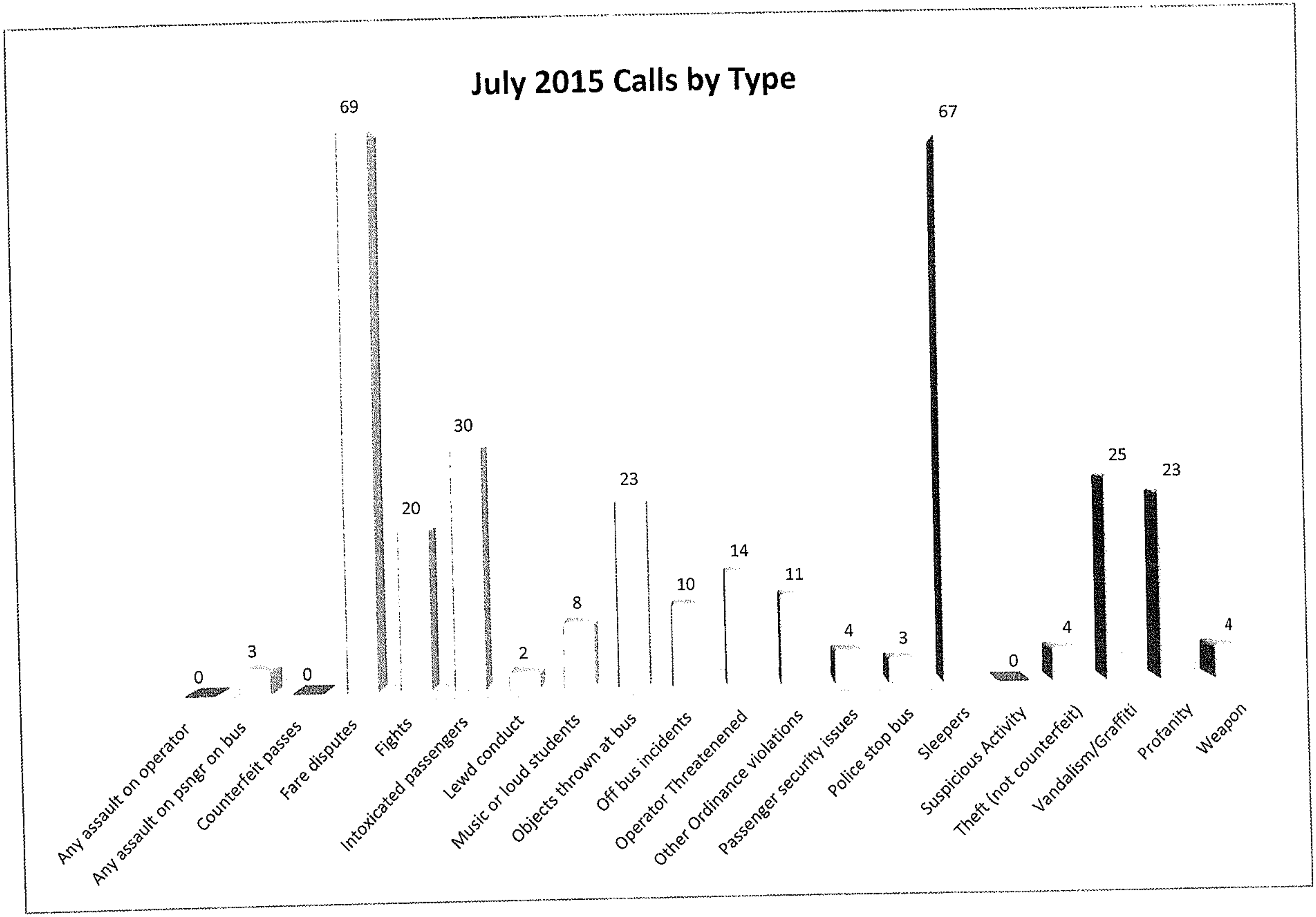
PUR
GOL
Other
Route Number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0
3
0
69
20
30
2
8
23
10
14
11
4
3
67
0
4
25
23
4
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Fare disputes
Fights
Intoxicated passengers
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51	0
52	0
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55	0
56	0
57	0
60	0
61	1
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63	0
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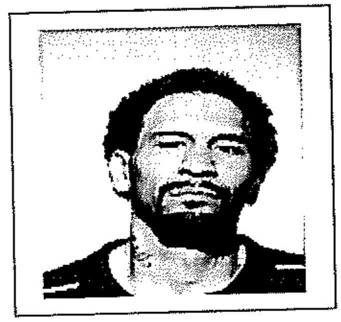
MAJOR INCIDENT UPDATES **August 19, 2015**

OPEN CASES



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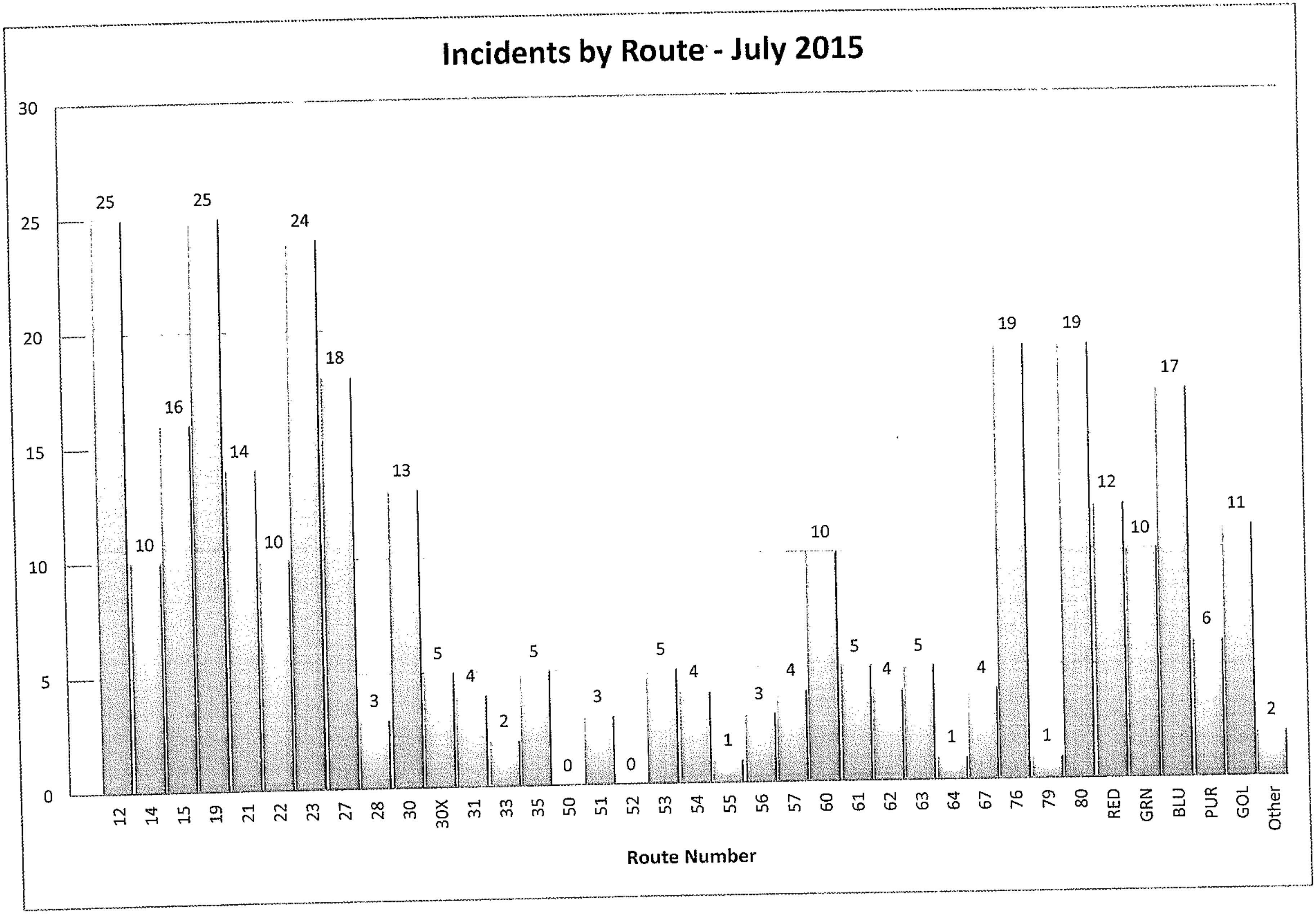

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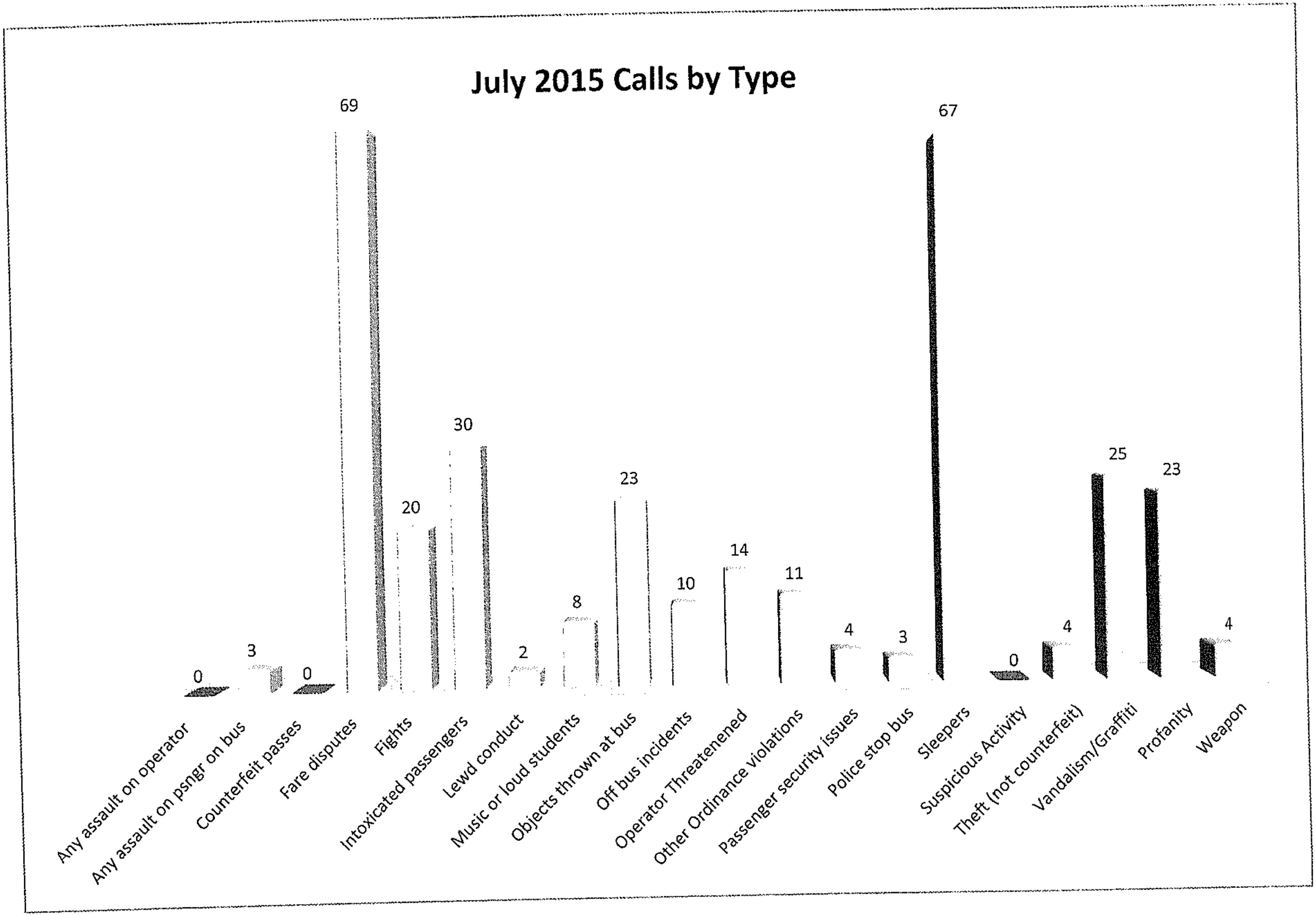

July 2015 Calls by Type
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30
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8
23
10
14
11
4
3
67
0
4
25
23
4
Any assault on operator
Any assault on psngr on bus
Counterfeit passes
Fare disputes
Fights
Intoxicated passengers
Lewd conduct
Music or loud students
Objects thrown at bus
Off bus incidents
Operator Threatenened
Other Ordinance violations
Passenger security issues
Police stop bus
Sleepers
Suspicious Activity
Theft (not counterfeit)
Vandalism/Graffiti
Profanity
Weapon

Security Committee Meeting – August 20, 2015

Agenda:

- Reports and Incidents Overview
- Schools and Operator Security Reports

- Transit Security Task Force.

- Security Project Updates
  - Grants
  - Security camera update

- Station Updates

Date for Next meeting is
Thursday, **September 17th, 2015**

9:00 a.m. in the Transportation Training Room

The Impact of the Taser on Suspect Resistance: Identifying Predictors of Effectiveness

Michael D. White and Justin Ready

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The Impact of the Taser on Suspect Resistance

Identifying Predictors of Effectiveness

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Despite the Taser's increasing popularity among police agencies, questions have been raised concerning the weapon's use and effectiveness as well as its potential to cause serious injury or death. This article examines all Taser deployments by the New York City Police Department from 2002 to 2005 (N = 375) and uses two multivariate approaches—logistic regression and chi-square automatic interaction detection—to identify predictors of Taser effectiveness, measured as continued suspect resistance and officer satisfaction. Findings indicate that several factors are associated with reduced effectiveness, including suspect body weight (more than 200 pounds), drug and alcohol use, physical violence, and close distance (3 feet or less) between the officer and the suspect. Although this study represents a preliminary effort at identifying predictors of Taser effectiveness, there are clear training and policy implications for police departments.

Keywords: *police use of force; Taser; less-than-lethal weapons; conducted energy device (CED)*

Conducted energy devices (CEDs)—most notably, the Taser—are being adopted and deployed by police agencies on a broad scale across the United States. Taser International, the leading developer of stun device technology, has sold more than 200,000 weapons to more than 9,000 police agencies in the United States (Davis, 2007). The economic trends are perhaps a better indicator of the enormous growth of the Taser; Taser International's revenue grew from approximately \$2.5 million for fiscal year 1999 to an estimated \$67 million in 2004 (McBride & Tedder, 2005).[1] Despite its increasing popularity among police departments and private consumers, questions have been raised concerning the weapon's use and

effectiveness as well as its potential to cause serious injury or death. The following examples illustrate why this topic has become contentious:

- Use: In fall 2005, police officers in Miami used a Taser on a 6-year-old boy who was cutting himself with a piece of glass and on a 12-year-old truant fleeing police.
- Effectiveness: In December 2005, Nashville, Tennessee, police officers used the Taser 19 times on a combative suspect before they were able to take him into custody (Bottoroff, 2005).
- Physiological impact: Amnesty International issued a report in 2004 describing 74 cases in the United States and Canada where a suspect died after being stunned by a Taser. The organization cites these deaths, recent biomedical research, and news reports of incidents involving the questionable use of Tasers to support a moratorium on their use.

Although a growing body of research has examined the physiological effects of the Taser (Ho, Miner, Lakireddy, Bultman, & Heegaard, 2006; Joint Non-Lethal Weapons Human Effects Center of Excellence, 2005; McDonald, Stratbucker, Nerheim, & Brewer, 2005), sparse empirical research has been conducted on the use and effectiveness of the instrument in a field setting. Consequently, our knowledge is largely limited to reports from the CED industry (e.g., Taser International) and police agencies on one side and documents from human rights groups (e.g., Amnesty International and the American Civil Liberties Union) on the other.[2]

This article seeks to add to the scientific knowledge base in this area through an examination of all Taser incidents involving officers in the New York Police Department (NYPD) from 2002 to 2005 (N = 375), with an emphasis on identifying predictors of weapon effectiveness. Specifically, the authors use both logistic regression and chi-square automatic interaction detection (CHAID), a form of segmentation modeling, to identify predictors of Taser effectiveness, measured as both the termination of suspect resistance and officer satisfaction with the weapon. The article concludes with a discussion of implications for the ongoing public discourse regarding the Taser as well as for police policy and practice.

Prior Research

Police and the Use of Force

Police officers have legal authority to use force in a wide range of situations, and the nature of this force can entail using empty-hand force and

less lethal weapons (e.g., baton, pepper spray, or CED), depriving an individual of liberty through arrest, and as a last resort, using a firearm to take an individual's life (Walker & Katz, 2002). Bittner (1970) asserts that the capacity to threaten or use physical force is the core function of the police that defines their role and shapes each contact with a citizen or suspect:

> There can be no doubt that this feature of police work is uppermost in the minds of people who solicit police aid or direct the attention of the police to problems, that persons against whom the police proceed have this feature in mind and conduct themselves accordingly, and that every conceivable police intervention projects the message that force may be, and may have to be, used to achieve a desired objective. (p. 40)

Despite its central role in police work, research indicates that police use of force is statistically rare, occurring in only about 1% of all police–citizen encounters (U.S. Bureau of Justice Statistics, 1999).[3] However, because of the sheer volume of police–citizen encounters in a given year (approximately 43 million), an estimated 421,000 use-of-force incidents occur annually, which translates into about 1,100 incidents per day. Rubinstein (1973) clearly illustrates the intrusive, dehumanizing effect that force can have on a citizen:

> [The patrol officer] may not only circumscribe a person's liberty by stopping him on the street, he may also completely violate the suspect's privacy and autonomy by running his hands over the man's entire body. The policeman knows that a frisk is a humiliation people usually accept from him because he can sustain his authority by almost any action he feels necessary. While he does not frisk people often to just humble them, he can do so; when he feels obliged to check someone for a concealed weapon, he is not usually in a position to request their permission, even if this were desirable. (p. 271; see also Skolnick & Fyfe, 1993, p. 94)

The consequences of police use of force can be severe and long lasting, far exceeding the immediate impact on the individual officer and citizen involved. Fyfe (1988) notes that use-of-force incidents have led to civil disorder and riots, the firing of police executives, millions of dollars in litigation, criminal prosecutions, and strained police–community relations. Recent examples include outbreaks of civil disorder in Cincinnati, Ohio, and St. Petersburg, Florida, in the late 1990s as well as the riots after the acquittal of the Los Angeles Police Department officers involved in the Rodney King incident.

Because of the magnitude of this responsibility delegated to the police and its potential consequences, police officers are mandated to use the minimum force necessary to accomplish their objective; force exceeding this minimum standard is considered excessive (Commission on Accreditation for Law Enforcement Agencies, 1999). Police departments closely monitor use of force and provide policy guidelines to officers typically through a "force continuum," which describes verbal and physical actions an officer can take in response to different levels of suspect resistance and behavior. The use-of-force continuum will usually highlight the minimum and maximum recommended force options available to the individual officer. As the subject's resistance or aggression increases, the officer may use greater degrees of force and is allowed to remain one level above the suspect as the interaction progresses (i.e., an officer may be permitted to use a less lethal weapon, such as pepper spray or a CED, in response to physical resistance by a suspect).

The Development of Less Lethal Alternatives

The role of the police in igniting the riots that marked the 1960s led scholars and police practitioners to reevaluate the force options available to patrol officers in responding to varying levels of suspect resistance. Although discussions regarding less lethal alternatives to the firearm date back to the 1920s, the President's Commission on Law Enforcement and the Administration of Justice (1967) brought the issue to the forefront of the policing agenda when it recommended the development and adoption of less lethal alternatives. During the past several decades, advances in technology have led to the development of a range of new alternatives, such as oleoresin capsicum (OC) spray, impact weapons, foams, ballistic rounds, nets, and most recently, CEDs (Wrobeleski & Hess, 2003). These weapons are intended to provide officers with more alternatives when a situation requires the application of force but has not escalated to the point where lethal force is necessary—thereby adding response options to the use-of-force continuum.

During the 1990s, the adoption of OC or pepper spray became commonplace among police agencies, and this trend was accompanied by a sizeable literature on its use, impact, and effectiveness (Smith & Alpert, 2000). The research on OC spray serves as an important backdrop for the current work on CEDs, because many of the same issues and concerns have been raised. Specifically, controversies surrounding the use of OC spray included its use

against passive resisters, disproportionate use against minorities, and potential health risks (Kaminski, Edwards, & Johnson, 1999). A number of studies have examined the effectiveness of OC spray, indicating relatively high rates of suspect incapacitation, reduced officer injuries, and less reliance on other types of force (Gauvin, 1994; Lumb & Friday, 1997; Nowicki, 1993). Using interrupted time-series analysis, Kaminksi, Edwards, and Johnson (1998) concluded that the adoption of OC spray in Baltimore County reduced the number of assaults on police by 15%. Furthermore, Kaminski et al. (1999) found that the effectiveness of OC spray was mitigated by suspect age, weight, distance, and drug use (but not alcohol).

New Technology Emerges: CEDs

For many police agencies, CEDs are more than just the latest novelty in less lethal alternatives; rather, they are becoming what mace was for police departments in the 1960s—an integral tool used in daily police practice. Advantages of CEDs over other less lethal alternatives—such as pepper spray, bean bag guns, and other soft-impact rounds—include the relatively short duration of their recovery time, their reliability at greater distances, their size and utility, and their perceived effectiveness.[4]

Nonetheless, some police departments have been cautious in adopting this technology on a broad scale, and anecdotal evidence suggests that line officers may be reluctant to use the device routinely because of its dubious public image. The Taser, an acronym for Thomas A. Swift Electric Rifle, "is a conducted energy weapon that fires a cartridge with two small probes that stay connected to the weapon by high-voltage, insulated wire" (Wrobeleski & Hess, 2003, p. 87). The M26 and X26 advanced Taser models introduced by Taser International in 1999 and 2003, respectively, are the two common "new generation" CEDs used by police agencies. These weapons discharge two darts to a distance of 21 feet, delivering a 50,000-volt shock in a 5-second cycle. The electrical charge overrides the central nervous system, resulting in the loss of neuromuscular control, which gives the officer time to gain control of the suspect and apply handcuffs, if necessary.

Questions Surrounding the Taser

The controversy regarding the Taser has occurred in the public domain and has been widely publicized. News reports describing incidents in which police officers used the weapon against the elderly, children, and the mentally ill have made national headlines. Favorable and unfavorable

media images of police practices have been competing for public attention and serve as the backdrop against which the Taser is being assessed by the public and government officials (Lovell, 2003). Currently, empirical research is not driving the debate. This is unsettling, considering that mainstream media depictions of the police are often inaccurate or unrealistic (Ian Ross, 2000; Manning, 1977, 1997). The controversy regarding the Taser came to a head in 2004 when Amnesty International issued its report:

> In its recommendations . . . *Amnesty International* is reiterating its call on federal, state and local authorities and law enforcement agencies to suspend all transfers and use of electro-shock weapons, pending an urgent rigorous, independent and impartial inquiry into their use and effects. (Amnesty International, 2004, p. 3).

The conclusions of the Amnesty International report underscored the controversy and ongoing debate between CED manufacturers and human rights organizations about the expanded use of CEDs among police agencies in the United States. The organizations' concerns focused on fatalities occurring after Taser deployment as well as the potential for abuse by police and its use as a routine force option. CED manufacturers argue, however, that the device is a safe alternative to other less lethal weapons that reduces injuries to officers and suspects. More generally, concerns about CEDs have emerged in three critical areas. Each is discussed below.

When is it appropriate to use the device? No consensus exists among police agencies regarding where the Taser should be placed on the force continuum (U.S. Government Accountability Office, 2005). Should CEDs be placed at the same level as pepper spray, or are they more appropriate farther down the use-of-force continuum as a last alternative to the firearm? Should they be used against suspects who are passively resisting an officer (e.g., ignoring verbal commands) or only against individuals who are actively resisting arrest? Is there any justification for using the Taser against a minor, a senior citizen, or a pregnant woman? Police departments have varied considerably in their responses to these questions, and both the International Association of Chiefs of Police (IACP; 2005) and the Police Executive Research Forum (PERF; 2005) have taken action recently by developing training guidelines and model policies to offer guidance to agencies in their deployment of CEDs. For example, both the IACP and PERF suggest that CEDs only be used against those who are actively resisting, that they not be used against children or the elderly except

in emergency situations, and that each deployment is closely supervised and documented.

Does it work effectively? Since January 2000, *The New York Times* has printed nearly 200 news stories describing incidents in which officers across the United States have used the Taser to control or subdue a suspect. A review of these articles reveals an abundance of cases in which the Taser appears not to have the intended physiological effect on a suspect. In some cases, one or both of the prongs missed the target, or the prongs hit the target but failed to penetrate the suspect's clothing. To date, much of the academic research on the effectiveness of CEDs has relied on field reports completed by officers after deploying the weapon, which measure whether the CED functioned properly, enabling the officer to incapacitate or arrest the subject. Field data analyzed by Taser International (2006) and internal evaluations conducted by police agencies (see, e.g., Seattle Police Department, 2004) place the effectiveness rate of the Taser somewhere between 80% and 94%, but there is sparse independent empirical research studying the effectiveness of the device. White and Ready (2007) calculated an effectiveness rating by examining the impact of the Taser on suspect resistance. They found that use of the weapon caused suspects to stop resisting in 86% of all Taser deployments by the study department.

Several police agencies that have implemented CEDs on a broad scale have later reported reductions in injuries sustained during police–citizen contacts. Police departments in Austin, Texas; Putnam County, Florida; and Cincinnati, Ohio, experienced reductions in injuries to both suspects and officers after adopting the Taser (see Putnam County Sheriff's Office, 2005; Taser International, 2006). Although these trends are noteworthy, questions remain concerning the extent to which the Taser contributed to these reductions. Retrospective analysis of injury trends may not account for other variables (e.g., more training, crime trends, new leadership, etc.) that influence yearly injuries sustained during police–citizen encounters. At present, there are no national-level baseline data concerning the number of police agencies that have reported reductions in injuries after adopting the Taser as compared to the number of agencies that have not reported reductions. The degree to which the device is used effectively depends less on the physiological effects of the technology than on the policy guidelines and field training that departments apply to reinforce accepted standards of use.

Proponents in the law enforcement community claim that the Taser can serve as a substitute for lethal force and other forms of less lethal force (e.g., baton) that may result in serious injury or death (Heck, 2003;

McBride & Tedder, 2005; U.S. Bureau of Justice Statistics, 1999). This is an empirical question that has not been tested, and any practical benefits must be balanced against the potentially harmful physiological effects of the device.

What is its impact on the likelihood of serious injury or death to a suspect? As noted earlier, Amnesty International called for a moratorium on police use of the Taser in late 2004, citing 74 deaths that occurred in North America following deployment of the weapon. Although there is no evidence of a direct causal link between use of the Taser and elevated risk of serious injury or death, a review of the Amnesty International report suggests that the risk of death may be greater for those with preexisting medical conditions (particularly heart conditions) as well as those under the influence of drugs or alcohol. Recent studies supported by the federal government have tested the physiological effects of CEDs on healthy adult volunteers (a sample that may be very different than suspects targeted by police officers) and have concluded that no decisive evidence of ventricular fibrillation or other serious medical side effects exists (Ho et al., 2006; Joint Non-Lethal Weapons Human Effects Center of Excellence, 2005; McDonald et al., 2005). The Canadian Police Research Centre (2005) conducted an exhaustive review of existing research and concluded that "definitive research or evidence does not exist that implicates a causal relationship between the use of CEDs and death" (p. ii).

In sum, despite the growing popularity of CEDs in American policing, researchers have failed to keep pace with the diffusion of this rapidly spreading technology. A developing body of scientific research has begun to address the research question relating to the potential for the Taser to cause serious injury or death, but the questions concerning when it is appropriate to deploy the weapon (and against whom) and its degree of effectiveness remain largely unanswered. Guidelines outlined by PERF and IACP have played a critical role in clarifying some of the important issues for police administrators. This article seeks to inform the use and effectiveness dialogue by shifting the emphasis toward prediction; that is, under what circumstances and against what types of suspect behavior is the Taser most likely to be effective? In other words, what are the characteristics of police officers and suspects and incident-related circumstances that increase or reduce the odds that police use of the CED will result in a successful resolution?

Method

NYPD and the Taser

This article examines all Taser incidents involving police officers from the NYPD from January 2002 through December 2005 ($N = 375$). The NYPD is cautious in its approach to the deployment of Tasers, and its use is closely monitored. The Taser is issued only to officers in the Emergency Service Unit (ESU). The ESU is responsible for situations that require advanced equipment and expertise, such as crisis situations involving the mentally ill, hostages, and suicidal suspects. The unit consists of several hundred officers, which is a relatively small proportion of the 35,000 sworn NYPD officers. Also, supervisors at the rank of sergeant and above are trained to use the Taser, and each precinct is equipped with one or more devices that can be signed out, though they are not required to carry it. The patrol guide details fairly specific circumstances in which it is appropriate to use the device:

> Patrol supervisors or uniformed members of the service assigned to the Emergency Services Unit may utilize a Taser/electronic stun device to assist in restraining emotionally disturbed persons if necessary. The Taser/electronic stun device may be used:
>
> a. To restrain an EDP [emotionally disturbed person] who is evincing behavior that might result in physical injury to himself or others, OR
> b. To restrain person(s) who, through the use of drugs, alcohol, or other mind-altering substances, are evincing behavior that might result in physical injury to himself or others.
>
> Emergency Service Unit personnel will obtain the permission of the Emergency Service Unit Supervisor prior to utilizing a Taser/electronic stun device, except in emergencies. (NYPD, 2000)

As a result, deployment of the Taser is allowed only in situations involving an EDP or person under the influence of drugs or alcohol who is posing a threat of physical injury where either ESU officers are dispatched or a supervisor is present and has a Taser in his or her possession.[5]

The data analyzed for the current study are derived from a "Taser/stun device report," which is completed every time an officer deploys the weapon.[6] The report contains a series of questions that use check boxes to elicit a range of information about demographic characteristics of the suspect, his or her emotional and physical state, behavior and level of resistance.

weapons present, the rank and assignment of the officer, and characteristics of Taser deployment (e.g., distance, effect, etc.). Most items on the report are formatted as multiple-choice questions, with an additional narrative section where the officer is required to describe the incident in detail. From these reports, the authors created a data set in SPSS that captures 40 variables relating to each Taser incident. These independent variables serve as predictors of Taser effectiveness for the multivariate analysis. Though the research was admittedly limited by the information collected on the Taser/stun device report, the authors note the earlier work conducted by Kaminski et al. (1999), which employed a similar design and analysis, with similar variables, for an evaluation of the effectiveness of OC spray.

The Dependent Variable: Measuring Effectiveness

The dependent variables used in the study include three separate but related measures of effectiveness. The first two measures of effectiveness are based on the extent of suspect resistance. Specifically, the field report contains several items that measure whether suspect resistance ended after the Taser was deployed and notes how much time transpired (in seconds) before the suspect was incapacitated. A follow-up item requires the responding officer to indicate whether the suspect was incapacitated at all. The average time to incapacitation was 8.10 seconds, but this measure should be viewed with caution. It is likely that officers at the scene were far more concerned about bringing the suspect under physical control than counting the number of seconds needed to terminate the struggle and apply handcuffs. For this reason, we will focus on the dichotomous measures of resistance for the analysis.

In one third of the cases (33.0%), the suspect continued resisting against the officer after the Taser was deployed. The cases involving continued resistance can be divided into two categories based on the nature and duration of the resistance. In 32 cases, the resistance continued immediately following the Taser deployment because the suspect was not restrained by the weapon; that is, at no point was the subject subdued, and he or she continued to resist (*continual resistance*). The Taser was clearly ineffective during these incidents, perhaps because of loose or heavy clothing blocking the darts from making full contact, mechanical failure, or resilience on the part of the suspect. In the other 65 cases involving continued resistance, the subject was initially incapacitated by the Taser and the officer(s) gained control temporarily; however, the suspect began resisting again at a subsequent

point in time (*any resistance*). The distinction between these two different outcomes draws attention to the temporary impact of the Taser (i.e., the involuntary loss of muscle control is not long term) and shows the importance of carefully observing the suspect's actions immediately after the Taser is deployed. Because of the practical importance of this distinction in resistance, both measures are used as dependent variables in the analysis. The base rates for any subsequent resistance and continual resistance are 33.0% and 10.9%, respectively.[7]

At the end of the Taser/stun device report, the officer is instructed to indicate whether the device performed satisfactorily (yes or no). Police officers' responses to this question serve as the third measure of Taser effectiveness. Officers reported that the Taser performed satisfactorily during 78.7% of the cases. Officer satisfaction is likely related to a host of factors, including the physiological effect on the suspect and the outcome of the deployment taken as a whole. Did the Taser discharge as intended? Did both prongs strike the target, and if so, did they penetrate the suspects' clothing? Did the suspect stop resisting the officer and was he or she subsequently taken into custody? Finally, was anyone seriously injured during the altercation?

Data Analysis

The authors employed two analytic approaches, logistic regression and CHAID (a form of segmentation modeling), to identify predictors of Taser effectiveness. Descriptive analyses were conducted to identify significant relationships at the bivariate level. The bivariate findings, theory, and practical expectations directed the identification of predictors for the multivariate analysis, though all variables were included in the multivariate analysis. Logistic regression is employed because all three measures of effectiveness are dichotomous outcomes with yes-or-no responses. Similar to logistic regression, CHAID predicts the probability of an event's occurring, but the method relies on different assumptions and properties and uses segmentation modeling to accomplish the task. CHAID divides a population into "increasingly homogenous" segments that differ on the basis of the dependent variable; in this case, suspect resistance and officer satisfaction (Jones, Harris, Fader, & Grubstein, 2001, p. 490). The resulting segments are mutually exclusive and exhaustive, and as the analysis proceeds, the best predictor is selected among a particular subgroup of cases based on chi-square analysis.

CHAID analysis is employed in this study because it offers a number of advantages. First, "one significant advantage of this approach is that the model can find different combinations of predictors for different subsets of the population" (Jones et al., 2001, p. 490). This is especially useful if there is reason to suspect that predictors may differ in their impact among subgroups. For example, predictors of suspect resistance may be different for intoxicated and sober suspects, and CHAID facilitates the identification and exploration of these interactions. Second, Jones et al. (2001) point out that numerous studies have examined statistical issues in risk prediction (Gottfredson, 1987; Simon, 1971; Tarling & Perry, 1985), including the use of CHAID and more traditional methods such as logistic regression, and the general consensus is that "no method is consistently better than any other" (Tarling & Perry, 1985, p. 212). With this conclusion in mind, multiple methods allow researchers to either "triangulate" their findings or identify inconsistencies across techniques. Last, an additional benefit of CHAID is the user-friendly visual representation of variables that interact to produce an outcome; in this case, the technique highlights the important situational dynamics of Taser incidents—and how those dynamics relate to outcomes—in a more interpretable manner for practitioners and policy makers.

Limitations and Considerations

Several limitations of this study should be considered. First, the article examines official reports from one police department that has deployed the Taser in a controlled, limited manner. This impairs the generalizability of the findings to other police departments, particularly, those agencies that have issued the Taser to all patrol officers.[8] Second, this study examines only Taser incidents that generated an official police report. There is no indication that officers are not completing the Taser field report on a systematic basis, especially considering that the device tracks each deployment electronically; however, it is possible that some incidents did not result in a report. Third, anecdotal evidence provides some support for a deterrent effect when the Taser is exposed to a potential subject but not used; that is, much like the firearm, suspects may become compliant when confronted with the imminent possibility of being stunned with the Taser. Researchers and police practitioners would consider this type of incident as a successful de-escalation, but these situations are not captured in the data because the NYPD requires a field report after discharge only.

Results

Descriptive Analysis of Taser Incidents

Suspect characteristics. Suspects targeted in the Taser incidents were primarily male (88.8%) with a mean age of 34.9; more than half were African American (52.1%), 18.7% were White, and 27.3% were Hispanic (see Table 1). Most of the suspects did not appear under the influence of drugs or alcohol (87.2%), but the majority exhibited signs of mental illness (92.5%) and were therefore identified by the responding officers as EDPs.[9] About 40% of the subjects were armed with a weapon (39.6%), most commonly, a kitchen knife or cutting instrument (84% of armed suspects, 32% of all cases).[10] The vast majority of suspects (95%) engaged in physical violence. The violent behavior was directed at an officer during more than half of the incidents (53.3%), one fifth involved a threat of suicide or self-harm (18.6%), and the remaining violent individuals (18.9%) directed their aggression toward multiple individuals at the scene.

Officer characteristics. The Taser/stun device report captures limited information regarding the officer who deploys the weapon. More than half of the officers who used the device were detectives (55.5%), and 41.2% were patrol officers. Just 3.2% were supervisors. More than 90% of the officers were assigned to the ESU. In the majority of cases, the officer deploying the Taser was not alone. One or more back-up officers were present during nearly all of the incidents (93.5%), and a supervisor was present in 88.1% of the cases.[11]

At the bivariate level, there are notable differences in officer rank with regard to the outcomes of interest: satisfaction and suspect resistance. During the study period, 12 cases involved supervisors who were not assigned to the ESU (i.e., patrol sergeants). The effectiveness ratings from these supervisors are significantly lower than the ratings from the ESU officers: Any suspect resistance was reported by 54.5% of the supervisors, compared to 26.7% of police officers and 36.3% of detectives; 20.0% of the supervisors reported resistance immediately after the Taser was used, compared to 7.6% of police officers and 12.0% of detectives; and 41.7% of the supervisors reported being satisfied with the Taser, compared to 81.7% of police officers and 79.4% of detectives.[12] These findings may have implications for the NYPD, because supervisors outside of the ESU receive less training in use of the Taser and may also be using an older model of the device.

Table 1
Characteristics of Suspects and Officers Involved in Taser Deployments

	Percentage	*n*
Suspect characteristics		
Gender		
Male	88.8	332
Female	11.2	42
Total	100.0	374
Racial background		
African American	52.1	189
White	18.7	68
Hispanic	27.3	99
Asian or Other	1.9	7
Total	100.0	363
Mean age = 34.9 years		332
Emotionally disturbed		
No	7.5	28
Yes	92.5	347
Total	100.0	375
Intoxicated		
No	87.2	321
Drugs	7.1	26
Alcohol	4.3	16
Both drugs and alcohol	1.4	5
Total	100.0	368
Armed with a weapon		
No	60.4	217
Yes	39.6	142
Total	100.0	359
Violent behavior		
No	5.2	19
Toward self	18.6	68
Toward officer	53.3	195
Toward other citizens	4.1	15
Toward multiple	18.9	69
Total	100.0	366
Officer characteristics		
Rank		
Patrol officer	41.2	153
Detective	55.5	206
Supervisor	3.2	12
Total	100.0	371
Command		
Emergency Service Unit	91.2	321
Other	8.8	31
Total	100.0	352
Back-up present		
No	6.5	22
Yes	93.5	318
Total	100.0	340
Supervisor Present		
No	11.9	42
Yes	88.1	310
Total	100.0	352

Note: Total numbers are different because of missing data. In some of the study cases, information for one or more variables was missing, and the tables reflect known information only.

Incident characteristics. More than three quarters of the incidents occurred indoors (see Table 2). Per department policy, the majority of suspects (95.6%) were transported to a hospital for a physical examination following the incident. Interestingly, three quarters of the subjects (75.9%) were not arrested after the incident, although many of them were held at the hospital for psychological examination and/or civil commitment. The average distance between the officer and the suspect at the time of deployment is approximately 5.5 feet. In 80.7% of the incidents, the Taser was deployed only once by the officer, and in nearly 80% of the cases, both darts made contact with the suspect as intended. Officers used the device in stun mode in 48 incidents (direct contact to skin, no darts).[13] In 22% of the cases, officers also used another nonlethal device, most typically another type of stun device (14%) or pepper spray (5%). In 86% of the cases, a supervisor indicated that use of the Taser was consistent with departmental policy.[14] Findings with regard to officer satisfaction and suspect resistance—the dependent variables for the multivariate analysis—have been summarized above.

Multivariate Analysis

Logistic regression analysis. Table 3 displays the results of the logistic regression models predicting the three measures of Taser effectiveness. The table provides the logistic regression coefficients, standard errors, and odds ratios for the independent variables in each of the models. The likelihood ratio test for each of the models was statistically significant, and Nagelkerke R^2 estimates suggest that the models predicting any subsequent suspect resistance, resistance immediately after use of the Taser, and officer satisfaction accounted for 23%, 13%, and 21% of the explained variation, respectively.[15] In the first model, statistically significant predictors of any suspect resistance include the following:

- The suspect's body weight is greater than 200 pounds.
- Distance between the officer and the suspect is 3 feet or less.
- The suspect is under the influence of drugs or alcohol.
- The suspect directs violence toward an officer or citizen (as opposed to oneself).
- One or both Taser darts missed the intended target.
- The officer used another nonlethal device before or after using the Taser.[16]

Specifically, when one or both Taser darts miss the suspect, the likelihood of any suspect resistance increases by about 300%. Three predictors—violence directed at an officer or citizen, drug or alcohol intoxication, and

Table 2
Characteristics of Incidents Resulting in Taser Deployments

Incident Characteristic	Percentage	n
Location		
Indoors	77.5	286
Outdoors	22.5	83
Total	100.0	369
Suspect arrested		
No	75.9	274
Yes	24.1	87
Total	100.0	361
Suspect transported to hospital		
No	4.4	16
Yes	95.6	346
Total	100.0	362
Number of Taser deployments		
One	80.7	284
More than one	19.3	68
Total	100.0	352
Mean distance between officer and suspect = 5.41 feet		
Darts on target		
Both darts on target	77.7	240
One dart missed	4.5	14
Both darts missed	1.6	5
Darts made contact but fell from clothing	0.6	2
Device used in stun mode	15.5	48
Total	100.0	309
Was suspect incapacitated?		
No	13.2	42
Yes	86.8	277
Total	100.0	319
Mean time to incapacitation = 8.10 seconds		
Did suspect continue to resist?		
No	67.0	235
Yes	33.0	116
Total	100.0	351
Officer satisfied with Taser?		
No	21.3	74
Yes	78.7	273
Total	100.0	347

Note: Total numbers are different because of missing data. In some of the study cases, information for one or more variables was missing, and the tables reflect known information only.

police use of another less lethal weapon—more than double the odds of the occurrence of any suspect resistance during Taser incidents. In addition, suspects who weigh more than 200 pounds are about 84% more likely to resist the officer after the Taser is deployed.

Significant predictors of resistance occurring immediately after deployment of the Taser include the following:

- The suspect's body weight is greater than 200 pounds.
- The suspect is under the influence of drugs or alcohol.
- One or both Taser darts missed the intended target.

Findings for the second model are similar to the model predicting any suspect resistance. Continual resistance immediately after the Taser is deployed is most likely to occur in circumstances where the Taser darts miss a large suspect who is intoxicated.

Results from the model predicting officer satisfaction indicate that the following independent variables are statistically significant:

- The suspect's body weight is 200 pounds or less.
- Distance between the officer and the suspect is greater than 3 feet.
- The suspect is armed with a knife or gun.
- Both Taser darts struck the intended target.[17]

Interestingly, the strongest predictor of officer satisfaction with the Taser is the suspect's being armed with a knife or gun. When the suspect is armed with a weapon, the likelihood of police's reporting that they are satisfied with the Taser is about 200% greater. A possible explanation may be that the likelihood that harmful consequences will occur when the Taser does not work properly is greater when the suspect is armed with a knife or gun: therefore, the sense of relief experienced when the device does perform properly in these volatile situations affects the officer's reporting of satisfaction. The distance between the officer and the suspect during the Taser deployment is also positively associated with officer satisfaction with the device.

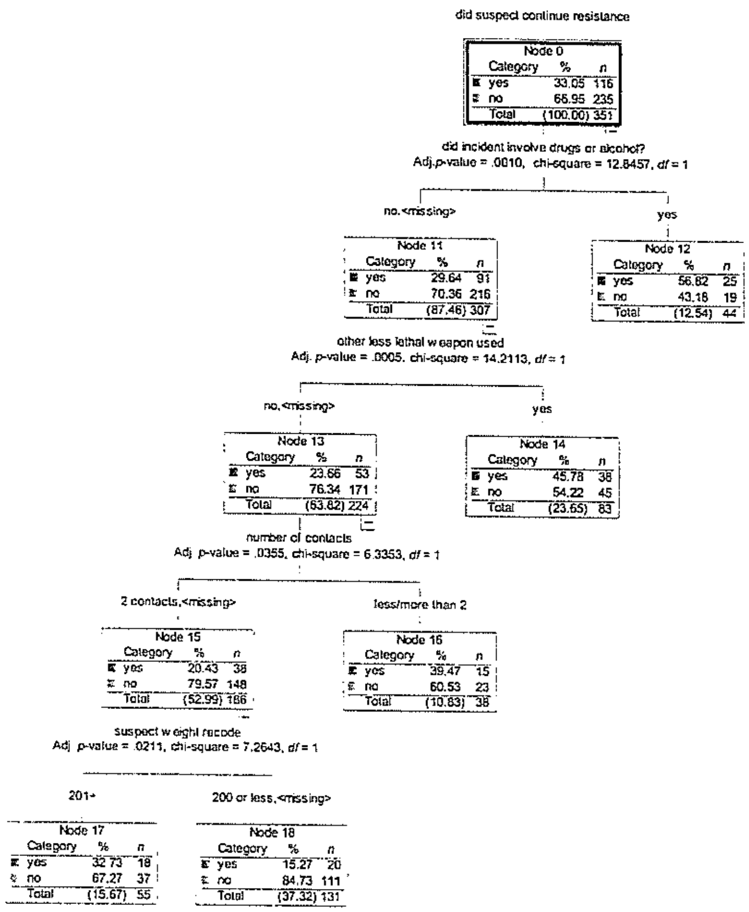
CHAID analysis. Figures 1 to 3 show the results of the CHAID analysis, which uses the same set of variables to predict Taser effectiveness. In Figure 1, the top cell (or root node) in the CHAID tree reflects 33.05% of the cases where any suspect resistance occurred. The initial split was made on the basis of whether the suspect was under the influence of drugs or alcohol, thus separating the 375 Taser cases into two cells: those where the

Table 3
Logistic Regression Predicting Three Measures of Taser Effectiveness

Predictor Variables	*B*	*SE*	Wald	Odds Ratio	*p* Value
Any suspect resistance					
Suspect weight	0.612	.302	4.114	1.844	.043
Distance	−0.667	.306	4.735	0.513	.030
Suspect intoxicated	0.954	.410	5.418	2.596	.020
Suspect violent toward others	0.884	.373	5.617	2.421	.018
One or both prongs miss target	1.393	.531	6.887	4.028	.009
Other less lethal weapon used	1.057	.312	11.445	2.877	.001
Log likelihood	285.065				
R^2 (Nagelkerke)	.227				
Chi-square	46.051				
df	6				
Significance	.000				
n	255				
Resistance immediately after deployment					
Suspect weight	0.882	.416	4.484	2.415	.034
Suspect intoxicated	1.285	.486	6.982	3.614	.008
One or both prongs miss target	1.744	.569	9.379	5.717	.002
Log likelihood	164.691				
R^2 (Nagelkerke)	.130				
Chi-square	17.634				
df	3				
Significance	.001				
n	262				
Officer satisfaction					
Suspect weight	−0.904	.338	7.133	0.405	.008
Distance	0.928	.337	7.586	2.528	.006
Suspect armed with gun or knife	1.111	.422	6.945	3.037	.008
One or both prongs miss target	−2.193	.578	14.408	0.112	.000
Log likelihood	229.067				
R^2 (Nagelkerke)	.213				
Chi-square	37.268				
df	4				
Significance	.000				
n	246				

suspect was not intoxicated (n = 307; 87.46% of the total) and those where the suspect was intoxicated (n = 44; 12.54% of the total). The splits in CHAID are made according to differences in the dependent variable (i.e., any suspect resistance): Of suspects who were intoxicated, 56.8% continued to resist, compared to 29.6% of suspects who were not intoxicated. An additional split was made from the *not intoxicated* cell and is based on

Figure 1
CHAID Analysis Predicting Any Suspect Resistance



Note: CHAID = chi-square automatic interaction detection.

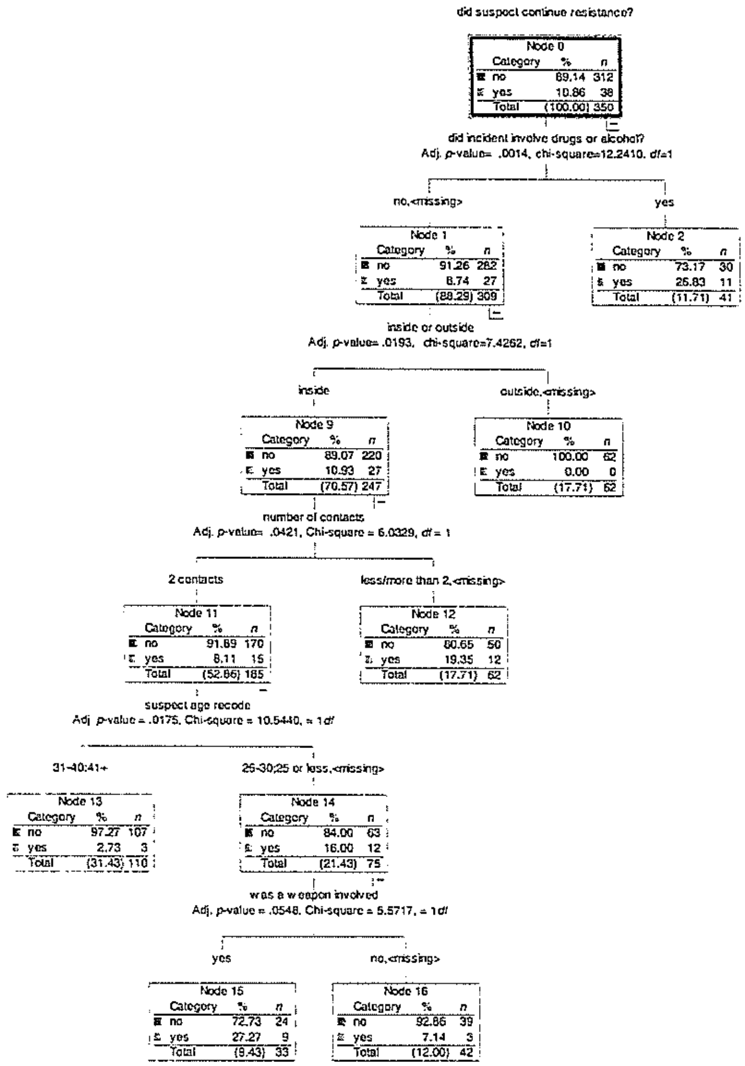
whether police used another less lethal weapon: Suspect resistance occurred in 45.8% of cases where another less lethal weapon was used in addition to the Taser, compared to 23.7% of cases where only the Taser was used. The next split was made from the cell indicating that no other less lethal weapon

was used except the Taser. This split is based on the number of darts that made contact with the suspect: Subjects who were not intoxicated during the encounter, where no other less lethal weapon was used except the Taser, continued to resist during 20.4% of the cases where two darts made contact, compared to 39.5% of the cases where fewer or more than two contacts were made.[18] The final split is made from the cell indicating that two darts made contact and is based on suspect body weight: Suspects in cases where both darts made contact, where no other less lethal weapon was used except the Taser, and where the suspect was not intoxicated were more likely to continue to resist if they weighed more than 200 pounds (32.7% compared to 15.3% for those who weighed 200 pounds or less). Table 4 summarizes the termination cells for the CHAID tree predicting any suspect resistance, which includes the predictors, cell size, percentage of the total cases, and percentage of the dependent variable: any suspect resistance.

Figure 2 displays the CHAID tree predicting continual resistance, and the top cell represents 10.9% of the cases where suspect resistance occurred immediately after the deployment. The initial split is based on the use of drugs or alcohol, as it was for the first CHAID tree: Intoxicated suspects continued to resist immediately after the Taser was deployed in 26.8% of the cases, compared to 8.7% of the cases in which the suspect was not intoxicated. Several additional splits flow from the cell indicating that the suspect was not intoxicated. The next split is based on whether the Taser incident occurred indoors or outside (10.9% suspect resistance inside compared to 0.0% resistance outside). From the cell indicating that the incident occurred indoors, the next split is based on whether the two darts made contact or not (8.1% resistance compared to 19.4%). From the "two contacts" cell, the split is based on whether the suspect was 30 years old or younger (16.0% resistance) as opposed to 31 years old or older (2.7% resistance). The final split flows from the *30 years old or younger* cell and is based on whether the suspect was armed with a weapon (27.3% resistance) or not (7.1% resistance). Termination cell summaries are again shown in Table 4.

Figure 3 shows the CHAID tree for the last measure of effectiveness: officer satisfaction. An initial split is based on the number of darts that made contact—two darts, or fewer or more—with greater officer satisfaction when two darts made contact (83.7% vs. 66.3%). The next split, made from the *two contacts* cell, is based on the distance between the police officer and the suspect. Officer satisfaction is greater when the officers are 4 feet or more away from the target: In this category, 86.7% of the officers reported being satisfied, compared to 72.0% for the officers who were 3 feet away or closer (see Table 4 for summary).

Figure 2
CHAID Analysis Predicting Resistance Immediately After Deployment



Note: CHAID = chi-square automatic interaction detection.

Table 4
Summary of CHAID End Groups

	n	% of Total	% of Suspect Resistance
Any suspect resistance			
Suspect intoxicated	44	12.54	56.82
Suspect not intoxicated (or missing); other less lethal weapon used	83	23.65	45.78
Suspect not intoxicated (or missing); no other less lethal weapon used (or missing); not two contacts	38	10.83	39.47
Suspect not intoxicated (or missing); no other less lethal weapon used (or missing); two contacts (or missing); suspect weighs 201+ pounds	55	15.67	32.73
Suspect not intoxicated (or missing); no other less lethal weapon used (or missing); two contacts (or missing); suspect weighs 200 pounds or less (or missing)	131	37.32	15.27
Total	351	100.00	
Resistance immediately after deployment			
Suspect not intoxicated (or missing); occurred inside; two contacts; suspect 30 or younger (or missing); suspect has weapon	33	9.43	27.27
Suspect intoxicated	41	11.71	26.83
Suspect not intoxicated (or missing); occurred inside; not two contacts (or missing)	62	17.71	19.35
Suspect not intoxicated (or missing); occurred inside; two contacts; suspect 30 or younger (or missing); suspect has no weapon (or missing)	42	12.00	7.14
Suspect not intoxicated (or missing); occurred inside; two contacts; suspect 31 or older	110	31.43	2.73
Suspect not intoxicated (or missing); occurred outside (or missing)	62	17.71	0.00
Total	350	100.00	
Officer satisfaction			
Two contacts; distance 4 feet or more (or missing)	196	56.48	86.73
Two contacts; distance 3 feet or less	50	14.41	72.00
Not two contacts (or missing)	101	29.11	66.34
Total	347	100.00	

Note: CHAID = chi-square automatic interaction detection analysis.

profound implications for police administrators who are responsible for upholding use-of-force standards. This article seeks to contribute to the dialogue on CEDs by identifying predictors of Taser effectiveness.

Findings from the descriptive analysis suggest consistency across the types of incidents (and suspects) in which officers in the NYPD deploy the Taser.

- Most suspects were male, African American or Hispanic, and in their 30s.
- Few suspects were under the influence of alcohol or drugs, but nearly all were identified as exhibiting signs of mental illness.[19]
- Nearly all suspects engaged in violent behavior.
- Just fewer than half of suspects were armed, and among armed suspects, the majority possessed a knife or cutting instrument.
- Nearly all the officers using the Taser in the NYPD were assigned to the ESU.
- Back-up officers and supervisors were present in almost all cases.
- A large majority of suspects were incapacitated by the Taser after the first deployment, and most were incapacitated within 5 seconds.
- Most of the subjects were not arrested on criminal charges, although nearly all were transported to a hospital for physical and/or psychological evaluation.

Findings from the multivariate analyses, both logistic regression and CHAID, are remarkably consistent in predicting the three effectiveness measures:

Any suspect resistance (a measure of ineffectiveness)

- Suspect body weight was over 200 pounds (logistic and CHAID).
- Suspect was intoxicated (logistic and CHAID).
- One or both Taser darts missed the intended target (logistic and CHAID).
- Officer used another less lethal weapon (logistic and CHAID).
- Distance between the officer and the suspect was 3 feet or less (logistic).
- Suspect directed violence toward an officer or citizen (logistic).

Resistance occurring immediately after Taser use (a measure of ineffectiveness)

- Suspect was intoxicated (logistic and CHAID).
- One or both Taser darts missed the intended target (logistic and CHAID).
- Suspect body weight was more than 200 pounds (logistic).
- For a subset of cases, incident occurred indoors, suspect was 30 years old or younger, and suspect was armed (CHAID).

Officer satisfaction (a measure of effectiveness)

- Suspect and officer were more than 3 feet apart (logistic and CHAID).
- Both Taser darts struck the intended target (logistic and CHAID).
- Suspect body weight was 200 pounds or less (logistic).
- Suspect was armed with a gun or knife (logistic).

Three important findings emerge from the analysis. First, the analysis suggests that Taser effectiveness can be modeled using multivariate techniques, as several suspect- and incident-related variables are associated with a greater or lesser likelihood of effectiveness. Considering the paucity of research examining use and effectiveness of the Taser, this finding alone is important. Second, a number of variables were noticeably absent from the statistically significant predictors of Taser effectiveness identified in the multivariate analysis. For example, the race and gender of the suspects were unrelated to any of the three measures of effectiveness. Importantly, whether the suspect was classified as "emotionally disturbed" was also unrelated to Taser effectiveness. Note that only 28 cases did not involve a suspect classified as an EDP, so caution should be used in generalizing to this subgroup. The findings relating to EDPs are particularly important, however, because anecdotal evidence made available by the news media and interest groups suggests that the mentally ill may be more likely to continue to resist the police and to experience serious injury or death when stunned by the Taser. The results of this study indicate that the suspects' mental health at the time of the incident did not affect the effectiveness of the Taser. Additionally, the authors reviewed all news reports (N = 192) of Taser incidents printed in *The New York Times* during the study period to become more familiar with the qualitative aspects of the incidents and found evidence of only one case where NYPD deployment of the Taser resulted in the death of an emotionally disturbed suspect.[20]

The third important research finding relates to the variables that were identified as significant predictors in the multivariate analyses, including suspect intoxication, body weight, violence directed at an officer or citizen, and distance between the officer and the suspect. A relatively small proportion of the Taser cases involved an intoxicated suspect—13%, or 46 incidents—but effectiveness dropped significantly for those cases: Intoxicated suspects were twice as likely to exhibit any resistance during the encounter (57% compared to 30%, respectively), they were about 3 times as likely to resist immediately after police deployed the Taser (27% compared to 9%, respectively), and intoxication was associated with lower officer-reported satisfaction with the Taser (67% compared to 80%, respectively).[21] Although the reason for this finding is not clear, one possible explanation relates to

the effect of drugs and alcohol on the suspect's ability to reason and process information. The intoxicated suspects may be less capable of thinking rationally during the police–citizen encounter and therefore less inclined to comply with the officer's instructions after the effects of the Taser wear off. This finding clearly warrants attention from police researchers and practitioners. If it is replicated in other police jurisdictions, with other suspect samples, there are clear policy and training implications. Police field training can highlight the increased likelihood of continued resistance among intoxicated suspects and provide officers with a clear set of guidelines to anticipate and curtail resistance to prevent violence escalation and serious injuries.

The emergence of suspect body weight as a predictor of Taser effectiveness is both interesting and puzzling. Evidence that the weapon is less effective against heavier individuals is not apparent from the CED industry reports or the growing clinical research. This study finds suspect weight—with a cutoff at 200 pounds—a significant predictor of both resistance measures and officer satisfaction. Depending on the degree to which body weight moderates the effects of the Taser, there are implications for Taser use and for police policy and training. Police officers may need to prepare for the greater likelihood of resistance immediately after using the weapon on particularly tall or heavy suspects. Policy should offer guidance on subsequent responses, which may include additional Taser deployments or alternative less lethal weapons. Given the potential relationship between multiple Taser deployments and elevated risk of serious injury or death, police departments may need to craft their policies carefully. Moreover, researchers should consider investigating the potential for an interaction effect between body weight and intoxication. For example, 18 cases in the study data involve an intoxicated suspect who weighs more than 200 pounds, of whom 13 (72%) continued to resist the officer after being stunned with a Taser. This is clearly an important issue that requires further investigation.

Two other suspect-related variables were significant in the multivariate analysis: violent behavior directed at an officer or another person and whether the subject was armed with a weapon. Suspects who were suicidal, engaged in self-harm, or threatened self-harm were less likely to continue resisting after being stunned with the Taser, compared to those who were acting violently toward an officer or citizen. The implications for police are straightforward: Suspects who direct their violence toward others—most notably, the police officer—represent the greatest risk of a physical struggle after being stunned with the Taser, and therefore, officers should remain especially vigilant when using the Taser on subjects that fit this description.

The association between armed suspects and measures of effectiveness indicates that police use of the Taser is most effective in those situations where the potential for serious injury or death is highest. Further research is needed to substantiate this finding, but there are a number of potential explanations:

- High-risk situations could be fundamentally different in ways that affect officer satisfaction.
- The actual physiological effects of the Taser may be different (e.g., more effective) in these types of encounters.
- Police officer performance during and after Taser use may be different in high-risk encounters (e.g., quicker reaction times, better handcuffing, etc.).

Several incident-related characteristics are also associated with the effectiveness measures, notably, distance from the intended target, police use of another less lethal device in addition to the Taser, and the number of darts that make contact with the suspect. The importance of the number of darts that strike the subject and police use of other less lethal weapons is clear. For the Taser to deliver the current, both darts must strike the suspect, penetrate the clothing, and attach to the skin. If this does not occur, the device will not work as intended, and consequently, resistance will be more likely to continue. Although the field report does not specify the order in which multiple weapons are used, the fact that more than one weapon is used implies that one or more instruments were ineffective in curtailing resistance.

The significance of the distance from the suspect as a predictor of effectiveness has both training and policy implications. Taser International offers cartridges with maximum ranges of 15 feet, 21 feet, 25 feet, and even 35 feet. The study findings suggest that the Taser is less effective when used at close range—within 3 feet or less of the target. (Note that distance remained significant when controlling for use of the device in stun mode, i.e., direct contact to the suspect's skin.) The reasons for this are unclear, although use at close range may increase the likelihood that suspect movement could affect the accuracy of the weapon, the suspect could grasp or bump into the weapon at time of discharge, or the darts may not spread out sufficiently to deliver the optimal current. Police agencies may want to consult with each other or the CED manufacturer to determine if this short-range problem has emerged elsewhere. Regardless, maintaining a safe distance whenever possible is of central importance; in fact, the NYPD (2000) patrol guide states that officers should maintain a "zone of safety" of 20 feet and call ESU when

responding to EDPs. Findings from this study suggest that the "safe-distance" principle should be reinforced for ESU as well, particularly when there is reasonable suspicion that a Taser may be deployed.

Conclusion

This article sought to address questions about the use and effectiveness of CEDs by examining all Taser deployments by the NYPD from 2002 to 2005 (N = 375). The authors employ both logistic regression and CHAID analysis to identify predictors of Taser effectiveness, measured as the extent of suspect resistance and officer satisfaction. A number of statistically significant predictors surfaced with policy and training implications, including suspect body weight, drug and alcohol use, violent behavior, and the distance between the responding officer and the suspect. Considering the lack of empirical research predicting Taser effectiveness, this article takes an important step in thinking about the circumstances in which favorable deployment outcomes are likely to occur.

As we suggested earlier, there is an ongoing discourse between civil rights organizations and the CED industry regarding the widespread adoption of these devices. Although this research offers an objective, empirical analysis of Taser deployments, for a number of reasons, it is difficult for the authors to weigh in on this debate. First, much of the debate has focused on the physiological effects of CEDs, which is not a focus of this research. Second, we have examined one police department with a restrictive and closely monitored deployment pattern, which limits the conclusions we can draw. Alternatively, this research shows that the study police department experienced positive outcomes while avoiding the current controversies associated with use and effectiveness. Both PERF and IACP offer detailed guidance on model policy and procedures for the Taser, most of which mirror the NYPD approach. Thus, we can conclude that with regard to the use and effectiveness questions only, this research suggests that departments can successfully deploy the Taser—avoiding problems with misuse and abuse—by implementing and closely monitoring the guidelines developed by PERF and IACP.

Nonetheless, additional research on this topic is necessary not only because the technology is relatively new but also because different agencies are adopting the weapon to varying degrees and developing different standards and expectations concerning its proper use. A multisite analysis of police agencies that have incorporated the Taser into routine practice based on

different approaches would yield valuable comparative data. This type of cross-site approach—coupled with the release of research supported by the National Institute of Justice, particularly, the national-level study being conducted by Alpert and colleagues—will enable researchers to begin asking more complex questions about police use of the Taser, such as to what extent it is used by officers as an alternative to other less lethal weapons (and physical force) and what types of information would be required for a rigorous cost-benefit analysis of the Taser.

Notes

1. There are competitors to Taser, including Stinger Systems and Law Enforcement Associates, but Taser dominates the market with approximately 95% of conducted energy device (CED) sales in the United States. Stinger Systems has sold just 12,000 weapons since 2000. Law Enforcement Associates introduced their CED only recently, in March 2005.

2. Important considerations and limitations associated with these reports include small sampling frames and potentially competing interests among those who carried out the studies. The National Institute of Justice is currently funding several national-level research projects on the Taser, but these studies have just begun.

3. This estimate becomes much greater if handcuffing and verbal commands are included as use of force.

4. For example, the effects of mace and pepper spray are often felt for several hours, and their range of effectiveness is much shorter (which increases the likelihood of other officers' being hit). Beanbag guns and similar impact munitions are often fired from a specialized shotgun that is larger and bulkier than CED.

5. The New York Police Department's (NYPD; 2000) patrol guide also offers a definition of an emotionally disturbed person (EDP):

> A person who appears to be mentally ill or temporarily deranged and is conducting himself in a manner which a police officer reasonably believes is likely to result in serious injury to himself or others. (p. 1)

In situations involving an EDP, officers are instructed to create and maintain a "zone of safety" of approximately 20 feet and to call for the Emergency Service Unit (ESU) and a patrol supervisor as well as an ambulance (NYPD, 2000). Officers are not to attempt to take an EDP into custody unless

- The EDP is unarmed, not violent and is willing to leave voluntarily; OR
- The EDP's actions constitute an immediate threat of serious physical injury or death to himself or others. (NYPD, 2000, p. 1)

6. These reports were provided to the authors by the supervisor of the department's training division. Although the form is used primarily for the Taser, there were 33 forms involving use of another type of nonlethal weapon: either a stun device or other similar alternative. Because the focus of this article is the Taser, these cases were excluded from the analysis.

7. Given that the intent of the Taser is temporary incapacitation only, the latter suspect resistance measure—10.9%—is probably a fairer measure of the Taser's effectiveness. Also, the *any suspect resistance* measure includes both types of resistance (i.e., continual resistance is a subset of the more general resistance measure). Both measures are examined in the multivariate analysis.

8. At the same time, it is worth noting that the limited manner in which the NYPD has implemented the Taser is a practical advantage to police administrators in New York, who have avoided being criticized in the news media for excessive reliance on the Taser.

9. This variable is based on the police officer's assessment of the suspect at the time of the incident. It is not based on more definitive tests, such as a urinalysis or blood or hair analysis. Although this would appear to suggest that police officers in the study department use the Taser disproportionately against the mentally ill in crisis, this finding must be interpreted in the context of how the department has deployed the Taser. Per department policy, the ESU is called when the patrol officers or supervisors on scene determine that the situation involves an EDP who is behaving in a manner that could result in physical injury or death to the EDP or others (NYPD, 2000). Thus, these data are a reflection of the types of suspects typically handled by the ESU—a highly specialized group of officers—not the suspects typically handled by line officers.

10. There were also two cases where the suspect was armed with a gun: In one case, the suspect was threatening to commit suicide, and in the other case, the suspect had taken a hostage and was threatening multiple people (including the hostage and himself). Of the remaining cases involving an armed suspect, the most common weapon was a blunt object, such as a metal pipe, baseball bat, chair, or large stick.

11. The nearly universal presence of back-up officers and supervisors is again dictated by the fact that most of these cases involve the ESU. This unit is typically called to the scene by the first responding officer, and often a supervisor will also respond.

12. Both police officers and detectives are assigned ranks in the ESU. Chi-square values indicate that the satisfaction and any-resistance differences are statistically significant (p = .005 and p = .050, respectively). It may be useful in future research to examine length of time on the job and officer training as factors related to effectiveness. These variables may more accurately capture the relationship between officer's use of the Taser—especially among non-ESU personnel—and effectiveness measures.

13. Information on the number of dart contacts was not reported in 66 cases. Rather than make assumptions about the number of contacts, the authors have proceeded conservatively and coded these cases as missing. This decision, however, reduces the number of cases available for multivariate analysis.

14. In the remaining 14% of the cases (n = 53), the form was not signed and there was no information about whether the use met departmental policy. However, a review of the narrative of those 53 cases suggests that they too conformed with department policy on use of the Taser.

15. Nagelkerke R^2 provides an approximation of the explained variation in a logistic regression model. This measure of model strength is considered slightly more conservative than the R^2 statistic in ordinary least squares regression but less conservative than the Cox and Snell R^2 estimate, which does not have a maximum value of 1.0.

16. Although the "Taser/stun device report" indicates whether another nonlethal device was also used, it does not specify which is used first, the Taser or the alternative.

17. Suspect resistance was also a predictor of officer satisfaction, but it has been excluded from the analyses because it serves as the other effectiveness measure. The authors question the value of a model that uses one outcome measure to predict another.

Oleoresin Capsicum Spray and Tasers:

A Comparison of Factors Predicting Use and Effectiveness

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Oleoresin Capsicum Spray and Tasers:

A Comparison of Factors Predicting Use and Effectiveness

ABSTRACT

In the last few decades, several less-lethal forms of force have been introduced, adopted, and deployed by police agencies. Oleoresin capsicum spray is now used in nearly every department across the United States; the Taser is used in the majority of police departments. Despite their widespread use, we still know relatively little about the factors associated with the use of OC spray and Tasers and the effectiveness of these weapons in incapacitating subjects. This paper contributes to that discussion by analyzing 504 use-of-force incidents where the police used OC spray or Tasers during the event. Data were obtained from a large municipal police department on incidents that occurred in 2010 and 2011. Policy implications and directions for further research are discussed.

INTRODUCTION

A fundamental but controversial function of the police is their ability to use coercive force (Bittner, 1970; Klockars, 1985). Force is most likely to be used by the police in situations where they are confronted with non-compliant subjects (Reiss, 1971; Terrill & Mastrofski, 2002). In such situations, police officers have several options. At one end of the spectrum, beyond verbal commands and threats, officers may use bodily force (e.g., decentralizations, focused strikes). Bodily force alone is the most common form of physical force used by police officers (Adams, 1999). At the other end of the spectrum, officers may use their firearms. The use of firearms is considered a last resort; it is only to be used to defend human life. In between bodily force and deadly force, there are several "less-than-lethal" or "less-lethal" options.

In the last few decades, several less-lethal forms of force have been introduced, adopted, and deployed by police agencies. Today, nearly all local departments authorize the use of one or more less-lethal weapons (Reaves, 2010). The most common less-lethal weapon is pepper spray, authorized by 97% of all local departments (Reaves, 2010). Conducted Energy Devices (CEDs)[1], including Tasers[2] and stun guns, are authorized by 60% of all local police agencies (Reaves, 2010). While the number of departments authorizing pepper spray is not much higher than in the year 2000 (91%; Hickman & Reaves, 2003), the number of local police departments that authorize the use of CEDs has dramatically increased since 2000, when just 7% authorized them (Reaves, 2010).

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[1] CEDs are sometimes also known as Electronic Control Devices (ECDs), Conducted Electrical Weapons (CEWs), or Conducted Energy Weapons (CEWs).

[2] The Taser (short for the Thomas A. Swift Electric Rifle) is currently the most popular CED on the market. It is also the CED used by the department in this study. As such, we use the term "Taser" rather than the more general "CED" throughout this paper.

In response to the greater prevalence and use of less-lethal weapons, particularly OC spray and Tasers, a substantial amount of research has been conducted on issues related to them. For instance, researchers have analyzed the frequency with which different types of force are used before, during, and after OC spray or Tasers are introduced in departments (e.g., Lin & Jones, 2010; Lumb & Friday, 1997). Studies have examined the factors associated with the use of OC spray (Morabito & Doerner, 1997) and Tasers (Crow & Adrion, 2011; Gau, Mosher, & Pratt, 2010) as well as officer and citizen injuries associated with their use (e.g., Terrill & Paoline, 2011; Kaminski et al., 2013; Paoline, Terrill, & Ingram, 2012; Kaminski et al., 1999; Smith et al., 2007). Finally, researchers have examined the effectiveness of OC spray (Morabito & Doerner, 1997; Kaminski, Edwards, & Johnson, 1999; Adang et al., 2006) and Tasers (White & Ready, 2010; White & Ready, 2007), defining effectiveness in terms of their ability to induce subject compliance.

While this research has advanced our understanding of the benefits and limitations of OC spray and Tasers, we still know relatively little about the factors associated with the use of OC spray and Tasers and the effectiveness of these weapons in incapacitating subjects. In particular, there are no studies to date that directly compare the use and relative effectiveness of OC spray and the Taser within the same jurisdiction during the same time frame.[3] Some studies examine OC spray, while others examine Tasers. It is difficult, if not impossible, to draw definitive conclusions about the use and relative effectiveness of OC spray and Tasers on the basis of studies that do not include both OC spray and Taser incidents, do not compare OC spray with Tasers, that use different sampling procedures and measurements schemes for critical variables,

[3] An exception is a study performed by TASER International (as cited in White and Ready, 2007). In this study, the effectiveness of the OC spray and the Taser were compared, but only when both were used in the same incident. In these encounters, OC spray was effective 33% of the time while the TASER was effective in 83% of cases (Taser International, 2002).

and that were conducted in different police departments with different use-of-force policies and continuums. As such, we do not know whether Tasers are significantly more (or less) effective than OC spray in similar situations, or whether different factors predict their use and effectiveness. This study examines the factors that predict the use and effectiveness of OC spray (N= 259) and Tasers (N=245) in a single large municipal police department. Data were obtained from official use-of-force reports of the police department on incidents that occurred in 2010 and 2011.

LITERATURE REVIEW

Police use of force, defined as "acts that threaten or inflict physical harm on suspects" (Terrill, 2003, p. 56), has been an important and constant topic of research since the 1970s. This attention is warranted for theoretical and practical reasons. Theoretically, research on police use of force is important because it involves the defining characteristic of policing. In large part, an understanding of the complexities and dilemmas of police work depends on an understanding of police use of force. Practically speaking, research on the control of police use of force is important in that use of force can have devastating—and deadly—consequences. As such, it can dramatically affect police-community relations, public cooperation with the police, and the legitimacy of the police more generally.

Due to the potentially serious consequences of police use of force, police officers are constrained in their ability to use it. Along with legal (*Graham v. Connor*, 490 U.S. 386 1989) and accreditation standards (Commission on Accreditation for Law Enforcement Agencies, 1999), the majority of police departments guide officer behavior with a "continuum of force" or "force continuum" (Terrill & Paoline, 2012). Most often, officers are to base force decisions on

the level of suspect resistance or aggression; force is only escalated to the next level when less forceful actions fail to induce suspect compliance. While OC spray and Tasers are usually placed at the same level on force continuums (Alpert et al., 2011; IACP, 2005), there is little agreement between and among departments where they should be placed. In some departments, OC spray and the Tasers are placed at the lower end of the continuum, authorizing their use against passive resisters; other departments place them closer to lethal force on the continuum, authorizing their use only against active resisters. Where OC spray and Tasers are located on the continuum of force matters when understanding the circumstances in which the weapons are used (Crow & Adrion, 2011; Morabito & Doerner, 1997). In turn, the circumstances in which OC spray and Tasers are used may have implications for their effectiveness in inducing compliance among subjects.

OC SPRAY AND TASERS

Oleoresin capsicum (OC) spray, otherwise known as pepper spray, was introduced to law enforcement in the 1980s. OC is an inflammatory agent naturally found in cayenne peppers. When a person is sprayed with OC spray, the effects are immediate: the respiratory tract becomes inflamed, the individual experiences an intense burning sensation and swelling around the eyes, and the subject's eyes close involuntarily (Lumb & Friday, 1997). Although the subject may be in extreme discomfort, he or she may still be able to resist. Ideally though, the effects of OC spray render a resistive suspect passive and compliant, and the officer is able to take the suspect into custody without further incident.

Once introduced, OC spray immediately demonstrated advantages over other forms of force. The effects of OC spray, while immediate and dramatic, were more temporary than other

forms of chemical gasses used previously (Lumb & Friday, 1997). OC spray proved more effective on intoxicated individuals than mace, and was less prone to secondary contamination (White & Ready, 2007). Finally, OC spray was less likely to cause injury than bodily force, batons, and flashlights (Lumb & Friday, 1997). As summarized by Lumb & Friday (1997):

> ...OC spray is an effective alternative to the more harmful types of weapons available to police. OC causes almost instantaneous incapacitation and leaves no long term residual effects. It allows the officer to stay away from the suspect when affecting a custodial arrest that is being resisted, and there are few problems associated with transporting the person, as OC spray residue dissipates fairly quickly (p. 138).

Today, while OC spray is standard issue in police departments, CEDs, such as the Taser and other stun devices, are still gaining popularity. First introduced in the 1990s, the Taser is a 50,000 volt, 26-watt weapon that uses nitrogen cartridges to fire its probes. Once the probes attach to the suspect, the Taser delivers an electrical current which overrides the central nervous system, causing involuntary muscle contractions and incapacitation (Alpert et al., 2011; Means & Edwards, 2005).

The Taser has advantages over other less-lethal alternatives including their greater reliability at longer distances, the relatively quick recovery time involved, and their perceived effectiveness in inducing suspect compliance (White & Ready 2010). In addition, because Tasers do not rely on pain to induce compliance, ideally they should be more effective on persons who have a higher tolerance of pain, such as people under the influence of drugs or alcohol or who have a mental illness (Means & Edwards, 2005).

Despite their popularity and advantages, OC spray and Tasers are not without controversy. One concern relates to their safety. In the late 1980s and early 1990s, OC spray was claimed to have caused several in-custody deaths (ACLU of Southern California, 1993; Alpert et al., 2011). Twenty years later, the Taser was also alleged to be a proximate cause of in-

custody deaths (Alpert et al., 2011; White & Ready, 2007). Research has shown that most deaths involving OC spray were instead the result of positional asphyxia, pre-existing health conditions, or were drug-related (Granfield, Onnen, & Petty, 1994; Petty, 2004). With regard to Tasers, it has been demonstrated that the risk of death when a Taser is used is less than 0.25 percent (NIJ, 2011), and in those situations the death is likely to be a result of drug intoxication, preexisting heart conditions, and exposure to other forms of nonlethal police force (White & Ready, 2007).

Another concern relates to police overuse of OC spray and Tasers (Alpert et al., 2011). For instance, members of the ACLU and Amnesty International have voiced concern that OC spray and Tasers are used in a disparate fashion against members of minority groups (ACLU of Southern California, 1993; Amnesty International, 2006). A related concern is that police have authorized their use too low on continuums of force and consequently are using them against passive (versus active) resisters (Terrill & Mastrofski, 2002). Finally, there are concerns about the use of OC spray and Tasers with the elderly, children, pregnant women, and persons with medical conditions that put them at greater risk of experiencing dangerous medical side effects (Amnesty International, 2006; Sloane & Vilke, 2006).

A final concern has to do with manufacturer exaggeration of the capabilities and effectiveness of OC spray and Tasers in incapacitating subjects, which, in part, may have contributed to their widespread adoption in police departments. Some early studies reported "effectiveness rates" as high as 100% for OC spray (as cited in Adang et al., 2006) and 94% for the Taser (as cited in White & Ready, 2010). Objective empirical research on the effectiveness of these devices remains rather sparse. Of the independent studies that do exist, effectiveness rates have not been found to be as high as those originally reported by the manufacturers. For

instance, and as discussed below, Kaminski et al. (1999) found an effectiveness rate of 71% for OC spray. White and Ready (2010) found an effectiveness rate of 85% for the Taser.

RESEARCH ON THE USE AND EFFECTIVENESS OF OC SPRAY AND TASERS

While research appears to have ameliorated concerns about OC spray and Tasers causing serious injury and death, there remain concerns about their use and effectiveness. In response, there has been a growing body of literature that examines the use and effectiveness of these weapons. Given the objectives of the current study, we review here the studies that examine the factors associated with the *use* of OC spray and Tasers and the *effectiveness* of OC spray and Tasers (with effectiveness defined in terms their ability to facilitate the arrests of resisting subjects).

The Use of OC Spray

Morabito and Doerner (1997) analyzed OC spray use-of-force reports from the Tallahassee Police Department. They examined characteristics of officers and suspects that were associated with the use of OC spray at two points in time: prior to and after a change in the circumstances in which OC spray was authorized in the department. At Time 1, OC spray was only authorized in cases when the suspect was actively physically resisting police. At Time 2, the threshold for the use of OC spray was reduced from active physical resistance to verbal/passive physical resistance. At Time 1, OC spray use was compared to impact weapons such as batons, flashlights, and stun guns. At Time 2, OC spray use was compared to the use of soft hand techniques (punches, kicks, and pain compliance techniques). The officer characteristics of interest included race, gender, education and experience. Suspect variables

included race, gender, height and weight (relative to the officer's height and weight), suspect intoxication, and whether the suspect was armed or attacked the officer. While none of the predictor variables were significant at Time 1, several factors were associated with OC spray use at Time 2. At Time 2, male, educated, and veteran officers were more likely to use OC spray than soft hand techniques. OC spray was also more likely to be used than soft hand techniques when the suspect was heavier and taller than the officer and when the suspect was armed.

The Use of Tasers

Gau, Mosher, and Pratt (2010) analyzed case file data on Tasers and other types of force used by officers in a state patrol agency from 2005 to 2007. The authors were primarily interested in examining possible racial disparities in the use of a Tasers on subjects. Tasers were used in nearly one-half of all use-of-force incidents. They found that compared to other forms of force, Tasers were equally likely to be used on white, Hispanic, and Black subjects; although when a Taser was used, Hispanic subjects were more likely than White subjects to have a Taser be the first type of force used. The authors also found that females were less likely to be "tased" than males, and that subjects who actively resisted and who were assaultive were *less* likely to be tased than subjects who passively resisted. Finally, white officers were significantly less likely to use a Taser than officers of other races.

Crow and Adrion (2011) analyzed 461 use-of-force incidents (reports) that occurred between 2004 and 2010 in a medium-sized municipal police department. The authors compared incidents where a Taser was used and incidents where "other" types of force were used (takedowns, physical force, pepper foam, impact weapons, police dog, use of a vehicle as a weapon, and firearms). The authors found that a Taser was *less* likely to be used than other forms

of force when subjects physically resisted and when resistance involved a weapon. A Taser was equally likely to be used when resistance was in the form of "presence," "flight," and "verbal" (meanings unspecified). A Taser was more likely to be used than other forms of force on non-white and male subjects. Older officers were significantly more likely to use Tasers. A policy change to restrict the use of Tasers also had its intended affect; after the policy change, Tasers were less likely to be deployed. Call type, time of day of the incident, officer sex, race, age, and rank did not affect the likelihood of Taser use.

The Effectiveness of OC Spray

Three studies have examined the effectiveness of OC spray (Morabito & Doerner, 1997; Adang et al., 2006; Kaminski, Edwards, & Johnson, 1999), generally defined in terms of the extent to which it facilitates the arrests of suspects who resist. As previously noted, Morabito and Doerner (1997) analyzed use of force reports from the Tallahassee Police Department. Although these authors were most concerned with the factors associated with the use of OC spray, they also briefly considered the effectiveness of it. As the authors explained, OC spray "was considered effective if it induced the expected physiological effects and enabled the officer to take the subject into custody without further incident" (p. 690). They calculated a "success rate" of 73% for OC spray and found that OC spray worked "equally well on mentally disturbed subjects, intoxicated subjects, and physically stressed subjects who were involved in either a foot chase or a physical struggle" (p. 690).

Kaminski et al. (1999) analyzed data on incidents where OC spray was used by officers in the Baltimore County Police Department. Based on assessments provided by officers who were involved in the incidents, three measures of OC spray effectiveness were constructed. In

their most conservative measure, they defined effectiveness in terms of whether the use of OC spray incapacitated (fully and immediately immobilized) the suspect (yes/no). According to this measure, OC spray was effective in 71% of cases. Their second measure of effectiveness was also dichotomous, measured as the officer's assessment of whether the use of OC spray eased arrest (yes/no). In this case, the use of OC spray was deemed effective 85% of the time. Their third measure of effectiveness consisted of a 5-point scale ranging from totally effective (i.e., incapacitated suspect) to totally ineffective (i.e., OC spray had no effect). Here, OC spray was considered effective 84% of the time.

Kaminski et al. (1999) examined the effects of suspect characteristics on OC spray effectiveness. In particular, they examined the variables of suspect race, gender, age, weight, height, and condition (i.e., suspect was drinking, mentally disturbed, on drugs, or other). The authors also examined the distance from which OC was sprayed. They found that OC spray was more effective (yes/no) with younger and older suspects (but less effective among middle-aged suspects) and intoxicated suspects. It was less effective when it was used on suspects who were under the influence of drugs and when sprayed from longer distances.

Adang et al. (2006) analyzed data on incidents where OC spray was used by police officers in the Netherlands. They used surveys of officers, supervisors, and prosecutors to measure the effectiveness of OC in several ways: the degree to which the subject was incapacitated (with options ranging from "completely" to "not at all"), the degree to which OC made the arrest easier ("much easier" to "much more difficult"), whether suspects became more or less aggressive after exposure to OC spray ("much more" to "much less"), and how satisfied officers were with the performance of OC spray ("dissatisfied" to "highly satisfied"). Estimates of effectiveness ranged from 69% (suspects who became less aggressive after being sprayed with

OC) to 92% (officers who were satisfied with the performance of OC spray). In the model predicting the extent of suspect incapacitation, four of thirteen independent variables were statistically significant. Specifically, OC spray was less effective when used by less experienced officers, against minority suspects, when suspects were warned beforehand they were going to be sprayed, and when suspects were under the influence of drugs.

The Effectiveness of Tasers

Two studies have examined the effectiveness of Tasers with specific regard to the incapacitation of subjects in arrest situations (White & Ready, 2007; White & Ready, 2010). White and Ready (2007) examined the effects of Tasers based on self-report surveys completed by (primarily SWAT) officers who worked in a large metropolitan police department. They considered the Taser effective if it led to the "successful incapacitation" of the subject. They found that after deploying a Taser, "85% of subjects were subdued by the Taser and taken into custody" (p. 183). The authors developed a multivariate "violence escalation scale" that they used to score each Taser incident. The scale included whether the subject was violent, armed with a weapon (and what type of weapon), under the influence of drugs or alcohol, mentally ill, the weight of the subject, and whether the officer was alone. Although individual analyses were not provided on each variable, the analyses performed on the scale revealed that the Taser was the most effective in the "highest risk" situations.

White and Ready (2010) analyzed Taser deployments from the New York City Police Department; the data were derived from the reports that officers completed subsequent to the deployment of the weapon. Three measures of Taser effectiveness were used in the study. The first measure was the officer's assessment of whether the Taser performed satisfactorily (yes/no).

Officers rated the performance of the Taser as satisfactory in 79% of cases. While this indicator of effectiveness was also used in prior studies (see Adang et al., 2006), the other two are unique in that they measure suspect resistance or, in other words, the *in*effectiveness of the Taser. The authors classified suspect resistance two ways: First, "continual resistance" included those situations where the suspect was not affected at any point by the weapon; the suspect continued to resist after the Taser was deployed. This occurred in 33% of all Taser deployments. In these instances the Taser was clearly ineffective. Second, "any resistance" included those situations where the Taser temporarily resulted in the incapacitation of the suspect, but the suspect resisted again prior to the conclusion of the incident. This occurred in about 11% of Taser deployments.

In their models predicting Taser (in)effectiveness, White and Ready (2010) explored the impact of multiple officer, suspect, and incident characteristics. They found the Taser to be less effective on heavier subjects (i.e., over 200 lbs), subjects who were under the influence of drugs or alcohol, subjects who were violent, when another less lethal weapon was used, when one or both prongs missed the subject, and when the Taser was fired from farther away (i.e., greater than three feet). When effectiveness was based on officer satisfaction, the Taser was also perceived to be more effective when the suspect was armed with a knife or gun.

Conclusions

There are too few studies available to draw confident conclusions about the factors that affect the use and effectiveness of OC spray and Tasers. Other than that males are more likely than females to be subject to a Taser than other forms of force (Gau, Mosher, & Pratt 2010; Crow and Adrion 2011), that OC spray is less likely to be effective on subjects who are under the influence of drugs compared to subjects who are not (Kaminski et al. 1999; Adang et al. 2006),

and that departmental policy affects the use of OC spray and Tasers (Crow & Adrion 2011; Morabito & Doerner, 1997), there is little consistency in findings. There is also little consistency in variables included in previous studies and the measurement of those variables.

It is safe to conclude, however, that estimates regarding the effectiveness of OC and Tasers depend at least in part on the measures used; different definitions of effectiveness produce different rates of effectiveness. In the studies reviewed here, rates of OC effectiveness ranged from 69% to 92% (Adang et al., 2006), while the effectiveness of the Taser ranged from 66% to 89% (White & Ready, 2010). The variation in effectiveness estimates notwithstanding, it appears that most studies show the Taser to be more effective than OC spray.

Our study adds to the discourse on the use and effectiveness of OC spray and the Taser in several ways. First and most importantly, this study is the first that directly compares OC spray with Tasers in terms of their use and their effectiveness, and we do so in the context of the same study site. Second, we include all intentional OC spray and Taser deployments to provide a potentially more inclusive assessment of effectiveness.[4] Lastly, we provide a logical measure of weapon effectiveness that incorporates the dynamic nature of use of force incidents and we use this same measure to evaluate OC spray and Tasers.

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[4] Interestingly, Kaminski et al. (1999) excluded from their analyses incidents where OC was used but where it missed its intended target and incidents where it was used in a crowd situation. The authors also explain that if multiple officers or multiple subjects were involved in the incident, a single officer and/or a single subject was selected for analysis. In addition, it is unknown what, if any, other types of force were used before or after the deployment of OC spray. Adang et al. (2006), like Kaminski et al. (1999), excluded several categories of incidents from their analysis: incidents where officers deployed OC spray but it missed its intended target, where OC was intended to be used but the canister malfunctioned, incidents that involved a crowd situation, and when it was deployed against female subjects. In addition, the authors did not specify what, if any, other types of force were used before or after the deployment of OC spray. It is unknown how these factors may have affected their conclusions about OC spray effectiveness.

METHOD

Data

The data for this study were obtained from a large municipal police department. At the time of the study, the department employed approximately 2,000 sworn officers, about 1,200 of whom were patrol officers. The police department served a population of approximately 600,000; 40% of the population was African American and 10% was Latino.

Analyses were performed on all use of force incidents in 2010 and 2011 where an officer from the department intentionally discharged OC spray (n=259) or deployed a Taser (n=245) against a person. While an additional 24 incidents involved the use of OC and a Taser, and another 45 incidents involved the use of another type of weapon, the analyses conducted here focus on the 504 incidents where OC *or* a Taser was used.

All officers in the department were trained and authorized to carry and use OC spray. During the academy, officers received 4 to 8 hours of instruction on the use of OC spray. Only about 300 officers (approximately 25% of patrol officers) were trained and certified to use a Taser. Further, on each of the three shifts at each of the eight districts, approximately six to eight Tasers were available to be signed out and carried by the certified Taser officers. Therefore, at any given time during the time of this study, there were no more than 68 Tasers actually being carried by officers. With regard to Taser training, officers who volunteered for training first had to be approved by Internal Affairs. Officers who were selected to be Taser trained participated in 16 hours of "new user" training and an additional 8 hours of "refresher" training every 2 years.[5]

At the time of the study, the use of force policy of the department specified OC spray and Tasers as "control devices." According to the policy, "the goal of control devices is to overcome

[5] The only training required by TASER International is the 8 hours of "new user" training.

active resistance or its threat [italics added]." Control devices, escort holds, compliance holds and passive counter measures were more broadly considered "control alternatives." Although a continuum of force was not specified per se, "intervention options" were provided; these options ranged from presence, dialogue, control alternatives, protective alternatives (e.g., focused strikes, vertical stuns), to deadly force (see Figure 1).

Most of the data for the study were obtained from a case management system used by the police department and were converted into a Statistical Package for the Social Sciences (SPSS) data file for analyses. The database was organized with use of force incidents as the unit of analysis. The use of force data were based on reports that were completed by supervisory officers when a use of force incident occurred. According to the official policy of the department at the time of the study, a use of force report was to be completed by a supervisor when an officer: (a) discharged a firearm, (b) used a baton, (c) discharged Oleoresin Capsicum (OC), (d) deployed an Electronic Control Device (Taser), (e) used any other type of force, which resulted in an injury, or a complaint of an injury, to a person, or (f) when a department canine bit a subject in the performance of their duty. Clearly, this is a relatively narrow definition of force as it does not include incidents where only bodily force was used when that force did not result in an injury (or a complaint of an injury) to a subject (or verbal force, see Terrill & Mastrofski, 2002). Nevertheless, that the department policy did not require all bodily force incidents to be reported is of little concern in this study. This study focuses specifically on incidents that involved the use OC spray or a Taser. Departmental policy specified that all such incidents be recorded and all types of force used in those incidents be recorded.

Along with the departmental use of force report, a narrative of the incidents was also written by the supervisory officer and was included in the case management system. For this

study, all of the narratives for incidents that involved the use of OC and/or a Taser were reviewed (787 pages) and additional data were coded from them (e.g., level of subject resistance, the order in which force was used by officers).

Variables

The two primary dependent variables in this study are: 1) the *use of* OC spray and the Taser and 2) the *effectiveness of* OC spray and the Taser. Determining whether or not a particular type of force was used in an incident was relatively straight-forward. If OC was sprayed or a Taser was deployed, OC or the Taser was considered to have been used. If the target was missed, if the weapon malfunctioned, if it was used in a crowd situation, or if it was used against females, the incident was still included. If the incident involved multiple officers and/or multiple subjects, the incident was included. In the few incidents that involved multiple subjects, the characteristics of the person identified as the primary subject in the officer's report was coded.

Determining the effectiveness of OC spray and the Taser was more complicated. As discussed earlier, previous studies have used different measures of effectiveness although each study, in one way or another, examined how well, or to what degree, OC spray or the Taser incapacitated the subject who resisted the police. Of course, the variation in measurement is important to consider when interpreting findings across studies. Ultimately, in a use of force incident, the legitimate objective is to neutralize the threat posed by the subject and gain control over that subject. Most often, practically speaking, "gaining control" means using as much force as necessary in order to place handcuffs on the subject. Many use-of-force situations are

complicated; they unfold, one action leads to another, but ultimately force is used to gain control over the physical actions of the subject.

In this study, we provide a relatively straight-forward, bottom-line, measure of OC and Taser effectiveness. OC spray and/or Tasers were considered effective in two circumstances: First, if OC or a Taser was the *only* type of force that was used in the incident in order to subdue/handcuff the subject, OC or the Taser was considered effective. In these situations, OC spray or the Taser, by itself, led to the legitimate desired outcome; it was effective. Second, if OC or a Taser was the *last* type of force used in the incident prior to the subject being subdued/handcuffed, then OC or the Taser was considered effective. For example, if OC spray was deployed but then some other type of force was necessary in order to gain control over the subject to the point of placing him in handcuffs, then the OC was considered ineffective. OC may, or may not, have had some effect, but ultimately it was not effective in achieving the legitimate objective of the use of force incident—additional force needed to be used.

Of course, one must not lose sight of the possible cumulative effects that various types of force that were used in an incident may have in bringing an incident to an end. Indeed, several of the studies reviewed above simply did not take into account any other types of force that may have been used in the incident. Given the nature of the data analyzed in this study, measuring the precise effect that various forms of force may have had in a use of force incident is difficult, if not impossible. Nevertheless, to the extent possible, and when possible, we consider not only the last type of force used, but all types of force used in the incident. It is also important to highlight that the same criteria are used in measuring the effectiveness of OC and Tasers, providing for an equal ("apples-to-apples") comparison of the effectiveness of the two forms of

force. It is in these ways that an understanding of the relative effectiveness of OC and Tasers can be achieved.

Independent Variables

The independent variables in this study consist of subject characteristics and actions (see Tables 1 and 2 for coding and descriptive statistics). In particular, we focus on: 1) who was the subject? and 2) what did the subject do? Officer characteristics are not included primarily because of the analytic difficulties in doing so.[6] The number of officers who used force in an incident and the number of officers present when force was used were coded and included in the analyses as controls. The number of subjects who had force used upon them was also coded and included as a control.[7]

Data on "who the subject was" (i.e., the characteristics of the subject) were coded according to the supervisor's report. These variables consisted of subject race (white/minority[8]), age, sex, height, and weight.

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[6] Of course, this is a less than optimal solution to the issue; however, previous studies have struggled with the same issue and also resolved it in less than optimal ways. For instance, studies that have included officer characteristics either included only one officer when multiple officers were involved in the incident (Adang et al., 2006; Kaminski et al., 1999), or counted single incidents multiple times if multiple officers used force (White and Ready, 2007). Some studies are unclear about how multiple officer and multiple subject incidents were handled in the analyses (Morabito and Doerner, 1997). Each of these options essentially reduces the complexity of the incidents that are analyzed. None of these options are good, nor is the exclusion of officer characteristics; however, by not including officer characteristics we do not systematically exclude cases. Clearly, there is a trade-off between model error and sample bias.

[7] As noted, in multiple subject incidents, the characteristics of the primary subject, as identified in the police narrative report, were coded and included in the analyses.

[8] Ideally, sub-racial and ethnic groups would be analyzed instead of the "minority" category (Gau et al., 2010). However, too few Hispanics and/or other ethnic/racial group members were included among the incidents. The "minority" group classification consisted of 90% African American subjects (377 out of 419).

Most of the data on "what the subject did" (i.e., how the subject acted) were coded from the narrative reports prepared by supervisory officers and the statements included in the reports. These variables consisted of: whether the subject was mentally disturbed (yes/no), whether the subject was under the influence of drugs or alcohol (yes/no), whether a subject was believed to be armed with a weapon (yes/no), whether a subject was actually armed with a weapon (yes/no),whether a subject fled the police on foot (yes/no), whether a subject assaulted an officer ("yes" if it was stated in the narrative that the subject intentionally hit, kicked, bit, shot, stabbed, or spat upon an officer, "no" otherwise), and the level of resistance offered by the subject (coded on the basis of information provided in the narrative).[9]

RESULTS

Given the purposes of this study, results are organized into two sections: 1) those that relate to the *use* of OC spray and the Taser and 2) those that relate to the *effectiveness* of OC spray and the Taser. We begin with bivariate analyses and multivariate analyses of OC/Taser use and then turn attention to bivariate and multivariate analyses of OC/Taser effectiveness.

The Use of OC Spray and Tasers

How do the 259 incidents where OC spray was used differ from the 245 incidents where a Taser was used? This question was first addressed by calculating statistical differences

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[9] Examples of *passive* resistance included when a subject refused to exit a car, subject went limp, subject refused to move after being ordered to do so, subject refused to show hands after being ordered to do so; examples of *verbal* resistance included when a subject told the officer(s) to leave him/her alone, subject stated he or she will not comply; examples of *defensive* resistance included when subject attempted to or actually fled the police, the subject attempted to hide from the police, subject pulled away from the officer, subject got up after being directed to the ground; examples of *active* resistance included subject fighting with the police, subject lunging at officer, subject attempting to disarm the officer (Terrill and Mastrofski, 2002).

between the variables of interest and OC spray and Taser incidents on the basis of chi-square and t tests (for the sake of space, results are not tabled here). Next, a logistic regression equation was estimated to identify factors that predicted OC spray versus Taser use; these results are shown in Table 3.

In the bivariate analyses, OC spray was significantly more likely than a Taser to be used on minority subjects ($X^2 = 6.82$; $p < .01$); OC spray and a Taser were equally likely to be used regardless of subject age, sex, weight, or height. A Taser was significantly more likely to be used than OC when the subject appeared to be mentally disturbed ($X^2 = 18.61$; $p < .01$), was believed to be armed with a weapon ($X^2 = 19.23$; $p < .01$), when the subject was actually armed with a weapon ($X^2 = 6.52$; $p < .05$), and when the subject fled the police on foot ($X^2 = 16.14$; $p < .01$). OC spray and Tasers were equally likely to be used when the subject was believed to be under the influence of alcohol or drugs, when the subject assaulted a police officer, and regardless of the amount of resistance provided to the police. OC was more likely to be used than a Taser when more than one subject had force used upon them in the incident ($t = -2.03$; $p < .05$); a Taser was more likely to be used than OC when more officers used force in the incident ($t = 2.30$; $p < .05$) and when more officers were present at the incident ($t = 6.39$; $p < .01$).

Table 3 shows the results of the logistic regression analyses performed for OC spray and Taser use. Due to substantial missing data, subject height and weight were not included in the equation. Two models were estimated: one compares those incidents where OC was used to those incidents where a Taser was used ("OC Used"), the other compares Taser use to OC use ("Taser Used"). The independent variables identified as significant in the earlier analyses are similar to those identified as significant here. First, all other variables held constant, when the subject was believed to be mentally disturbed, a Taser was more than two times more likely to be

used than OC spray (odds ratio = 3.296; p = .000). Second, when the subject was believed to be armed, a Taser was significantly more likely to be used than OC spray (odds ratio = 1.858; p = .023). Third, when the subject fled the police on foot, a Taser was significantly more likely to be used on the subject than OC spray (odds ratio = 2.452; p = .000). Fourth, when there were more subjects involved, OC spray was nearly 80% more likely to be used than a Taser (odds ratio = 1.794; p = .04). Finally, when there were more officers present at the incident, a Taser was significantly more likely to be used (odds ratio = 1.668; p = .000).

The Effectiveness of OC Spray and Tasers

Before examining the factors associated with the effectiveness of OC and Tasers spray, it is necessary to calculate an effectiveness rate for OC spray and Tasers (see Table 4). Of the 259 incidents where OC spray was used, 63 involved only the use of OC spray. That no other force was needed to subdue the subject can be considered reasonable evidence that OC spray was effective. In the other 196 incidents, OC spray and some other force were used. In these 196 incidents, the order in which force was applied is meaningful. In 128 of these 196 incidents, OC ended the encounter; presumably OC was used to subdue the subject because the force that was applied prior to the OC did not work, or did not appear to be working, at least in the judgment of the officer who deployed the OC spray.[10] There were 68 incidents where OC was deployed during the incident but some other force ended the encounter.[11] To calculate an effectiveness rate of OC spray, the 63 incidents that only involved OC spray and the 128 incidents where OC

[10] Of the 128 incidents, in 125 of them bodily force was used prior to OC spray; in 3 incidents, bodily force and a baton were used prior to OC.

[11] Of the 68 incidents, 63 ended as a result of bodily force, 5 ended with the use of a baton.

was used last are combined (63 + 128) and divided by the total number of incidents in which a OC spray was used (259). This calculation results in a 73.8% effectiveness rate.

Of the 245 incidents where a Taser was used, in 85 of them, only a Taser was used. In the other 160 incidents, a Taser and some other force were used. In 136 of the 160 incidents, a Taser was the last type of force used.[12] In the other 24 incidents, a Taser was deployed first but some other force ended the encounter.[13] To calculate an effectiveness rate of Tasers, the 85 incidents that only involved a Taser and the 136 incidents where a Taser was used last are combined (85 + 136) and divided by the total number of incidents in which a Taser was used (245). This calculation results in a 90.2% effectiveness rate. Using the same parameters for calculating the effectiveness of OC spray and Tasers, it is clear that Tasers demonstrate a substantially higher effectiveness rate than OC.

As demonstrated in prior studies, OC spray and Tasers may be more effective with some subjects than with others. Again, we calculated statistical differences between the variables of interest and OC spray and Taser incidents on the basis of chi-square and *t* tests (results not tabled). Overall, the results showed that the effectiveness of OC and Tasers did not vary significantly by any of the subject demographic variables included: subject race, age, sex, height, or weight. OC spray was significantly less effective when the subject was believed to be armed ($X^2 = 4.67; p < .05$), when the subject assaulted the police ($X^2 = 5.88; p < .05$), and when the subject provided higher levels of resistance ($X^2 = 16.91; p < .01$). As with OC spray, Tasers

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[12] Of the 136 incidents, in 135 of them bodily force was used prior to the Taser; in 1 incident, bodily force and a baton was used prior to a Taser.

[13] Of the 24 incidents, 21 ended as a result of bodily force, 1 ended with the use of a baton, and 2 ended with the use of a firearm.

were less effective with greater subject resistance ($X^2 = 10.78; p < .05$). The results also showed that OC spray and Tasers were less likely to be the last type of force used (less likely to be "effective") when more officers used force in the incident ($t = 3.73; p < .01$ and $t = 3.29; p < .01$, respectively). OC spray and Tasers were also less likely to be the last type of force used when more officers were present during the incident ($t = 3.00; p < .01$ and $t = 2.04; p < .05$, respectively).

To identify more directly the factors that predict the effectiveness of OC spray and Tasers, two logistic regression equations were estimated: one for OC effectiveness the other for Taser effectiveness (see Table 5). For each model, the comparison was between effective versus not effective. There are two primary findings worthy of discussion based on the logistic regression results. First, while the OC model is significant, the Taser model is not. It appears that the Taser is uniformly effective, regardless of the variables included here. Second, of all the variables examined, the only significant predictor of OC spray effectiveness is subject resistance. With more resistance offered, OC spray was 48% less likely to be effective (odds ratio = .515; p = .027).[14] Apparently, OC spray alone is not enough to subdue a subject who is more resistive.

DISCUSSION

Previous research on the use and effectiveness of OC spray and Tasers is characterized by incomplete and conflicting findings. There are simply too few studies from which to draw conclusions. Varying study sites, comparisons, data sources, and measurement schemes certainly contribute to these conflicting findings. Nevertheless, a basic conclusion of previous research is that OC spray and Tasers are used in different circumstances. This study used

[14] Congruent with Kaminski et al. (1999), in each of the logistic regression models, younger and older subjects (under 22 and over 38) were compared to "middle" aged subjects (22-37). The results of the analyses did not change in any meaningful way.

OC Spray/Taser Effectiveness

The only significant predictor of OC spray (in)effectiveness was subject resistance. The more a subject resisted the police, the less likely OC spray was to be effective. In particular, when OC spray was used in situations where the subject resisted, it was likely that OC was not the last type of force used. Either the OC spray led to additional resistance that had to be overcome with other force, or OC was not effective in subduing a subject who was already resisting. The model predicting Taser effectiveness was not significant; this suggests that the Taser was effective to the degree that our predictors did not contribute to our understanding of its effectiveness. As noted, the observed level of Taser effectiveness may be a function of the circumstances in which Tasers are used, the amount and quality of training officers received with the Taser, as well as their limited deployment in the study department.

With regard to the effectiveness rates of OC spray and the Taser, and congruent with previous studies, we found that the Taser was substantially more effective than OC spray. Given the research that has been conducted, it is safe to say that Tasers have inherent advantages over OC spray in their ability to incapacitate subjects. However, with this conclusion, it is important not to lose sight of the fact that OC spray and Tasers are simply tools and, like hammers, can be more effectively used by some people than others.

In summary, OC spray and Taser use and effectiveness are clearly different outcomes with different predictors. Overall, suspect behaviors are of value in predicting the *use* of OC and Tasers but not when predicting their *effectiveness*. While suspect behaviors may drive the decision to choose OC spray or the Taser over other forms of force, other factors determine whether OC spray or the Taser actually work to induce suspect compliance. For example, whether OC spray actually works may have less to do with the subject's characteristics and

actions, and more to do with the capabilities of the weapon itself (e.g., amount of OC sprayed, distance between officer and suspect when OC is sprayed). Further research that directly compares OC spray with Tasers may highlight other critical variables that would help explain the use and effectiveness of them.

IMPLICATIONS FOR POLICY AND RESEARCH

Given the relative paucity of research on the use and effectiveness of OC spray and Tasers, specific policy implications are premature. However, when considering the current findings along with the results of prior studies, several policy- and especially research-related questions come to light.

In particular, how Tasers are distributed among officers may have implications for their use and effectiveness in particular police departments. Specifically, are Tasers used at a higher rate if more officers are equipped with them? Is OC spray used at a lower rate if more officers are equipped with Tasers? If more officers are equipped with Tasers, and Tasers are used more frequently, is Taser effectiveness impacted? In addition, does the amount, type, and quality of training received by officers on OC spray and Tasers impact their use and effectiveness? To what extent does organizational policy regarding the use of OC spray and Tasers affect their use and effectiveness? As such, it would be worthwhile and interesting to consider the use and effectiveness of OC and Tasers across similar departments with different deployment arrangements, training standards, and policies regarding the OC and Tasers. Clearly, there is variance between departments in this regard.

It will not be until research accumulates that it will be possible to draw conclusions about the use and effectiveness of OC and Tasers with confidence. Along with factors already mentioned, the effectiveness of OC spray and Tasers are likely to depend on factors not included

in this study or in most others, including the distance from which the weapon was used, the type of clothing worn by the subject (heavy clothing being worn by the subject may inhibit the use of a Taser and/or the effectiveness of it), whether the target was moving at the time of weapon deployment, and the height/weight the subject in relation to the officer.

Another interesting topic for research on the issue is the impact of the *threat* of Taser use on resisting subjects. Adang et al. (2006) examined the impact of threats with respect to OC spray (in their study, OC spray was less effective when suspects were warned beforehand they were going to be sprayed), but no studies have looked at this issue with respect to Tasers; we currently lack information about how often Tasers are threatened to be used (or how often they are even displayed) by officers and the effects of those actions. Such studies could enhance our understanding of the overall effectiveness of the weapons and inform associated policy.

While there is a clear need for additional research on the use of effectiveness of OC spray and Tasers, there is also a need for additional research on the use and effectiveness of bodily force in use of force situations, especially given its frequency. Most use of force incidents begin with bodily force and most injuries to officers and subjects are as a result of bodily force (Adams, 1999). As such, it would be worthwhile for researchers to consider the effectiveness and other issues related to the use of bodily force. What factors predict the effectiveness or ineffectiveness of bodily force? There are many forms of bodily force, what types are most often used and most effective? Answers to these questions may provide insight into situations where bodily force (or certain types of bodily force) should be avoided and OC spray or Tasers used instead.

LIMITATIONS

This study contributes to the discussion about the factors associated with the use and effectiveness of OC spray and Tasers, but it has limitations. First, the data used in the study were collected from police reports which provide the official account of what happened during the use of force incident. Even the order in which force was used, which was critical for the measurement of OC spray and Taser effectiveness in this study, could be misrepresented in the reports. Although there is no evidence of systematic distortion or under-reporting in the reports, the accuracy of the reports could be questioned in this regard. Although many other use-of-force studies, and studies on other topics for that matter, also use official police reports, the veracity of the reports needs to be considered when drawing conclusions on the basis of them.

Second, the generalizability of the findings presented here can be questioned. This department had a unique arrangement for the deployment of Tasers among officers and had a specific policy which guided officer decision making in use of force incidents that involved OC spray and Tasers. Establishing external validity is always an empirical issue; as noted, there is a need for additional research to be conducted on the topic in other police departments.

Finally, this study included a relatively limited range of variables in trying to predict the use and effectiveness of OC spray and Tasers. We would benefit from additional studies that were able to include a wider range of independent variables in the prediction models. By addressing these limitations, a more complete understanding of the factors that predict the use and effectiveness of OC spray and Tasers may be developed.

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Figure 1

Description of "Intervention Options" Used in Study Department

MODE	Definition	Authorized Police Response(s)
Presence	To present a visible display of authority	Open stance, ready stance, defensive stance
Dialog	To verbally persuade	Search talk, persuasion, light control talk, heavy control talk
Control Alternatives	To overcome passive resistance, active resistance, or their threats	Escort holds, compliance holds, control devices **(i.e., OC, ECDs)**, passive countermeasures
Protective Alternatives	To overcome continued resistance, assaultive behavior, or their threats	Active countermeasures, incapacitating techniques, intermediate weapons
Deadly Force	To stop the threat	Deadly force

Table 1

OC or Taser Used: Coding and Descriptive Statistics

Variable	Scale	OC Used			Taser Used		
		M	SD	N	M	SD	N
Subject Characteristics							
Race	0=minority 1=white	.11	.31	253	.20	.40	241
Age	in years	30.70	11.17	252	30.06	10.65	239
Sex	0=female 1=male	.88	.33	251	.92	.27	240
Height	in inches	69.42	3.28	192	69.81	3.46	186
Weight	in pounds	187.49	40.76	192	188.35	46.91	186
Subject Actions							
Mental Disturbed	0=no 1=yes	.09	.29	259	.23	.42	245
Under Influence	0=no 1=yes	.43	.50	258	.46	.50	244
Believed Armed	0=no 1=yes	.22	.41	259	.40	.49	245
Actually Armed	0=no 1=yes	.08	.28	259	.16	.37	245
Fled Police	0=no 1=yes	.22	.41	259	.38	.49	245
Resistance	0=none 1=passive/verbal 2=defensive 3=active	2.40	.76	258	2.44	.73	245
Assaulted Police	0=no 1=yes	.17	.38	259	.13	.34	245
Controls							
# of Subjects		1.12	.47	259	1.04	.35	245
# of Officers Used Force		1.72	.86	259	1.92	1.12	245
# of Officers Present		2.44	1.16	259	3.37	2.03	245

Table 2

OC or Taser Effective: Coding and Descriptive Statistics

Variable	Scale	OC Effective M	SD	N	Taser Effective M	SD	N
Subject Characteristics							
Race	0=minority 1=white	.12	.32	187	.19	.40	217
Age	in years	30.86	11.47	185	30.02	10.62	215
Sex	0=female 1=male	.86	.35	184	.92	.28	216
Height	in inches	69.29	3.37	140	69.67	3.38	170
Weight	in pounds	184.40	39.78	140	188.05	44.00	170
Subject Actions							
Mental Disturbed	0=no 1=yes	.09	.29	191	.23	.42	221
Under Influence	0=no 1=yes	.42	.50	190	.46	.50	220
Believed Armed	0=no 1=yes	.18	.39	191	.38	.49	221
Actually Armed	0=no 1=yes	.07	.26	191	.15	.36	221
Fled Police	0=no 1=yes	.19	.39	191	.37	.48	221
Resistance	0=none 1=passive/verbal 2=defensive 3=active	2.28	.80	190	2.44	.71	221
Assaulted Police	0=no 1=yes	.14	.34	191	.12	.33	221
Controls							
# of Subjects Force Used Upon		1.14	.49	191	1.04	.37	221
# of Officers Used Force		1.60	.75	191	1.85	1.06	221
# of Officers Present		2.31	1.02	191	3.29	1.92	221

Table 3

Logistic Regression Models of OC or Taser Use

Variable	OC Used 0=no 1=yes B	p	Exp(B)	Taser Used 0=no 1=yes B	p	Exp(B)
Subject Race	-.579	.056	.560	.579	.056	1.785
Subject Age	.017	.093	1.017	-.017	.093	.983
Subject Sex	-.076	.836	.927	.076	.836	1.079
Subject Mental Disturbed	-1.193	.000	.303	1.193	.000	3.296
Subject Under Influence	-.316	.150	.729	.316	.150	1.372
Subject Believed Armed	-.619	.023	.538	.619	.023	1.858
Subject Actually Armed	.149	.704	1.160	-.149	.704	.862
Subject Fled Police	-.897	.000	.408	.897	.000	2.452
Subject Resistance	-.199	.207	.819	.199	.207	1.221
Subject Assaulted Police	.527	.079	1.694	-.527	.079	.590
No. of Subjects	.584	.041	1.794	-.584	.041	.558
No. of Officers Used Force	.202	.140	1.224	-.202	.140	.817
No. of Officers Present	-.512	.000	.599	.512	.000	1.668
Constant	1.301	.054	3.673	-1.301	.054	.272
Log likelihood	565.613			565.613		
Model Chi Square	103.617			103.617		
df	13			13		
Significance	.000			.000		
R Squared (Nagelkerke)	.258			.258		
N	483			483		

Notes: B=log odds, p=significance, Exp (B)=odds ratios

Table 4

OC and Taser Effectiveness

OC was Used in 259 incidents (no Taser used)

In 63 incidents only OC used
In 196 incidents OC and other form(s) of force were used

In 128 of the 196 incidents, OC ended the encounter
In 68 of the 196 incidents, another type of force ended encounter
(i.e., bodily force = 63; baton = 5)

63 + 128 = 191 / 259 = OC 73.8% effective rate

Taser was Used in 245 incidents (no OC used)

In 85 incidents only a Taser used
In 160 incidents a Taser and other form(s) of force were used

In 136 of the 160 incidents, a Taser ended the encounter
In 24 of the 160 incidents, another type of force ended encounter
(bodily force = 21; baton = 1; firearm = 2)

85 + 136 = 221 / 245 = Taser 90.2% effective rate

OC and Taser were Used in 24 incidents

In 22 of the 24 incidents, the Taser ended the encounter
In 2 of the 24 incidents, OC ended the encounter

Another Weapon was Used in 45 incidents (no OC or Taser)

In 22 of the 45 incidents, only a firearm was used
In 14 of the 45 incidents, bodily force and a baton were used
In 4 of the 45 incidents, only a baton was used
In 3 of the 45 incidents, bodily force and a firearm were used
In 1 of the 45 incidents, gas and a firearm was used
In 1 of the 45 incidents, bodily force and a flashlight were used

Table 5

Logistic Regression of OC and Taser Effectiveness

	OC Effective			Taser Effective		
	0=no 1=yes			0=no 1=yes		
Variable	B	p	Exp(B)	B	p	Exp(B)
Subject Race	.424	.434	1.528	-.317	.617	.728
Subject Age	.012	.451	1.012	-.014	.557	.986
Subject Sex	-1.433	.076	.239	-.419	.714	.658
Subject Mental Disturbed	-.423	.455	.655	-.001	.999	.999
Subject Under Influence	-.340	.323	.712	.071	.890	1.073
Subject Believed Armed	-.351	.411	.704	-.416	.456	.660
Subject Actually Armed	-.726	.251	.484	-.397	.556	.672
Subject Fled Police	-.265	.483	.767	-.768	.144	.464
Subject Resistance	-.664	.027	.515	.232	.516	1.261
Subject Assaulted Police	-.529	.189	.589	-.754	.255	.470
No. of Subjects	.661	.222	1.037	.657	.697	1.929
No. of Officers Used Force	-.414	.062	.661	-.531	.017	.588
No. of Officers Present	-.174	.286	.840	.000	.998	1.000
Constant	4.651	.001	104.660	3.647	.122	38.343
Log likelihood	244.171			139.531		
Model Chi Square	41.147			15.443		
df	13			13		
Significance	.000			.281		
R Squared (Nagelkerke)	.224			.134		
N	248			235		

Notes: B=log odds, p=significance, Exp(B)=odds ratios

The Impact of the Taser on Suspect Resistance: Identifying Predictors of Effectiveness

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The Impact of the Taser on Suspect Resistance

Identifying Predictors of Effectiveness

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Despite the Taser's increasing popularity among police agencies, questions have been raised concerning the weapon's use and effectiveness as well as its potential to cause serious injury or death. This article examines all Taser deployments by the New York City Police Department from 2002 to 2005 (N = 375) and uses two multivariate approaches—logistic regression and chi-square automatic interaction detection—to identify predictors of Taser effectiveness, measured as continued suspect resistance and officer satisfaction. Findings indicate that several factors are associated with reduced effectiveness, including suspect body weight (more than 200 pounds), drug and alcohol use, physical violence, and close distance (3 feet or less) between the officer and the suspect. Although this study represents a preliminary effort at identifying predictors of Taser effectiveness, there are clear training and policy implications for police departments.

Keywords: *police use of force; Taser; less-than-lethal weapons; conducted energy device (CED)*

Conducted energy devices (CEDs)—most notably, the Taser—are being adopted and deployed by police agencies on a broad scale across the United States. Taser International, the leading developer of stun device technology, has sold more than 200,000 weapons to more than 9,000 police agencies in the United States (Davis, 2007). The economic trends are perhaps a better indicator of the enormous growth of the Taser; Taser International's revenue grew from approximately $2.5 million for fiscal year 1999 to an estimated $67 million in 2004 (McBride & Tedder, 2005).[1] Despite its increasing popularity among police departments and private consumers, questions have been raised concerning the weapon's use and

effectiveness as well as its potential to cause serious injury or death. The following examples illustrate why this topic has become contentious:

- Use: In fall 2005, police officers in Miami used a Taser on a 6-year-old boy who was cutting himself with a piece of glass and on a 12-year-old truant fleeing police.
- Effectiveness: In December 2005, Nashville, Tennessee, police officers used the Taser 19 times on a combative suspect before they were able to take him into custody (Bottoroff, 2005).
- Physiological impact: Amnesty International issued a report in 2004 describing 74 cases in the United States and Canada where a suspect died after being stunned by a Taser. The organization cites these deaths, recent biomedical research, and news reports of incidents involving the questionable use of Tasers to support a moratorium on their use.

Although a growing body of research has examined the physiological effects of the Taser (Ho, Miner, Lakireddy, Bultman, & Heegaard, 2006; Joint Non-Lethal Weapons Human Effects Center of Excellence, 2005; McDonald, Stratbucker, Nerheim, & Brewer, 2005), sparse empirical research has been conducted on the use and effectiveness of the instrument in a field setting. Consequently, our knowledge is largely limited to reports from the CED industry (e.g., Taser International) and police agencies on one side and documents from human rights groups (e.g., Amnesty International and the American Civil Liberties Union) on the other.[2]

This article seeks to add to the scientific knowledge base in this area through an examination of all Taser incidents involving officers in the New York Police Department (NYPD) from 2002 to 2005 ($N = 375$), with an emphasis on identifying predictors of weapon effectiveness. Specifically, the authors use both logistic regression and chi-square automatic interaction detection (CHAID), a form of segmentation modeling, to identify predictors of Taser effectiveness, measured as both the termination of suspect resistance and officer satisfaction with the weapon. The article concludes with a discussion of implications for the ongoing public discourse regarding the Taser as well as for police policy and practice.

Prior Research

Police and the Use of Force

Police officers have legal authority to use force in a wide range of situations, and the nature of this force can entail using empty-hand force and

less lethal weapons (e.g., baton, pepper spray, or CED), depriving an individual of liberty through arrest, and as a last resort, using a firearm to take an individual's life (Walker & Katz, 2002). Bittner (1970) asserts that the capacity to threaten or use physical force is the core function of the police that defines their role and shapes each contact with a citizen or suspect:

> There can be no doubt that this feature of police work is uppermost in the minds of people who solicit police aid or direct the attention of the police to problems, that persons against whom the police proceed have this feature in mind and conduct themselves accordingly, and that every conceivable police intervention projects the message that force may be, and may have to be, used to achieve a desired objective. (p. 40)

Despite its central role in police work, research indicates that police use of force is statistically rare, occurring in only about 1% of all police–citizen encounters (U.S. Bureau of Justice Statistics, 1999).[3] However, because of the sheer volume of police–citizen encounters in a given year (approximately 43 million), an estimated 421,000 use-of-force incidents occur annually, which translates into about 1,100 incidents per day. Rubinstein (1973) clearly illustrates the intrusive, dehumanizing effect that force can have on a citizen:

> [The patrol officer] may not only circumscribe a person's liberty by stopping him on the street, he may also completely violate the suspect's privacy and autonomy by running his hands over the man's entire body. The policeman knows that a frisk is a humiliation people usually accept from him because he can sustain his authority by almost any action he feels necessary. While he does not frisk people often to just humble them, he can do so; when he feels obliged to check someone for a concealed weapon, he is not usually in a position to request their permission, even if this were desirable. (p. 271; see also Skolnick & Fyfe, 1993, p. 94)

The consequences of police use of force can be severe and long lasting, far exceeding the immediate impact on the individual officer and citizen involved. Fyfe (1988) notes that use-of-force incidents have led to civil disorder and riots, the firing of police executives, millions of dollars in litigation, criminal prosecutions, and strained police–community relations. Recent examples include outbreaks of civil disorder in Cincinnati, Ohio, and St. Petersburg, Florida, in the late 1990s as well as the riots after the acquittal of the Los Angeles Police Department officers involved in the Rodney King incident.

Because of the magnitude of this responsibility delegated to the police and its potential consequences, police officers are mandated to use the minimum force necessary to accomplish their objective; force exceeding this minimum standard is considered excessive (Commission on Accreditation for Law Enforcement Agencies, 1999). Police departments closely monitor use of force and provide policy guidelines to officers typically through a "force continuum," which describes verbal and physical actions an officer can take in response to different levels of suspect resistance and behavior. The use-of-force continuum will usually highlight the minimum and maximum recommended force options available to the individual officer. As the subject's resistance or aggression increases, the officer may use greater degrees of force and is allowed to remain one level above the suspect as the interaction progresses (i.e., an officer may be permitted to use a less lethal weapon, such as pepper spray or a CED, in response to physical resistance by a suspect).

The Development of Less Lethal Alternatives

The role of the police in igniting the riots that marked the 1960s led scholars and police practitioners to reevaluate the force options available to patrol officers in responding to varying levels of suspect resistance. Although discussions regarding less lethal alternatives to the firearm date back to the 1920s, the President's Commission on Law Enforcement and the Administration of Justice (1967) brought the issue to the forefront of the policing agenda when it recommended the development and adoption of less lethal alternatives. During the past several decades, advances in technology have led to the development of a range of new alternatives, such as oleoresin capsicum (OC) spray, impact weapons, foams, ballistic rounds, nets, and most recently, CEDs (Wrobeleski & Hess, 2003). These weapons are intended to provide officers with more alternatives when a situation requires the application of force but has not escalated to the point where lethal force is necessary—thereby adding response options to the use-of-force continuum.

During the 1990s, the adoption of OC or pepper spray became commonplace among police agencies, and this trend was accompanied by a sizeable literature on its use, impact, and effectiveness (Smith & Alpert, 2000). The research on OC spray serves as an important backdrop for the current work on CEDs, because many of the same issues and concerns have been raised. Specifically, controversies surrounding the use of OC spray included its use

against passive resisters, disproportionate use against minorities, and potential health risks (Kaminski, Edwards, & Johnson, 1999). A number of studies have examined the effectiveness of OC spray, indicating relatively high rates of suspect incapacitation, reduced officer injuries, and less reliance on other types of force (Gauvin, 1994; Lumb & Friday, 1997; Nowicki, 1993). Using interrupted time-series analysis, Kaminksi, Edwards, and Johnson (1998) concluded that the adoption of OC spray in Baltimore County reduced the number of assaults on police by 15%. Furthermore, Kaminski et al. (1999) found that the effectiveness of OC spray was mitigated by suspect age, weight, distance, and drug use (but not alcohol).

New Technology Emerges: CEDs

For many police agencies, CEDs are more than just the latest novelty in less lethal alternatives; rather, they are becoming what mace was for police departments in the 1960s—an integral tool used in daily police practice. Advantages of CEDs over other less lethal alternatives—such as pepper spray, bean bag guns, and other soft-impact rounds—include the relatively short duration of their recovery time, their reliability at greater distances, their size and utility, and their perceived effectiveness.[4]

Nonetheless, some police departments have been cautious in adopting this technology on a broad scale, and anecdotal evidence suggests that line officers may be reluctant to use the device routinely because of its dubious public image. The Taser, an acronym for Thomas A. Swift Electric Rifle, "is a conducted energy weapon that fires a cartridge with two small probes that stay connected to the weapon by high-voltage, insulated wire" (Wrobeleski & Hess, 2003, p. 87). The M26 and X26 advanced Taser models introduced by Taser International in 1999 and 2003, respectively, are the two common "new generation" CEDs used by police agencies. These weapons discharge two darts to a distance of 21 feet, delivering a 50,000-volt shock in a 5-second cycle. The electrical charge overrides the central nervous system, resulting in the loss of neuromuscular control, which gives the officer time to gain control of the suspect and apply handcuffs, if necessary.

Questions Surrounding the Taser

The controversy regarding the Taser has occurred in the public domain and has been widely publicized. News reports describing incidents in which police officers used the weapon against the elderly, children, and the mentally ill have made national headlines. Favorable and unfavorable

media images of police practices have been competing for public attention and serve as the backdrop against which the Taser is being assessed by the public and government officials (Lovell, 2003). Currently, empirical research is not driving the debate. This is unsettling, considering that mainstream media depictions of the police are often inaccurate or unrealistic (Ian Ross, 2000; Manning, 1977, 1997). The controversy regarding the Taser came to a head in 2004 when Amnesty International issued its report:

> In its recommendations . . . *Amnesty International* is reiterating its call on federal, state and local authorities and law enforcement agencies to suspend all transfers and use of electro-shock weapons, pending an urgent rigorous, independent and impartial inquiry into their use and effects. (Amnesty International, 2004, p. 3).

The conclusions of the Amnesty International report underscored the controversy and ongoing debate between CED manufacturers and human rights organizations about the expanded use of CEDs among police agencies in the United States. The organizations' concerns focused on fatalities occurring after Taser deployment as well as the potential for abuse by police and its use as a routine force option. CED manufacturers argue, however, that the device is a safe alternative to other less lethal weapons that reduces injuries to officers and suspects. More generally, concerns about CEDs have emerged in three critical areas. Each is discussed below.

When is it appropriate to use the device? No consensus exists among police agencies regarding where the Taser should be placed on the force continuum (U.S. Government Accountability Office, 2005). Should CEDs be placed at the same level as pepper spray, or are they more appropriate farther down the use-of-force continuum as a last alternative to the firearm? Should they be used against suspects who are passively resisting an officer (e.g., ignoring verbal commands) or only against individuals who are actively resisting arrest? Is there any justification for using the Taser against a minor, a senior citizen, or a pregnant woman? Police departments have varied considerably in their responses to these questions, and both the International Association of Chiefs of Police (IACP; 2005) and the Police Executive Research Forum (PERF; 2005) have taken action recently by developing training guidelines and model policies to offer guidance to agencies in their deployment of CEDs. For example, both the IACP and PERF suggest that CEDs only be used against those who are actively resisting, that they not be used against children or the elderly except

in emergency situations, and that each deployment is closely supervised and documented.

Does it work effectively? Since January 2000, *The New York Times* has printed nearly 200 news stories describing incidents in which officers across the United States have used the Taser to control or subdue a suspect. A review of these articles reveals an abundance of cases in which the Taser appears not to have the intended physiological effect on a suspect. In some cases, one or both of the prongs missed the target, or the prongs hit the target but failed to penetrate the suspect's clothing. To date, much of the academic research on the effectiveness of CEDs has relied on field reports completed by officers after deploying the weapon, which measure whether the CED functioned properly, enabling the officer to incapacitate or arrest the subject. Field data analyzed by Taser International (2006) and internal evaluations conducted by police agencies (see, e.g., Seattle Police Department, 2004) place the effectiveness rate of the Taser somewhere between 80% and 94%, but there is sparse independent empirical research studying the effectiveness of the device. White and Ready (2007) calculated an effectiveness rating by examining the impact of the Taser on suspect resistance. They found that use of the weapon caused suspects to stop resisting in 86% of all Taser deployments by the study department.

Several police agencies that have implemented CEDs on a broad scale have later reported reductions in injuries sustained during police–citizen contacts. Police departments in Austin, Texas; Putnam County, Florida; and Cincinnati, Ohio, experienced reductions in injuries to both suspects and officers after adopting the Taser (see Putnam County Sheriff's Office, 2005; Taser International, 2006). Although these trends are noteworthy, questions remain concerning the extent to which the Taser contributed to these reductions. Retrospective analysis of injury trends may not account for other variables (e.g., more training, crime trends, new leadership, etc.) that influence yearly injuries sustained during police–citizen encounters. At present, there are no national-level baseline data concerning the number of police agencies that have reported reductions in injuries after adopting the Taser as compared to the number of agencies that have not reported reductions. The degree to which the device is used effectively depends less on the physiological effects of the technology than on the policy guidelines and field training that departments apply to reinforce accepted standards of use.

Proponents in the law enforcement community claim that the Taser can serve as a substitute for lethal force and other forms of less lethal force (e.g., baton) that may result in serious injury or death (Heck, 2003;

McBride & Tedder, 2005; U.S. Bureau of Justice Statistics, 1999). This is an empirical question that has not been tested, and any practical benefits must be balanced against the potentially harmful physiological effects of the device.

What is its impact on the likelihood of serious injury or death to a suspect? As noted earlier, Amnesty International called for a moratorium on police use of the Taser in late 2004, citing 74 deaths that occurred in North America following deployment of the weapon. Although there is no evidence of a direct causal link between use of the Taser and elevated risk of serious injury or death, a review of the Amnesty International report suggests that the risk of death may be greater for those with preexisting medical conditions (particularly heart conditions) as well as those under the influence of drugs or alcohol. Recent studies supported by the federal government have tested the physiological effects of CEDs on healthy adult volunteers (a sample that may be very different than suspects targeted by police officers) and have concluded that no decisive evidence of ventricular fibrillation or other serious medical side effects exists (Ho et al., 2006; Joint Non-Lethal Weapons Human Effects Center of Excellence, 2005; McDonald et al., 2005). The Canadian Police Research Centre (2005) conducted an exhaustive review of existing research and concluded that "definitive research or evidence does not exist that implicates a causal relationship between the use of CEDs and death" (p. ii).

In sum, despite the growing popularity of CEDs in American policing, researchers have failed to keep pace with the diffusion of this rapidly spreading technology. A developing body of scientific research has begun to address the research question relating to the potential for the Taser to cause serious injury or death, but the questions concerning when it is appropriate to deploy the weapon (and against whom) and its degree of effectiveness remain largely unanswered. Guidelines outlined by PERF and IACP have played a critical role in clarifying some of the important issues for police administrators. This article seeks to inform the use and effectiveness dialogue by shifting the emphasis toward prediction; that is, under what circumstances and against what types of suspect behavior is the Taser most likely to be effective? In other words, what are the characteristics of police officers and suspects and incident-related circumstances that increase or reduce the odds that police use of the CED will result in a successful resolution?

Method

NYPD and the Taser

This article examines all Taser incidents involving police officers from the NYPD from January 2002 through December 2005 (N = 375). The NYPD is cautious in its approach to the deployment of Tasers, and its use is closely monitored. The Taser is issued only to officers in the Emergency Service Unit (ESU). The ESU is responsible for situations that require advanced equipment and expertise, such as crisis situations involving the mentally ill, hostages, and suicidal suspects. The unit consists of several hundred officers, which is a relatively small proportion of the 35,000 sworn NYPD officers. Also, supervisors at the rank of sergeant and above are trained to use the Taser, and each precinct is equipped with one or more devices that can be signed out, though they are not required to carry it. The patrol guide details fairly specific circumstances in which it is appropriate to use the device:

> Patrol supervisors or uniformed members of the service assigned to the Emergency Services Unit may utilize a Taser/electronic stun device to assist in restraining emotionally disturbed persons if necessary. The Taser/electronic stun device may be used:
>
> a. To restrain an EDP [emotionally disturbed person] who is evincing behavior that might result in physical injury to himself or others, OR
> b. To restrain person(s) who, through the use of drugs, alcohol, or other mind-altering substances, are evincing behavior that might result in physical injury to himself or others.
>
> Emergency Service Unit personnel will obtain the permission of the Emergency Service Unit Supervisor prior to utilizing a Taser/electronic stun device, except in emergencies. (NYPD, 2000)

As a result, deployment of the Taser is allowed only in situations involving an EDP or person under the influence of drugs or alcohol who is posing a threat of physical injury where either ESU officers are dispatched or a supervisor is present and has a Taser in his or her possession.[5]

The data analyzed for the current study are derived from a "Taser/stun device report," which is completed every time an officer deploys the weapon.[6] The report contains a series of questions that use check boxes to elicit a range of information about demographic characteristics of the suspect, his or her emotional and physical state, behavior and level of resistance,

weapons present, the rank and assignment of the officer, and characteristics of Taser deployment (e.g., distance, effect, etc.). Most items on the report are formatted as multiple-choice questions, with an additional narrative section where the officer is required to describe the incident in detail. From these reports, the authors created a data set in SPSS that captures 40 variables relating to each Taser incident. These independent variables serve as predictors of Taser effectiveness for the multivariate analysis. Though the research was admittedly limited by the information collected on the Taser/stun device report, the authors note the earlier work conducted by Kaminski et al. (1999), which employed a similar design and analysis, with similar variables, for an evaluation of the effectiveness of OC spray.

The Dependent Variable: Measuring Effectiveness

The dependent variables used in the study include three separate but related measures of effectiveness. The first two measures of effectiveness are based on the extent of suspect resistance. Specifically, the field report contains several items that measure whether suspect resistance ended after the Taser was deployed and notes how much time transpired (in seconds) before the suspect was incapacitated. A follow-up item requires the responding officer to indicate whether the suspect was incapacitated at all. The average time to incapacitation was 8.10 seconds, but this measure should be viewed with caution. It is likely that officers at the scene were far more concerned about bringing the suspect under physical control than counting the number of seconds needed to terminate the struggle and apply handcuffs. For this reason, we will focus on the dichotomous measures of resistance for the analysis.

In one third of the cases (33.0%), the suspect continued resisting against the officer after the Taser was deployed. The cases involving continued resistance can be divided into two categories based on the nature and duration of the resistance. In 32 cases, the resistance continued immediately following the Taser deployment because the suspect was not restrained by the weapon; that is, at no point was the subject subdued, and he or she continued to resist (*continual resistance*). The Taser was clearly ineffective during these incidents, perhaps because of loose or heavy clothing blocking the darts from making full contact, mechanical failure, or resilience on the part of the suspect. In the other 65 cases involving continued resistance, the subject was initially incapacitated by the Taser and the officer(s) gained control temporarily; however, the suspect began resisting again at a subsequent

point in time (*any resistance*). The distinction between these two different outcomes draws attention to the temporary impact of the Taser (i.e., the involuntary loss of muscle control is not long term) and shows the importance of carefully observing the suspect's actions immediately after the Taser is deployed. Because of the practical importance of this distinction in resistance, both measures are used as dependent variables in the analysis. The base rates for any subsequent resistance and continual resistance are 33.0% and 10.9%, respectively.[7]

At the end of the Taser/stun device report, the officer is instructed to indicate whether the device performed satisfactorily (yes or no). Police officers' responses to this question serve as the third measure of Taser effectiveness. Officers reported that the Taser performed satisfactorily during 78.7% of the cases. Officer satisfaction is likely related to a host of factors, including the physiological effect on the suspect and the outcome of the deployment taken as a whole. Did the Taser discharge as intended? Did both prongs strike the target, and if so, did they penetrate the suspects' clothing? Did the suspect stop resisting the officer and was he or she subsequently taken into custody? Finally, was anyone seriously injured during the altercation?

Data Analysis

The authors employed two analytic approaches, logistic regression and CHAID (a form of segmentation modeling), to identify predictors of Taser effectiveness. Descriptive analyses were conducted to identify significant relationships at the bivariate level. The bivariate findings, theory, and practical expectations directed the identification of predictors for the multivariate analysis, though all variables were included in the multivariate analysis. Logistic regression is employed because all three measures of effectiveness are dichotomous outcomes with yes-or-no responses. Similar to logistic regression, CHAID predicts the probability of an event's occurring, but the method relies on different assumptions and properties and uses segmentation modeling to accomplish the task. CHAID divides a population into "increasingly homogenous" segments that differ on the basis of the dependent variable; in this case, suspect resistance and officer satisfaction (Jones, Harris, Fader, & Grubstein, 2001, p. 490). The resulting segments are mutually exclusive and exhaustive, and as the analysis proceeds, the best predictor is selected among a particular subgroup of cases based on chi-square analysis.

CHAID analysis is employed in this study because it offers a number of advantages. First, "one significant advantage of this approach is that the model can find different combinations of predictors for different subsets of the population" (Jones et al., 2001, p. 490). This is especially useful if there is reason to suspect that predictors may differ in their impact among subgroups. For example, predictors of suspect resistance may be different for intoxicated and sober suspects, and CHAID facilitates the identification and exploration of these interactions. Second, Jones et al. (2001) point out that numerous studies have examined statistical issues in risk prediction (Gottfredson, 1987; Simon, 1971; Tarling & Perry, 1985), including the use of CHAID and more traditional methods such as logistic regression, and the general consensus is that "no method is consistently better than any other" (Tarling & Perry, 1985, p. 212). With this conclusion in mind, multiple methods allow researchers to either "triangulate" their findings or identify inconsistencies across techniques. Last, an additional benefit of CHAID is the user-friendly visual representation of variables that interact to produce an outcome; in this case, the technique highlights the important situational dynamics of Taser incidents—and how those dynamics relate to outcomes—in a more interpretable manner for practitioners and policy makers.

Limitations and Considerations

Several limitations of this study should be considered. First, the article examines official reports from one police department that has deployed the Taser in a controlled, limited manner. This impairs the generalizability of the findings to other police departments, particularly, those agencies that have issued the Taser to all patrol officers.[8] Second, this study examines only Taser incidents that generated an official police report. There is no indication that officers are not completing the Taser field report on a systematic basis, especially considering that the device tracks each deployment electronically; however, it is possible that some incidents did not result in a report. Third, anecdotal evidence provides some support for a deterrent effect when the Taser is exposed to a potential subject but not used; that is, much like the firearm, suspects may become compliant when confronted with the imminent possibility of being stunned with the Taser. Researchers and police practitioners would consider this type of incident as a successful de-escalation, but these situations are not captured in the data because the NYPD requires a field report after discharge only.

Results

Descriptive Analysis of Taser Incidents

Suspect characteristics. Suspects targeted in the Taser incidents were primarily male (88.8%) with a mean age of 34.9; more than half were African American (52.1%), 18.7% were White, and 27.3% were Hispanic (see Table 1). Most of the suspects did not appear under the influence of drugs or alcohol (87.2%), but the majority exhibited signs of mental illness (92.5%) and were therefore identified by the responding officers as EDPs.[9] About 40% of the subjects were armed with a weapon (39.6%), most commonly, a kitchen knife or cutting instrument (84% of armed suspects, 32% of all cases).[10] The vast majority of suspects (95%) engaged in physical violence. The violent behavior was directed at an officer during more than half of the incidents (53.3%), one fifth involved a threat of suicide or self-harm (18.6%), and the remaining violent individuals (18.9%) directed their aggression toward multiple individuals at the scene.

Officer characteristics. The Taser/stun device report captures limited information regarding the officer who deploys the weapon. More than half of the officers who used the device were detectives (55.5%), and 41.2% were patrol officers. Just 3.2% were supervisors. More than 90% of the officers were assigned to the ESU. In the majority of cases, the officer deploying the Taser was not alone. One or more back-up officers were present during nearly all of the incidents (93.5%), and a supervisor was present in 88.1% of the cases.[11]

At the bivariate level, there are notable differences in officer rank with regard to the outcomes of interest: satisfaction and suspect resistance. During the study period, 12 cases involved supervisors who were not assigned to the ESU (i.e., patrol sergeants). The effectiveness ratings from these supervisors are significantly lower than the ratings from the ESU officers: Any suspect resistance was reported by 54.5% of the supervisors, compared to 26.7% of police officers and 36.3% of detectives; 20.0% of the supervisors reported resistance immediately after the Taser was used, compared to 7.6% of police officers and 12.0% of detectives; and 41.7% of the supervisors reported being satisfied with the Taser, compared to 81.7% of police officers and 79.4% of detectives.[12] These findings may have implications for the NYPD, because supervisors outside of the ESU receive less training in use of the Taser and may also be using an older model of the device.

Table 1
Characteristics of Suspects and Officers Involved in Taser Deployments

	Percentage	*n*
Suspect characteristics		
Gender		
Male	88.8	332
Female	11.2	42
Total	100.0	374
Racial background		
African American	52.1	189
White	18.7	68
Hispanic	27.3	99
Asian or Other	1.9	7
Total	100.0	363
Mean age = 34.9 years		332
Emotionally disturbed		
No	7.5	28
Yes	92.5	347
Total	100.0	375
Intoxicated		
No	87.2	321
Drugs	7.1	26
Alcohol	4.3	16
Both drugs and alcohol	1.4	5
Total	100.0	368
Armed with a weapon		
No	60.4	217
Yes	39.6	142
Total	100.0	359
Violent behavior		
No	5.2	19
Toward self	18.6	68
Toward officer	53.3	195
Toward other citizens	4.1	15
Toward multiple	18.9	69
Total	100.0	366
Officer characteristics		
Rank		
Patrol officer	41.2	153
Detective	55.5	206
Supervisor	3.2	12
Total	100.0	371
Command		
Emergency Service Unit	91.2	321
Other	8.8	31
Total	100.0	352
Back-up present		
No	6.5	22
Yes	93.5	318
Total	100.0	340
Supervisor Present		
No	11.9	42
Yes	88.1	310
Total	100.0	352

Note: Total numbers are different because of missing data. In some of the study cases, information for one or more variables was missing, and the tables reflect known information only.

Incident characteristics. More than three quarters of the incidents occurred indoors (see Table 2). Per department policy, the majority of suspects (95.6%) were transported to a hospital for a physical examination following the incident. Interestingly, three quarters of the subjects (75.9%) were not arrested after the incident, although many of them were held at the hospital for psychological examination and/or civil commitment. The average distance between the officer and the suspect at the time of deployment is approximately 5.5 feet. In 80.7% of the incidents, the Taser was deployed only once by the officer, and in nearly 80% of the cases, both darts made contact with the suspect as intended. Officers used the device in stun mode in 48 incidents (direct contact to skin, no darts).[13] In 22% of the cases, officers also used another nonlethal device, most typically another type of stun device (14%) or pepper spray (5%). In 86% of the cases, a supervisor indicated that use of the Taser was consistent with departmental policy.[14] Findings with regard to officer satisfaction and suspect resistance—the dependent variables for the multivariate analysis—have been summarized above.

Multivariate Analysis

Logistic regression analysis. Table 3 displays the results of the logistic regression models predicting the three measures of Taser effectiveness. The table provides the logistic regression coefficients, standard errors, and odds ratios for the independent variables in each of the models. The likelihood ratio test for each of the models was statistically significant, and Nagelkerke R^2 estimates suggest that the models predicting any subsequent suspect resistance, resistance immediately after use of the Taser, and officer satisfaction accounted for 23%, 13%, and 21% of the explained variation, respectively.[15] In the first model, statistically significant predictors of any suspect resistance include the following:

- The suspect's body weight is greater than 200 pounds.
- Distance between the officer and the suspect is 3 feet or less.
- The suspect is under the influence of drugs or alcohol.
- The suspect directs violence toward an officer or citizen (as opposed to oneself).
- One or both Taser darts missed the intended target.
- The officer used another nonlethal device before or after using the Taser.[16]

Specifically, when one or both Taser darts miss the suspect, the likelihood of any suspect resistance increases by about 300%. Three predictors—violence directed at an officer or citizen, drug or alcohol intoxication, and

Table 2
Characteristics of Incidents Resulting in Taser Deployments

Incident Characteristic	Percentage	*n*
Location		
Indoors	77.5	286
Outdoors	22.5	83
Total	100.0	369
Suspect arrested		
No	75.9	274
Yes	24.1	87
Total	100.0	361
Suspect transported to hospital		
No	4.4	16
Yes	95.6	346
Total	100.0	362
Number of Taser deployments		
One	80.7	284
More than one	19.3	68
Total	100.0	352
Mean distance between officer and suspect = 5.41 feet		
Darts on target		
Both darts on target	77.7	240
One dart missed	4.5	14
Both darts missed	1.6	5
Darts made contact but fell from clothing	0.6	2
Device used in stun mode	15.5	48
Total	100.0	309
Was suspect incapacitated?		
No	13.2	42
Yes	86.8	277
Total	100.0	319
Mean time to incapacitation = 8.10 seconds		
Did suspect continue to resist?		
No	67.0	235
Yes	33.0	116
Total	100.0	351
Officer satisfied with Taser?		
No	21.3	74
Yes	78.7	273
Total	100.0	347

Note: Total numbers are different because of missing data. In some of the study cases, information for one or more variables was missing, and the tables reflect known information only.

police use of another less lethal weapon—more than double the odds of the occurrence of any suspect resistance during Taser incidents. In addition, suspects who weigh more than 200 pounds are about 84% more likely to resist the officer after the Taser is deployed.

Significant predictors of resistance occurring immediately after deployment of the Taser include the following:

- The suspect's body weight is greater than 200 pounds.
- The suspect is under the influence of drugs or alcohol.
- One or both Taser darts missed the intended target.

Findings for the second model are similar to the model predicting any suspect resistance. Continual resistance immediately after the Taser is deployed is most likely to occur in circumstances where the Taser darts miss a large suspect who is intoxicated.

Results from the model predicting officer satisfaction indicate that the following independent variables are statistically significant:

- The suspect's body weight is 200 pounds or less.
- Distance between the officer and the suspect is greater than 3 feet.
- The suspect is armed with a knife or gun.
- Both Taser darts struck the intended target.[17]

Interestingly, the strongest predictor of officer satisfaction with the Taser is the suspect's being armed with a knife or gun. When the suspect is armed with a weapon, the likelihood of police's reporting that they are satisfied with the Taser is about 200% greater. A possible explanation may be that the likelihood that harmful consequences will occur when the Taser does not work properly is greater when the suspect is armed with a knife or gun; therefore, the sense of relief experienced when the device does perform properly in these volatile situations affects the officer's reporting of satisfaction. The distance between the officer and the suspect during the Taser deployment is also positively associated with officer satisfaction with the device.

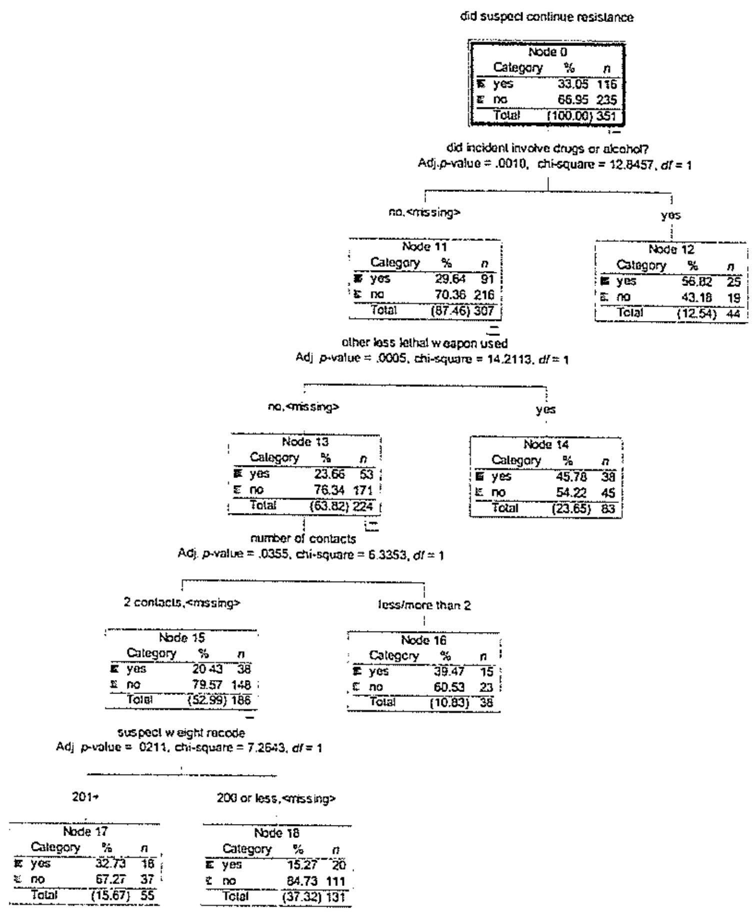
CHAID analysis. Figures 1 to 3 show the results of the CHAID analysis, which uses the same set of variables to predict Taser effectiveness. In Figure 1, the top cell (or root node) in the CHAID tree reflects 33.05% of the cases where any suspect resistance occurred. The initial split was made on the basis of whether the suspect was under the influence of drugs or alcohol, thus separating the 375 Taser cases into two cells: those where the

Table 3
Logistic Regression Predicting Three Measures of Taser Effectiveness

Predictor Variables	*B*	*SE*	Wald	Odds Ratio	*p* Value
Any suspect resistance					
Suspect weight	0.612	.302	4.114	1.844	.043
Distance	−0.667	.306	4.735	0.513	.030
Suspect intoxicated	0.954	.410	5.418	2.596	.020
Suspect violent toward others	0.884	.373	5.617	2.421	.018
One or both prongs miss target	1.393	.531	6.887	4.028	.009
Other less lethal weapon used	1.057	.312	11.445	2.877	.001
Log likelihood	285.065				
R^2 (Nagelkerke)	.227				
Chi-square	46.051				
df	6				
Significance	.000				
n	255				
Resistance immediately after deployment					
Suspect weight	0.882	.416	4.484	2.415	.034
Suspect intoxicated	1.285	.486	6.982	3.614	.008
One or both prongs miss target	1.744	.569	9.379	5.717	.002
Log likelihood	164.691				
R^2 (Nagelkerke)	.130				
Chi-square	17.634				
df	3				
Significance	.001				
n	262				
Officer satisfaction					
Suspect weight	−0.904	.338	7.133	0.405	.008
Distance	0.928	.337	7.586	2.528	.006
Suspect armed with gun or knife	1.111	.422	6.945	3.037	.008
One or both prongs miss target	−2.193	.578	14.408	0.112	.000
Log likelihood	229.067				
R^2 (Nagelkerke)	.213				
Chi-square	37.268				
df	4				
Significance	.000				
n	246				

suspect was not intoxicated (n = 307; 87.46% of the total) and those where the suspect was intoxicated (n = 44; 12.54% of the total). The splits in CHAID are made according to differences in the dependent variable (i.e., any suspect resistance): Of suspects who were intoxicated, 56.8% continued to resist, compared to 29.6% of suspects who were not intoxicated. An additional split was made from the *not intoxicated* cell and is based on

Figure 1
CHAID Analysis Predicting Any Suspect Resistance



Node	Category	%	n
Node 0	yes	33.05	116
	no	66.95	235
	Total	(100.00)	351
Node 11	yes	29.64	91
	no	70.36	216
	Total	(87.46)	307
Node 12	yes	56.82	25
	no	43.18	19
	Total	(12.54)	44
Node 13	yes	23.66	53
	no	76.34	171
	Total	(63.82)	224
Node 14	yes	45.78	38
	no	54.22	45
	Total	(23.65)	83
Node 15	yes	20.43	38
	no	79.57	148
	Total	(52.99)	186
Node 16	yes	39.47	15
	no	60.53	23
	Total	(10.83)	38
Node 17	yes	32.73	18
	no	67.27	37
	Total	(15.67)	55
Node 18	yes	15.27	20
	no	84.73	111
	Total	(37.32)	131

Note: CHAID = chi-square automatic interaction detection.

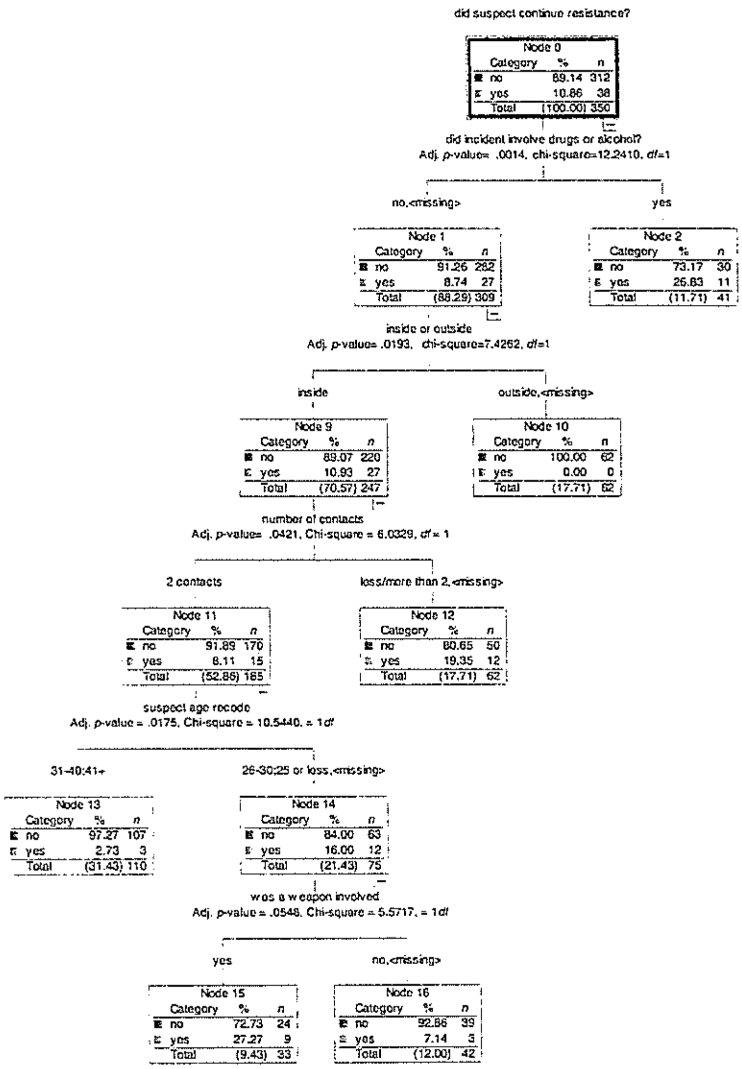
whether police used another less lethal weapon: Suspect resistance occurred in 45.8% of cases where another less lethal weapon was used in addition to the Taser, compared to 23.7% of cases where only the Taser was used. The next split was made from the cell indicating that no other less lethal weapon

was used except the Taser. This split is based on the number of darts that made contact with the suspect: Subjects who were not intoxicated during the encounter, where no other less lethal weapon was used except the Taser, continued to resist during 20.4% of the cases where two darts made contact, compared to 39.5% of the cases where fewer or more than two contacts were made.[18] The final split is made from the cell indicating that two darts made contact and is based on suspect body weight: Suspects in cases where both darts made contact, where no other less lethal weapon was used except the Taser, and where the suspect was not intoxicated were more likely to continue to resist if they weighed more than 200 pounds (32.7% compared to 15.3% for those who weighed 200 pounds or less). Table 4 summarizes the termination cells for the CHAID tree predicting any suspect resistance, which includes the predictors, cell size, percentage of the total cases, and percentage of the dependent variable: any suspect resistance.

Figure 2 displays the CHAID tree predicting continual resistance, and the top cell represents 10.9% of the cases where suspect resistance occurred immediately after the deployment. The initial split is based on the use of drugs or alcohol, as it was for the first CHAID tree: Intoxicated suspects continued to resist immediately after the Taser was deployed in 26.8% of the cases, compared to 8.7% of the cases in which the suspect was not intoxicated. Several additional splits flow from the cell indicating that the suspect was not intoxicated. The next split is based on whether the Taser incident occurred indoors or outside (10.9% suspect resistance inside compared to 0.0% resistance outside). From the cell indicating that the incident occurred indoors, the next split is based on whether the two darts made contact or not (8.1% resistance compared to 19.4%). From the "two contacts" cell, the split is based on whether the suspect was 30 years old or younger (16.0% resistance) as opposed to 31 years old or older (2.7% resistance). The final split flows from the *30 years old or younger* cell and is based on whether the suspect was armed with a weapon (27.3% resistance) or not (7.1% resistance). Termination cell summaries are again shown in Table 4.

Figure 3 shows the CHAID tree for the last measure of effectiveness: officer satisfaction. An initial split is based on the number of darts that made contact—two darts, or fewer or more—with greater officer satisfaction when two darts made contact (83.7% vs. 66.3%). The next split, made from the *two contacts* cell, is based on the distance between the police officer and the suspect. Officer satisfaction is greater when the officers are 4 feet or more away from the target: In this category, 86.7% of the officers reported being satisfied, compared to 72.0% for the officers who were 3 feet away or closer (see Table 4 for summary).

Figure 2
CHAID Analysis Predicting Resistance Immediately After Deployment



Note: CHAID = chi-square automatic interaction detection.

Table 4
Summary of CHAID End Groups

	n	% of Total	% of Suspect Resistance
Any suspect resistance			
Suspect intoxicated	44	12.54	56.82
Suspect not intoxicated (or missing); other less lethal weapon used	83	23.65	45.78
Suspect not intoxicated (or missing); no other less lethal weapon used (or missing); not two contacts	38	10.83	39.47
Suspect not intoxicated (or missing); no other less lethal weapon used (or missing); two contacts (or missing); suspect weighs 201+ pounds	55	15.67	32.73
Suspect not intoxicated (or missing); no other less lethal weapon used (or missing); two contacts (or missing); suspect weighs 200 pounds or less (or missing)	131	37.32	15.27
Total	351	100.00	
Resistance immediately after deployment			
Suspect not intoxicated (or missing); occurred inside; two contacts; suspect 30 or younger (or missing); suspect has weapon	33	9.43	27.27
Suspect intoxicated	41	11.71	26.83
Suspect not intoxicated (or missing); occurred inside; not two contacts (or missing)	62	17.71	19.35
Suspect not intoxicated (or missing); occurred inside; two contacts; suspect 30 or younger (or missing); suspect has no weapon (or missing)	42	12.00	7.14
Suspect not intoxicated (or missing); occurred inside; two contacts; suspect 31 or older	110	31.43	2.73
Suspect not intoxicated (or missing); occurred outside (or missing)	62	17.71	0.00
Total	350	100.00	
Officer satisfaction			
Two contacts; distance 4 feet or more (or missing)	196	56.48	86.73
Two contacts; distance 3 feet or less	50	14.41	72.00
Not two contacts (or missing)	101	29.11	66.34
Total	347	100.00	

Note: CHAID = chi-square automatic interaction detection analysis.

profound implications for police administrators who are responsible for upholding use-of-force standards. This article seeks to contribute to the dialogue on CEDs by identifying predictors of Taser effectiveness.

Findings from the descriptive analysis suggest consistency across the types of incidents (and suspects) in which officers in the NYPD deploy the Taser.

- Most suspects were male, African American or Hispanic, and in their 30s.
- Few suspects were under the influence of alcohol or drugs, but nearly all were identified as exhibiting signs of mental illness.[19]
- Nearly all suspects engaged in violent behavior.
- Just fewer than half of suspects were armed, and among armed suspects, the majority possessed a knife or cutting instrument.
- Nearly all the officers using the Taser in the NYPD were assigned to the ESU.
- Back-up officers and supervisors were present in almost all cases.
- A large majority of suspects were incapacitated by the Taser after the first deployment, and most were incapacitated within 5 seconds.
- Most of the subjects were not arrested on criminal charges, although nearly all were transported to a hospital for physical and/or psychological evaluation.

Findings from the multivariate analyses, both logistic regression and CHAID, are remarkably consistent in predicting the three effectiveness measures:

Any suspect resistance (a measure of ineffectiveness)

- Suspect body weight was over 200 pounds (logistic and CHAID).
- Suspect was intoxicated (logistic and CHAID).
- One or both Taser darts missed the intended target (logistic and CHAID).
- Officer used another less lethal weapon (logistic and CHAID).
- Distance between the officer and the suspect was 3 feet or less (logistic).
- Suspect directed violence toward an officer or citizen (logistic).

Resistance occurring immediately after Taser use (a measure of ineffectiveness)

- Suspect was intoxicated (logistic and CHAID).
- One or both Taser darts missed the intended target (logistic and CHAID).
- Suspect body weight was more than 200 pounds (logistic).
- For a subset of cases, incident occurred indoors, suspect was 30 years old or younger, and suspect was armed (CHAID).

Officer satisfaction (a measure of effectiveness)

- Suspect and officer were more than 3 feet apart (logistic and CHAID).
- Both Taser darts struck the intended target (logistic and CHAID).
- Suspect body weight was 200 pounds or less (logistic).
- Suspect was armed with a gun or knife (logistic).

Three important findings emerge from the analysis. First, the analysis suggests that Taser effectiveness can be modeled using multivariate techniques, as several suspect- and incident-related variables are associated with a greater or lesser likelihood of effectiveness. Considering the paucity of research examining use and effectiveness of the Taser, this finding alone is important. Second, a number of variables were noticeably absent from the statistically significant predictors of Taser effectiveness identified in the multivariate analysis. For example, the race and gender of the suspects were unrelated to any of the three measures of effectiveness. Importantly, whether the suspect was classified as "emotionally disturbed" was also unrelated to Taser effectiveness. Note that only 28 cases did not involve a suspect classified as an EDP, so caution should be used in generalizing to this subgroup. The findings relating to EDPs are particularly important, however, because anecdotal evidence made available by the news media and interest groups suggests that the mentally ill may be more likely to continue to resist the police and to experience serious injury or death when stunned by the Taser. The results of this study indicate that the suspects' mental health at the time of the incident did not affect the effectiveness of the Taser. Additionally, the authors reviewed all news reports ($N = 192$) of Taser incidents printed in *The New York Times* during the study period to become more familiar with the qualitative aspects of the incidents and found evidence of only one case where NYPD deployment of the Taser resulted in the death of an emotionally disturbed suspect.[20]

The third important research finding relates to the variables that were identified as significant predictors in the multivariate analyses, including suspect intoxication, body weight, violence directed at an officer or citizen, and distance between the officer and the suspect. A relatively small proportion of the Taser cases involved an intoxicated suspect—13%, or 46 incidents—but effectiveness dropped significantly for those cases: Intoxicated suspects were twice as likely to exhibit any resistance during the encounter (57% compared to 30%, respectively), they were about 3 times as likely to resist immediately after police deployed the Taser (27% compared to 9%, respectively), and intoxication was associated with lower officer-reported satisfaction with the Taser (67% compared to 80%, respectively).[21] Although the reason for this finding is not clear, one possible explanation relates to

the effect of drugs and alcohol on the suspect's ability to reason and process information. The intoxicated suspects may be less capable of thinking rationally during the police–citizen encounter and therefore less inclined to comply with the officer's instructions after the effects of the Taser wear off. This finding clearly warrants attention from police researchers and practitioners. If it is replicated in other police jurisdictions, with other suspect samples, there are clear policy and training implications. Police field training can highlight the increased likelihood of continued resistance among intoxicated suspects and provide officers with a clear set of guidelines to anticipate and curtail resistance to prevent violence escalation and serious injuries.

The emergence of suspect body weight as a predictor of Taser effectiveness is both interesting and puzzling. Evidence that the weapon is less effective against heavier individuals is not apparent from the CED industry reports or the growing clinical research. This study finds suspect weight—with a cutoff at 200 pounds—a significant predictor of both resistance measures and officer satisfaction. Depending on the degree to which body weight moderates the effects of the Taser, there are implications for Taser use and for police policy and training. Police officers may need to prepare for the greater likelihood of resistance immediately after using the weapon on particularly tall or heavy suspects. Policy should offer guidance on subsequent responses, which may include additional Taser deployments or alternative less lethal weapons. Given the potential relationship between multiple Taser deployments and elevated risk of serious injury or death, police departments may need to craft their policies carefully. Moreover, researchers should consider investigating the potential for an interaction effect between body weight and intoxication. For example, 18 cases in the study data involve an intoxicated suspect who weighs more than 200 pounds, of whom 13 (72%) continued to resist the officer after being stunned with a Taser. This is clearly an important issue that requires further investigation.

Two other suspect-related variables were significant in the multivariate analysis: violent behavior directed at an officer or another person and whether the subject was armed with a weapon. Suspects who were suicidal, engaged in self-harm, or threatened self-harm were less likely to continue resisting after being stunned with the Taser, compared to those who were acting violently toward an officer or citizen. The implications for police are straightforward: Suspects who direct their violence toward others—most notably, the police officer—represent the greatest risk of a physical struggle after being stunned with the Taser, and therefore, officers should remain especially vigilant when using the Taser on subjects that fit this description.

The association between armed suspects and measures of effectiveness indicates that police use of the Taser is most effective in those situations where the potential for serious injury or death is highest. Further research is needed to substantiate this finding, but there are a number of potential explanations:

- High-risk situations could be fundamentally different in ways that affect officer satisfaction.
- The actual physiological effects of the Taser may be different (e.g., more effective) in these types of encounters.
- Police officer performance during and after Taser use may be different in high-risk encounters (e.g., quicker reaction times, better handcuffing, etc.).

Several incident-related characteristics are also associated with the effectiveness measures, notably, distance from the intended target, police use of another less lethal device in addition to the Taser, and the number of darts that make contact with the suspect. The importance of the number of darts that strike the subject and police use of other less lethal weapons is clear. For the Taser to deliver the current, both darts must strike the suspect, penetrate the clothing, and attach to the skin. If this does not occur, the device will not work as intended, and consequently, resistance will be more likely to continue. Although the field report does not specify the order in which multiple weapons are used, the fact that more than one weapon is used implies that one or more instruments were ineffective in curtailing resistance.

The significance of the distance from the suspect as a predictor of effectiveness has both training and policy implications. Taser International offers cartridges with maximum ranges of 15 feet, 21 feet, 25 feet, and even 35 feet. The study findings suggest that the Taser is less effective when used at close range—within 3 feet or less of the target. (Note that distance remained significant when controlling for use of the device in stun mode, i.e., direct contact to the suspect's skin.) The reasons for this are unclear, although use at close range may increase the likelihood that suspect movement could affect the accuracy of the weapon, the suspect could grasp or bump into the weapon at time of discharge, or the darts may not spread out sufficiently to deliver the optimal current. Police agencies may want to consult with each other or the CED manufacturer to determine if this short-range problem has emerged elsewhere. Regardless, maintaining a safe distance whenever possible is of central importance; in fact, the NYPD (2000) patrol guide states that officers should maintain a "zone of safety" of 20 feet and call ESU when

responding to EDPs. Findings from this study suggest that the "safe-distance" principle should be reinforced for ESU as well, particularly when there is reasonable suspicion that a Taser may be deployed.

Conclusion

This article sought to address questions about the use and effectiveness of CEDs by examining all Taser deployments by the NYPD from 2002 to 2005 (N = 375). The authors employ both logistic regression and CHAID analysis to identify predictors of Taser effectiveness, measured as the extent of suspect resistance and officer satisfaction. A number of statistically significant predictors surfaced with policy and training implications, including suspect body weight, drug and alcohol use, violent behavior, and the distance between the responding officer and the suspect. Considering the lack of empirical research predicting Taser effectiveness, this article takes an important step in thinking about the circumstances in which favorable deployment outcomes are likely to occur.

As we suggested earlier, there is an ongoing discourse between civil rights organizations and the CED industry regarding the widespread adoption of these devices. Although this research offers an objective, empirical analysis of Taser deployments, for a number of reasons, it is difficult for the authors to weigh in on this debate. First, much of the debate has focused on the physiological effects of CEDs, which is not a focus of this research. Second, we have examined one police department with a restrictive and closely monitored deployment pattern, which limits the conclusions we can draw. Alternatively, this research shows that the study police department experienced positive outcomes while avoiding the current controversies associated with use and effectiveness. Both PERF and IACP offer detailed guidance on model policy and procedures for the Taser, most of which mirror the NYPD approach. Thus, we can conclude that with regard to the use and effectiveness questions only, this research suggests that departments can successfully deploy the Taser—avoiding problems with misuse and abuse—by implementing and closely monitoring the guidelines developed by PERF and IACP.

Nonetheless, additional research on this topic is necessary not only because the technology is relatively new but also because different agencies are adopting the weapon to varying degrees and developing different standards and expectations concerning its proper use. A multisite analysis of police agencies that have incorporated the Taser into routine practice based on

different approaches would yield valuable comparative data. This type of cross-site approach—coupled with the release of research supported by the National Institute of Justice, particularly, the national-level study being conducted by Alpert and colleagues—will enable researchers to begin asking more complex questions about police use of the Taser, such as to what extent it is used by officers as an alternative to other less lethal weapons (and physical force) and what types of information would be required for a rigorous cost-benefit analysis of the Taser.

Notes

1. There are competitors to Taser, including Stinger Systems and Law Enforcement Associates, but Taser dominates the market with approximately 95% of conducted energy device (CED) sales in the United States. Stinger Systems has sold just 12,000 weapons since 2000. Law Enforcement Associates introduced their CED only recently, in March 2005.

2. Important considerations and limitations associated with these reports include small sampling frames and potentially competing interests among those who carried out the studies. The National Institute of Justice is currently funding several national-level research projects on the Taser, but these studies have just begun.

3. This estimate becomes much greater if handcuffing and verbal commands are included as use of force.

4. For example, the effects of mace and pepper spray are often felt for several hours, and their range of effectiveness is much shorter (which increases the likelihood of other officers' being hit). Beanbag guns and similar impact munitions are often fired from a specialized shotgun that is larger and bulkier than CED.

5. The New York Police Department's (NYPD; 2000) patrol guide also offers a definition of an emotionally disturbed person (EDP):

> A person who appears to be mentally ill or temporarily deranged and is conducting himself in a manner which a police officer reasonably believes is likely to result in serious injury to himself or others. (p. 1)

In situations involving an EDP, officers are instructed to create and maintain a "zone of safety" of approximately 20 feet and to call for the Emergency Service Unit (ESU) and a patrol supervisor as well as an ambulance (NYPD, 2000). Officers are not to attempt to take an EDP into custody unless

- The EDP is unarmed, not violent and is willing to leave voluntarily; OR
- The EDP's actions constitute an immediate threat of serious physical injury or death to himself or others. (NYPD, 2000, p. 1)

6. These reports were provided to the authors by the supervisor of the department's training division. Although the form is used primarily for the Taser, there were 33 forms involving use of another type of nonlethal weapon: either a stun device or other similar alternative. Because the focus of this article is the Taser, these cases were excluded from the analysis.

7. Given that the intent of the Taser is temporary incapacitation only, the latter suspect resistance measure—10.9%—is probably a fairer measure of the Taser's effectiveness. Also, the *any suspect resistance* measure includes both types of resistance (i.e., continual resistance is a subset of the more general resistance measure). Both measures are examined in the multivariate analysis.

8. At the same time, it is worth noting that the limited manner in which the NYPD has implemented the Taser is a practical advantage to police administrators in New York, who have avoided being criticized in the news media for excessive reliance on the Taser.

9. This variable is based on the police officer's assessment of the suspect at the time of the incident. It is not based on more definitive tests, such as a urinalysis or blood or hair analysis. Although this would appear to suggest that police officers in the study department use the Taser disproportionately against the mentally ill in crisis, this finding must be interpreted in the context of how the department has deployed the Taser. Per department policy, the ESU is called when the patrol officers or supervisors on scene determine that the situation involves an EDP who is behaving in a manner that could result in physical injury or death to the EDP or others (NYPD, 2000). Thus, these data are a reflection of the types of suspects typically handled by the ESU—a highly specialized group of officers—not the suspects typically handled by line officers.

10. There were also two cases where the suspect was armed with a gun: In one case, the suspect was threatening to commit suicide, and in the other case, the suspect had taken a hostage and was threatening multiple people (including the hostage and himself). Of the remaining cases involving an armed suspect, the most common weapon was a blunt object, such as a metal pipe, baseball bat, chair, or large stick.

11. The nearly universal presence of back-up officers and supervisors is again dictated by the fact that most of these cases involve the ESU. This unit is typically called to the scene by the first responding officer, and often a supervisor will also respond.

12. Both police officers and detectives are assigned ranks in the ESU. Chi-square values indicate that the satisfaction and any-resistance differences are statistically significant (p = .005 and p = .050, respectively). It may be useful in future research to examine length of time on the job and officer training as factors related to effectiveness. These variables may more accurately capture the relationship between officer's use of the Taser—especially among non-ESU personnel—and effectiveness measures.

13. Information on the number of dart contacts was not reported in 66 cases. Rather than make assumptions about the number of contacts, the authors have proceeded conservatively and coded these cases as missing. This decision, however, reduces the number of cases available for multivariate analysis.

14. In the remaining 14% of the cases (n = 53), the form was not signed and there was no information about whether the use met departmental policy. However, a review of the narrative of those 53 cases suggests that they too conformed with department policy on use of the Taser.

15. Nagelkerke R^2 provides an approximation of the explained variation in a logistic regression model. This measure of model strength is considered slightly more conservative than the R^2 statistic in ordinary least squares regression but less conservative than the Cox and Snell R^2 estimate, which does not have a maximum value of 1.0.

16. Although the "Taser/stun device report" indicates whether another nonlethal device was also used, it does not specify which is used first, the Taser or the alternative.

17. Suspect resistance was also a predictor of officer satisfaction, but it has been excluded from the analyses because it serves as the other effectiveness measure. The authors question the value of a model that uses one outcome measure to predict another.

Oleoresin Capsicum Spray and Tasers:

A Comparison of Factors Predicting Use and Effectiveness

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Oleoresin Capsicum Spray and Tasers:

A Comparison of Factors Predicting Use and Effectiveness

ABSTRACT

In the last few decades, several less-lethal forms of force have been introduced, adopted, and deployed by police agencies. Oleoresin capsicum spray is now used in nearly every department across the United States; the Taser is used in the majority of police departments. Despite their widespread use, we still know relatively little about the factors associated with the use of OC spray and Tasers and the effectiveness of these weapons in incapacitating subjects. This paper contributes to that discussion by analyzing 504 use-of-force incidents where the police used OC spray or Tasers during the event. Data were obtained from a large municipal police department on incidents that occurred in 2010 and 2011. Policy implications and directions for further research are discussed.

INTRODUCTION

A fundamental but controversial function of the police is their ability to use coercive force (Bittner, 1970; Klockars, 1985). Force is most likely to be used by the police in situations where they are confronted with non-compliant subjects (Reiss, 1971; Terrill & Mastrofski, 2002). In such situations, police officers have several options. At one end of the spectrum, beyond verbal commands and threats, officers may use bodily force (e.g., decentralizations, focused strikes). Bodily force alone is the most common form of physical force used by police officers (Adams, 1999). At the other end of the spectrum, officers may use their firearms. The use of firearms is considered a last resort; it is only to be used to defend human life. In between bodily force and deadly force, there are several "less-than-lethal" or "less-lethal" options.

In the last few decades, several less-lethal forms of force have been introduced, adopted, and deployed by police agencies. Today, nearly all local departments authorize the use of one or more less-lethal weapons (Reaves, 2010). The most common less-lethal weapon is pepper spray, authorized by 97% of all local departments (Reaves, 2010). Conducted Energy Devices (CEDs)[1], including Tasers[2] and stun guns, are authorized by 60% of all local police agencies (Reaves, 2010). While the number of departments authorizing pepper spray is not much higher than in the year 2000 (91%; Hickman & Reaves, 2003), the number of local police departments that authorize the use of CEDs has dramatically increased since 2000, when just 7% authorized them (Reaves, 2010).

[1] CEDs are sometimes also known as Electronic Control Devices (ECDs), Conducted Electrical Weapons (CEWs), or Conducted Energy Weapons (CEWs).

[2] The Taser (short for the Thomas A. Swift Electric Rifle) is currently the most popular CED on the market. It is also the CED used by the department in this study. As such, we use the term "Taser" rather than the more general "CED" throughout this paper.

In response to the greater prevalence and use of less-lethal weapons, particularly OC spray and Tasers, a substantial amount of research has been conducted on issues related to them. For instance, researchers have analyzed the frequency with which different types of force are used before, during, and after OC spray or Tasers are introduced in departments (e.g., Lin & Jones, 2010; Lumb & Friday, 1997). Studies have examined the factors associated with the use of OC spray (Morabito & Doerner, 1997) and Tasers (Crow & Adrion, 2011; Gau, Mosher, & Pratt, 2010) as well as officer and citizen injuries associated with their use (e.g., Terrill & Paoline, 2011; Kaminski et al., 2013; Paoline, Terrill, & Ingram, 2012; Kaminski et al., 1999; Smith et al., 2007). Finally, researchers have examined the effectiveness of OC spray (Morabito & Doerner, 1997; Kaminski, Edwards, & Johnson, 1999; Adang et al., 2006) and Tasers (White & Ready, 2010; White & Ready, 2007), defining effectiveness in terms of their ability to induce subject compliance.

While this research has advanced our understanding of the benefits and limitations of OC spray and Tasers, we still know relatively little about the factors associated with the use of OC spray and Tasers and the effectiveness of these weapons in incapacitating subjects. In particular, there are no studies to date that directly compare the use and relative effectiveness of OC spray and the Taser within the same jurisdiction during the same time frame.[3] Some studies examine OC spray, while others examine Tasers. It is difficult, if not impossible, to draw definitive conclusions about the use and relative effectiveness of OC spray and Tasers on the basis of studies that do not include both OC spray and Taser incidents, do not compare OC spray with Tasers, that use different sampling procedures and measurements schemes for critical variables,

[3] An exception is a study performed by TASER International (as cited in White and Ready, 2007). In this study, the effectiveness of the OC spray and the Taser were compared, but only when both were used in the same incident. In these encounters, OC spray was effective 33% of the time while the TASER was effective in 83% of cases (Taser International, 2002).

and that were conducted in different police departments with different use-of-force policies and continuums. As such, we do not know whether Tasers are significantly more (or less) effective than OC spray in similar situations, or whether different factors predict their use and effectiveness. This study examines the factors that predict the use and effectiveness of OC spray (N= 259) and Tasers (N=245) in a single large municipal police department. Data were obtained from official use-of-force reports of the police department on incidents that occurred in 2010 and 2011.

LITERATURE REVIEW

Police use of force, defined as "acts that threaten or inflict physical harm on suspects" (Terrill, 2003, p. 56), has been an important and constant topic of research since the 1970s. This attention is warranted for theoretical and practical reasons. Theoretically, research on police use of force is important because it involves the defining characteristic of policing. In large part, an understanding of the complexities and dilemmas of police work depends on an understanding of police use of force. Practically speaking, research on the control of police use of force is important in that use of force can have devastating—and deadly—consequences. As such, it can dramatically affect police-community relations, public cooperation with the police, and the legitimacy of the police more generally.

Due to the potentially serious consequences of police use of force, police officers are constrained in their ability to use it. Along with legal (*Graham v. Connor*, 490 U.S. 386 1989) and accreditation standards (Commission on Accreditation for Law Enforcement Agencies, 1999), the majority of police departments guide officer behavior with a "continuum of force" or "force continuum" (Terrill & Paoline, 2012). Most often, officers are to base force decisions on

the level of suspect resistance or aggression; force is only escalated to the next level when less forceful actions fail to induce suspect compliance. While OC spray and Tasers are usually placed at the same level on force continuums (Alpert et al., 2011; IACP, 2005), there is little agreement between and among departments where they should be placed. In some departments, OC spray and the Tasers are placed at the lower end of the continuum, authorizing their use against passive resisters; other departments place them closer to lethal force on the continuum, authorizing their use only against active resisters. Where OC spray and Tasers are located on the continuum of force matters when understanding the circumstances in which the weapons are used (Crow & Adrion, 2011; Morabito & Doerner, 1997). In turn, the circumstances in which OC spray and Tasers are used may have implications for their effectiveness in inducing compliance among subjects.

OC SPRAY AND TASERS

Oleoresin capsicum (OC) spray, otherwise known as pepper spray, was introduced to law enforcement in the 1980s. OC is an inflammatory agent naturally found in cayenne peppers. When a person is sprayed with OC spray, the effects are immediate: the respiratory tract becomes inflamed, the individual experiences an intense burning sensation and swelling around the eyes, and the subject's eyes close involuntarily (Lumb & Friday, 1997). Although the subject may be in extreme discomfort, he or she may still be able to resist. Ideally though, the effects of OC spray render a resistive suspect passive and compliant, and the officer is able to take the suspect into custody without further incident.

Once introduced, OC spray immediately demonstrated advantages over other forms of force. The effects of OC spray, while immediate and dramatic, were more temporary than other

forms of chemical gasses used previously (Lumb & Friday, 1997). OC spray proved more effective on intoxicated individuals than mace, and was less prone to secondary contamination (White & Ready, 2007). Finally, OC spray was less likely to cause injury than bodily force, batons, and flashlights (Lumb & Friday, 1997). As summarized by Lumb & Friday (1997):

> ...OC spray is an effective alternative to the more harmful types of weapons available to police. OC causes almost instantaneous incapacitation and leaves no long term residual effects. It allows the officer to stay away from the suspect when affecting a custodial arrest that is being resisted, and there are few problems associated with transporting the person, as OC spray residue dissipates fairly quickly (p. 138).

Today, while OC spray is standard issue in police departments, CEDs, such as the Taser and other stun devices, are still gaining popularity. First introduced in the 1990s, the Taser is a 50,000 volt, 26-watt weapon that uses nitrogen cartridges to fire its probes. Once the probes attach to the suspect, the Taser delivers an electrical current which overrides the central nervous system, causing involuntary muscle contractions and incapacitation (Alpert et al., 2011; Means & Edwards, 2005).

The Taser has advantages over other less-lethal alternatives including their greater reliability at longer distances, the relatively quick recovery time involved, and their perceived effectiveness in inducing suspect compliance (White & Ready 2010). In addition, because Tasers do not rely on pain to induce compliance, ideally they should be more effective on persons who have a higher tolerance of pain, such as people under the influence of drugs or alcohol or who have a mental illness (Means & Edwards, 2005).

Despite their popularity and advantages, OC spray and Tasers are not without controversy. One concern relates to their safety. In the late 1980s and early 1990s, OC spray was claimed to have caused several in-custody deaths (ACLU of Southern California, 1993; Alpert et al., 2011). Twenty years later, the Taser was also alleged to be a proximate cause of in-

custody deaths (Alpert et al., 2011; White & Ready, 2007). Research has shown that most deaths involving OC spray were instead the result of positional asphyxia, pre-existing health conditions, or were drug-related (Granfield, Onnen, & Petty, 1994; Petty, 2004). With regard to Tasers, it has been demonstrated that the risk of death when a Taser is used is less than 0.25 percent (NIJ, 2011), and in those situations the death is likely to be a result of drug intoxication, preexisting heart conditions, and exposure to other forms of nonlethal police force (White & Ready, 2007).

Another concern relates to police overuse of OC spray and Tasers (Alpert et al., 2011). For instance, members of the ACLU and Amnesty International have voiced concern that OC spray and Tasers are used in a disparate fashion against members of minority groups (ACLU of Southern California, 1993; Amnesty International, 2006). A related concern is that police have authorized their use too low on continuums of force and consequently are using them against passive (versus active) resisters (Terrill & Mastrofski, 2002). Finally, there are concerns about the use of OC spray and Tasers with the elderly, children, pregnant women, and persons with medical conditions that put them at greater risk of experiencing dangerous medical side effects (Amnesty International, 2006; Sloane & Vilke, 2006).

A final concern has to do with manufacturer exaggeration of the capabilities and effectiveness of OC spray and Tasers in incapacitating subjects, which, in part, may have contributed to their widespread adoption in police departments. Some early studies reported "effectiveness rates" as high as 100% for OC spray (as cited in Adang et al., 2006) and 94% for the Taser (as cited in White & Ready, 2010). Objective empirical research on the effectiveness of these devices remains rather sparse. Of the independent studies that do exist, effectiveness rates have not been found to be as high as those originally reported by the manufacturers. For

instance, and as discussed below, Kaminski et al. (1999) found an effectiveness rate of 71% for OC spray. White and Ready (2010) found an effectiveness rate of 85% for the Taser.

RESEARCH ON THE USE AND EFFECTIVENESS OF OC SPRAY AND TASERS

While research appears to have ameliorated concerns about OC spray and Tasers causing serious injury and death, there remain concerns about their use and effectiveness. In response, there has been a growing body of literature that examines the use and effectiveness of these weapons. Given the objectives of the current study, we review here the studies that examine the factors associated with the *use* of OC spray and Tasers and the *effectiveness* of OC spray and Tasers (with effectiveness defined in terms their ability to facilitate the arrests of resisting subjects).

The Use of OC Spray

Morabito and Doerner (1997) analyzed OC spray use-of-force reports from the Tallahassee Police Department. They examined characteristics of officers and suspects that were associated with the use of OC spray at two points in time: prior to and after a change in the circumstances in which OC spray was authorized in the department. At Time 1, OC spray was only authorized in cases when the suspect was actively physically resisting police. At Time 2, the threshold for the use of OC spray was reduced from active physical resistance to verbal/passive physical resistance. At Time 1, OC spray use was compared to impact weapons such as batons, flashlights, and stun guns. At Time 2, OC spray use was compared to the use of soft hand techniques (punches, kicks, and pain compliance techniques). The officer characteristics of interest included race, gender, education and experience. Suspect variables

included race, gender, height and weight (relative to the officer's height and weight), suspect intoxication, and whether the suspect was armed or attacked the officer. While none of the predictor variables were significant at Time 1, several factors were associated with OC spray use at Time 2. At Time 2, male, educated, and veteran officers were more likely to use OC spray than soft hand techniques. OC spray was also more likely to be used than soft hand techniques when the suspect was heavier and taller than the officer and when the suspect was armed.

The Use of Tasers

Gau, Mosher, and Pratt (2010) analyzed case file data on Tasers and other types of force used by officers in a state patrol agency from 2005 to 2007. The authors were primarily interested in examining possible racial disparities in the use of a Tasers on subjects. Tasers were used in nearly one-half of all use-of-force incidents. They found that compared to other forms of force, Tasers were equally likely to be used on white, Hispanic, and Black subjects; although when a Taser was used, Hispanic subjects were more likely than White subjects to have a Taser be the first type of force used. The authors also found that females were less likely to be "tased" than males, and that subjects who actively resisted and who were assaultive were *less* likely to be tased than subjects who passively resisted. Finally, white officers were significantly less likely to use a Taser than officers of other races.

Crow and Adrion (2011) analyzed 461 use-of-force incidents (reports) that occurred between 2004 and 2010 in a medium-sized municipal police department. The authors compared incidents where a Taser was used and incidents where "other" types of force were used (takedowns, physical force, pepper foam, impact weapons, police dog, use of a vehicle as a weapon, and firearms). The authors found that a Taser was *less* likely to be used than other forms

of force when subjects physically resisted and when resistance involved a weapon. A Taser was equally likely to be used when resistance was in the form of "presence," "flight," and "verbal" (meanings unspecified). A Taser was more likely to be used than other forms of force on non-white and male subjects. Older officers were significantly more likely to use Tasers. A policy change to restrict the use of Tasers also had its intended affect; after the policy change, Tasers were less likely to be deployed. Call type, time of day of the incident, officer sex, race, age, and rank did not affect the likelihood of Taser use.

The Effectiveness of OC Spray

Three studies have examined the effectiveness of OC spray (Morabito & Doerner, 1997; Adang et al., 2006; Kaminski, Edwards, & Johnson, 1999), generally defined in terms of the extent to which it facilitates the arrests of suspects who resist. As previously noted, Morabito and Doerner (1997) analyzed use of force reports from the Tallahassee Police Department. Although these authors were most concerned with the factors associated with the use of OC spray, they also briefly considered the effectiveness of it. As the authors explained, OC spray "was considered effective if it induced the expected physiological effects and enabled the officer to take the subject into custody without further incident" (p. 690). They calculated a "success rate" of 73% for OC spray and found that OC spray worked "equally well on mentally disturbed subjects, intoxicated subjects, and physically stressed subjects who were involved in either a foot chase or a physical struggle" (p. 690).

Kaminski et al. (1999) analyzed data on incidents where OC spray was used by officers in the Baltimore County Police Department. Based on assessments provided by officers who were involved in the incidents, three measures of OC spray effectiveness were constructed. In

their most conservative measure, they defined effectiveness in terms of whether the use of OC spray incapacitated (fully and immediately immobilized) the suspect (yes/no). According to this measure, OC spray was effective in 71% of cases. Their second measure of effectiveness was also dichotomous, measured as the officer's assessment of whether the use of OC spray eased arrest (yes/no). In this case, the use of OC spray was deemed effective 85% of the time. Their third measure of effectiveness consisted of a 5-point scale ranging from totally effective (i.e., incapacitated suspect) to totally ineffective (i.e., OC spray had no effect). Here, OC spray was considered effective 84% of the time.

Kaminski et al. (1999) examined the effects of suspect characteristics on OC spray effectiveness. In particular, they examined the variables of suspect race, gender, age, weight, height, and condition (i.e., suspect was drinking, mentally disturbed, on drugs, or other). The authors also examined the distance from which OC was sprayed. They found that OC spray was more effective (yes/no) with younger and older suspects (but less effective among middle-aged suspects) and intoxicated suspects. It was less effective when it was used on suspects who were under the influence of drugs and when sprayed from longer distances.

Adang et al. (2006) analyzed data on incidents where OC spray was used by police officers in the Netherlands. They used surveys of officers, supervisors, and prosecutors to measure the effectiveness of OC in several ways: the degree to which the subject was incapacitated (with options ranging from "completely" to "not at all"), the degree to which OC made the arrest easier ("much easier" to "much more difficult"), whether suspects became more or less aggressive after exposure to OC spray ("much more" to "much less"), and how satisfied officers were with the performance of OC spray ("dissatisfied" to "highly satisfied"). Estimates of effectiveness ranged from 69% (suspects who became less aggressive after being sprayed with

OC) to 92% (officers who were satisfied with the performance of OC spray). In the model predicting the extent of suspect incapacitation, four of thirteen independent variables were statistically significant. Specifically, OC spray was less effective when used by less experienced officers, against minority suspects, when suspects were warned beforehand they were going to be sprayed, and when suspects were under the influence of drugs.

The Effectiveness of Tasers

Two studies have examined the effectiveness of Tasers with specific regard to the incapacitation of subjects in arrest situations (White & Ready, 2007; White & Ready, 2010). White and Ready (2007) examined the effects of Tasers based on self-report surveys completed by (primarily SWAT) officers who worked in a large metropolitan police department. They considered the Taser effective if it led to the "successful incapacitation" of the subject. They found that after deploying a Taser, "85% of subjects were subdued by the Taser and taken into custody" (p. 183). The authors developed a multivariate "violence escalation scale" that they used to score each Taser incident. The scale included whether the subject was violent, armed with a weapon (and what type of weapon), under the influence of drugs or alcohol, mentally ill, the weight of the subject, and whether the officer was alone. Although individual analyses were not provided on each variable, the analyses performed on the scale revealed that the Taser was the most effective in the "highest risk" situations.

White and Ready (2010) analyzed Taser deployments from the New York City Police Department; the data were derived from the reports that officers completed subsequent to the deployment of the weapon. Three measures of Taser effectiveness were used in the study. The first measure was the officer's assessment of whether the Taser performed satisfactorily (yes/no).

Officers rated the performance of the Taser as satisfactory in 79% of cases. While this indicator of effectiveness was also used in prior studies (see Adang et al., 2006), the other two are unique in that they measure suspect resistance or, in other words, the *in*effectiveness of the Taser. The authors classified suspect resistance two ways: First, "continual resistance" included those situations where the suspect was not affected at any point by the weapon; the suspect continued to resist after the Taser was deployed. This occurred in 33% of all Taser deployments. In these instances the Taser was clearly ineffective. Second, "any resistance" included those situations where the Taser temporarily resulted in the incapacitation of the suspect, but the suspect resisted again prior to the conclusion of the incident. This occurred in about 11% of Taser deployments.

In their models predicting Taser (in)effectiveness, White and Ready (2010) explored the impact of multiple officer, suspect, and incident characteristics. They found the Taser to be less effective on heavier subjects (i.e., over 200 lbs), subjects who were under the influence of drugs or alcohol, subjects who were violent, when another less lethal weapon was used, when one or both prongs missed the subject, and when the Taser was fired from farther away (i.e., greater than three feet). When effectiveness was based on officer satisfaction, the Taser was also perceived to be more effective when the suspect was armed with a knife or gun.

Conclusions

There are too few studies available to draw confident conclusions about the factors that affect the use and effectiveness of OC spray and Tasers. Other than that males are more likely than females to be subject to a Taser than other forms of force (Gau, Mosher, & Pratt 2010; Crow and Adrion 2011), that OC spray is less likely to be effective on subjects who are under the influence of drugs compared to subjects who are not (Kaminski et al. 1999; Adang et al. 2006),

and that departmental policy affects the use of OC spray and Tasers (Crow & Adrion 2011; Morabito & Doerner, 1997), there is little consistency in findings. There is also little consistency in variables included in previous studies and the measurement of those variables.

It is safe to conclude, however, that estimates regarding the effectiveness of OC and Tasers depend at least in part on the measures used; different definitions of effectiveness produce different rates of effectiveness. In the studies reviewed here, rates of OC effectiveness ranged from 69% to 92% (Adang et al., 2006), while the effectiveness of the Taser ranged from 66% to 89% (White & Ready, 2010). The variation in effectiveness estimates notwithstanding, it appears that most studies show the Taser to be more effective than OC spray.

Our study adds to the discourse on the use and effectiveness of OC spray and the Taser in several ways. First and most importantly, this study is the first that directly compares OC spray with Tasers in terms of their use and their effectiveness, and we do so in the context of the same study site. Second, we include all intentional OC spray and Taser deployments to provide a potentially more inclusive assessment of effectiveness.[4] Lastly, we provide a logical measure of weapon effectiveness that incorporates the dynamic nature of use of force incidents and we use this same measure to evaluate OC spray and Tasers.

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[4] Interestingly, Kaminski et al. (1999) excluded from their analyses incidents where OC was used but where it missed its intended target and incidents where it was used in a crowd situation. The authors also explain that if multiple officers or multiple subjects were involved in the incident, a single officer and/or a single subject was selected for analysis. In addition, it is unknown what, if any, other types of force were used before or after the deployment of OC spray. Adang et al. (2006), like Kaminski et al. (1999), excluded several categories of incidents from their analysis: incidents where officers deployed OC spray but it missed its intended target, where OC was intended to be used but the canister malfunctioned, incidents that involved a crowd situation, and when it was deployed against female subjects. In addition, the authors did not specify what, if any, other types of force were used before or after the deployment of OC spray. It is unknown how these factors may have affected their conclusions about OC spray effectiveness.

METHOD

Data

The data for this study were obtained from a large municipal police department. At the time of the study, the department employed approximately 2,000 sworn officers, about 1,200 of whom were patrol officers. The police department served a population of approximately 600,000; 40% of the population was African American and 10% was Latino.

Analyses were performed on all use of force incidents in 2010 and 2011 where an officer from the department intentionally discharged OC spray (n=259) or deployed a Taser (n=245) against a person. While an additional 24 incidents involved the use of OC and a Taser, and another 45 incidents involved the use of another type of weapon, the analyses conducted here focus on the 504 incidents where OC *or* a Taser was used.

All officers in the department were trained and authorized to carry and use OC spray. During the academy, officers received 4 to 8 hours of instruction on the use of OC spray. Only about 300 officers (approximately 25% of patrol officers) were trained and certified to use a Taser. Further, on each of the three shifts at each of the eight districts, approximately six to eight Tasers were available to be signed out and carried by the certified Taser officers. Therefore, at any given time during the time of this study, there were no more than 68 Tasers actually being carried by officers. With regard to Taser training, officers who volunteered for training first had to be approved by Internal Affairs. Officers who were selected to be Taser trained participated in 16 hours of "new user" training and an additional 8 hours of "refresher" training every 2 years.[5]

At the time of the study, the use of force policy of the department specified OC spray and Tasers as "control devices." According to the policy, "the goal of control devices is to overcome

[5] The only training required by TASER International is the 8 hours of "new user" training.

active resistance or its threat [italics added]." Control devices, escort holds, compliance holds and passive counter measures were more broadly considered "control alternatives." Although a continuum of force was not specified per se, "intervention options" were provided; these options ranged from presence, dialogue, control alternatives, protective alternatives (e.g., focused strikes, vertical stuns), to deadly force (see Figure 1).

Most of the data for the study were obtained from a case management system used by the police department and were converted into a Statistical Package for the Social Sciences (SPSS) data file for analyses. The database was organized with use of force incidents as the unit of analysis. The use of force data were based on reports that were completed by supervisory officers when a use of force incident occurred. According to the official policy of the department at the time of the study, a use of force report was to be completed by a supervisor when an officer: (a) discharged a firearm, (b) used a baton, (c) discharged Oleoresin Capsicum (OC), (d) deployed an Electronic Control Device (Taser), (e) used any other type of force, which resulted in an injury, or a complaint of an injury, to a person, or (f) when a department canine bit a subject in the performance of their duty. Clearly, this is a relatively narrow definition of force as it does not include incidents where only bodily force was used when that force did not result in an injury (or a complaint of an injury) to a subject (or verbal force, see Terrill & Mastrofski, 2002). Nevertheless, that the department policy did not require all bodily force incidents to be reported is of little concern in this study. This study focuses specifically on incidents that involved the use OC spray or a Taser. Departmental policy specified that all such incidents be recorded and all types of force used in those incidents be recorded.

Along with the departmental use of force report, a narrative of the incidents was also written by the supervisory officer and was included in the case management system. For this

study, all of the narratives for incidents that involved the use of OC and/or a Taser were reviewed (787 pages) and additional data were coded from them (e.g., level of subject resistance, the order in which force was used by officers).

Variables

The two primary dependent variables in this study are: 1) the *use of* OC spray and the Taser and 2) the *effectiveness of* OC spray and the Taser. Determining whether or not a particular type of force was used in an incident was relatively straight-forward. If OC was sprayed or a Taser was deployed, OC or the Taser was considered to have been used. If the target was missed, if the weapon malfunctioned, if it was used in a crowd situation, or if it was used against females, the incident was still included. If the incident involved multiple officers and/or multiple subjects, the incident was included. In the few incidents that involved multiple subjects, the characteristics of the person identified as the primary subject in the officer's report was coded.

Determining the effectiveness of OC spray and the Taser was more complicated. As discussed earlier, previous studies have used different measures of effectiveness although each study, in one way or another, examined how well, or to what degree, OC spray or the Taser incapacitated the subject who resisted the police. Of course, the variation in measurement is important to consider when interpreting findings across studies. Ultimately, in a use of force incident, the legitimate objective is to neutralize the threat posed by the subject and gain control over that subject. Most often, practically speaking, "gaining control" means using as much force as necessary in order to place handcuffs on the subject. Many use-of-force situations are

complicated; they unfold, one action leads to another, but ultimately force is used to gain control over the physical actions of the subject.

In this study, we provide a relatively straight-forward, bottom-line, measure of OC and Taser effectiveness. OC spray and/or Tasers were considered effective in two circumstances: First, if OC or a Taser was the *only* type of force that was used in the incident in order to subdue/handcuff the subject, OC or the Taser was considered effective. In these situations, OC spray or the Taser, by itself, led to the legitimate desired outcome; it was effective. Second, if OC or a Taser was the *last* type of force used in the incident prior to the subject being subdued/handcuffed, then OC or the Taser was considered effective. For example, if OC spray was deployed but then some other type of force was necessary in order to gain control over the subject to the point of placing him in handcuffs, then the OC was considered ineffective. OC may, or may not, have had some effect, but ultimately it was not effective in achieving the legitimate objective of the use of force incident—additional force needed to be used.

Of course, one must not lose sight of the possible cumulative effects that various types of force that were used in an incident may have in bringing an incident to an end. Indeed, several of the studies reviewed above simply did not take into account any other types of force that may have been used in the incident. Given the nature of the data analyzed in this study, measuring the precise effect that various forms of force may have had in a use of force incident is difficult, if not impossible. Nevertheless, to the extent possible, and when possible, we consider not only the last type of force used, but all types of force used in the incident. It is also important to highlight that the same criteria are used in measuring the effectiveness of OC and Tasers, providing for an equal ("apples-to-apples") comparison of the effectiveness of the two forms of

force. It is in these ways that an understanding of the relative effectiveness of OC and Tasers can be achieved.

Independent Variables

The independent variables in this study consist of subject characteristics and actions (see Tables 1 and 2 for coding and descriptive statistics). In particular, we focus on: 1) who was the subject? and 2) what did the subject do? Officer characteristics are not included primarily because of the analytic difficulties in doing so.[6] The number of officers who used force in an incident and the number of officers present when force was used were coded and included in the analyses as controls. The number of subjects who had force used upon them was also coded and included as a control.[7]

Data on "who the subject was" (i.e., the characteristics of the subject) were coded according to the supervisor's report. These variables consisted of subject race (white/minority[8]), age, sex, height, and weight.

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[6] Of course, this is a less than optimal solution to the issue; however, previous studies have struggled with the same issue and also resolved it in less than optimal ways. For instance, studies that have included officer characteristics either included only one officer when multiple officers were involved in the incident (Adang et al., 2006; Kaminski et al., 1999), or counted single incidents multiple times if multiple officers used force (White and Ready, 2007). Some studies are unclear about how multiple officer and multiple subject incidents were handled in the analyses (Morabito and Doerner, 1997). Each of these options essentially reduces the complexity of the incidents that are analyzed. None of these options are good, nor is the exclusion of officer characteristics; however, by not including officer characteristics we do not systematically exclude cases. Clearly, there is a trade-off between model error and sample bias.

[7] As noted, in multiple subject incidents, the characteristics of the primary subject, as identified in the police narrative report, were coded and included in the analyses.

[8] Ideally, sub-racial and ethnic groups would be analyzed instead of the "minority" category (Gau et al., 2010). However, too few Hispanics and/or other ethnic/racial group members were included among the incidents. The "minority" group classification consisted of 90% African American subjects (377 out of 419).

Most of the data on "what the subject did" (i.e., how the subject acted) were coded from the narrative reports prepared by supervisory officers and the statements included in the reports. These variables consisted of: whether the subject was mentally disturbed (yes/no), whether the subject was under the influence of drugs or alcohol (yes/no), whether a subject was believed to be armed with a weapon (yes/no), whether a subject was actually armed with a weapon (yes/no),whether a subject fled the police on foot (yes/no), whether a subject assaulted an officer ("yes" if it was stated in the narrative that the subject intentionally hit, kicked, bit, shot, stabbed, or spat upon an officer, "no" otherwise), and the level of resistance offered by the subject (coded on the basis of information provided in the narrative).[9]

RESULTS

Given the purposes of this study, results are organized into two sections: 1) those that relate to the *use* of OC spray and the Taser and 2) those that relate to the *effectiveness* of OC spray and the Taser. We begin with bivariate analyses and multivariate analyses of OC/Taser use and then turn attention to bivariate and multivariate analyses of OC/Taser effectiveness.

The Use of OC Spray and Tasers

How do the 259 incidents where OC spray was used differ from the 245 incidents where a Taser was used? This question was first addressed by calculating statistical differences

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[9] Examples of *passive* resistance included when a subject refused to exit a car, subject went limp, subject refused to move after being ordered to do so, subject refused to show hands after being ordered to do so; examples of *verbal* resistance included when a subject told the officer(s) to leave him/her alone, subject stated he or she will not comply; examples of *defensive* resistance included when subject attempted to or actually fled the police, the subject attempted to hide from the police, subject pulled away from the officer, subject got up after being directed to the ground; examples of *active* resistance included subject fighting with the police, subject lunging at officer, subject attempting to disarm the officer (Terrill and Mastrofski, 2002).

between the variables of interest and OC spray and Taser incidents on the basis of chi-square and t tests (for the sake of space, results are not tabled here). Next, a logistic regression equation was estimated to identify factors that predicted OC spray versus Taser use; these results are shown in Table 3.

In the bivariate analyses, OC spray was significantly more likely than a Taser to be used on minority subjects ($X^2 = 6.82; p < .01$); OC spray and a Taser were equally likely to be used regardless of subject age, sex, weight, or height. A Taser was significantly more likely to be used than OC when the subject appeared to be mentally disturbed ($X^2 = 18.61; p < .01$), was believed to be armed with a weapon ($X^2 = 19.23; p < .01$), when the subject was actually armed with a weapon ($X^2 = 6.52; p < .05$), and when the subject fled the police on foot ($X^2 = 16.14; p < .01$). OC spray and Tasers were equally likely to be used when the subject was believed to be under the influence of alcohol or drugs, when the subject assaulted a police officer, and regardless of the amount of resistance provided to the police. OC was more likely to be used than a Taser when more than one subject had force used upon them in the incident ($t = -2.03; p < .05$); a Taser was more likely to be used than OC when more officers used force in the incident ($t = 2.30; p < .05$) and when more officers were present at the incident ($t = 6.39; p < .01$).

Table 3 shows the results of the logistic regression analyses performed for OC spray and Taser use. Due to substantial missing data, subject height and weight were not included in the equation. Two models were estimated: one compares those incidents where OC was used to those incidents where a Taser was used ("OC Used"), the other compares Taser use to OC use ("Taser Used"). The independent variables identified as significant in the earlier analyses are similar to those identified as significant here. First, all other variables held constant, when the subject was believed to be mentally disturbed, a Taser was more than two times more likely to be

used than OC spray (odds ratio = 3.296; p = .000). Second, when the subject was believed to be armed, a Taser was significantly more likely to be used than OC spray (odds ratio = 1.858; p = .023). Third, when the subject fled the police on foot, a Taser was significantly more likely to be used on the subject than OC spray (odds ratio = 2.452; p = .000). Fourth, when there were more subjects involved, OC spray was nearly 80% more likely to be used than a Taser (odds ratio = 1.794; p = .04). Finally, when there were more officers present at the incident, a Taser was significantly more likely to be used (odds ratio = 1.668; p = .000).

The Effectiveness of OC Spray and Tasers

Before examining the factors associated with the effectiveness of OC and Tasers spray, it is necessary to calculate an effectiveness rate for OC spray and Tasers (see Table 4). Of the 259 incidents where OC spray was used, 63 involved only the use of OC spray. That no other force was needed to subdue the subject can be considered reasonable evidence that OC spray was effective. In the other 196 incidents, OC spray and some other force were used. In these 196 incidents, the order in which force was applied is meaningful. In 128 of these 196 incidents, OC ended the encounter; presumably OC was used to subdue the subject because the force that was applied prior to the OC did not work, or did not appear to be working, at least in the judgment of the officer who deployed the OC spray.[10] There were 68 incidents where OC was deployed during the incident but some other force ended the encounter.[11] To calculate an effectiveness rate of OC spray, the 63 incidents that only involved OC spray and the 128 incidents where OC

[10] Of the 128 incidents, in 125 of them bodily force was used prior to OC spray; in 3 incidents, bodily force and a baton were used prior to OC.

[11] Of the 68 incidents, 63 ended as a result of bodily force, 5 ended with the use of a baton.

was used last are combined (63 + 128) and divided by the total number of incidents in which a OC spray was used (259). This calculation results in a 73.8% effectiveness rate.

Of the 245 incidents where a Taser was used, in 85 of them, only a Taser was used. In the other 160 incidents, a Taser and some other force were used. In 136 of the 160 incidents, a Taser was the last type of force used.[12] In the other 24 incidents, a Taser was deployed first but some other force ended the encounter.[13] To calculate an effectiveness rate of Tasers, the 85 incidents that only involved a Taser and the 136 incidents where a Taser was used last are combined (85 + 136) and divided by the total number of incidents in which a Taser was used (245). This calculation results in a 90.2% effectiveness rate. Using the same parameters for calculating the effectiveness of OC spray and Tasers, it is clear that Tasers demonstrate a substantially higher effectiveness rate than OC.

As demonstrated in prior studies, OC spray and Tasers may be more effective with some subjects than with others. Again, we calculated statistical differences between the variables of interest and OC spray and Taser incidents on the basis of chi-square and *t* tests (results not tabled). Overall, the results showed that the effectiveness of OC and Tasers did not vary significantly by any of the subject demographic variables included: subject race, age, sex, height, or weight. OC spray was significantly less effective when the subject was believed to be armed ($X^2 = 4.67; p < .05$), when the subject assaulted the police ($X^2 = 5.88; p < .05$), and when the subject provided higher levels of resistance ($X^2 = 16.91; p < .01$). As with OC spray, Tasers

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[12] Of the 136 incidents, in 135 of them bodily force was used prior to the Taser; in 1 incident, bodily force and a baton was used prior to a Taser.

[13] Of the 24 incidents, 21 ended as a result of bodily force, 1 ended with the use of a baton, and 2 ended with the use of a firearm.

were less effective with greater subject resistance ($X^2 = 10.78$; $p < .05$). The results also showed that OC spray and Tasers were less likely to be the last type of force used (less likely to be "effective") when more officers used force in the incident ($t = 3.73$; $p < .01$ and $t = 3.29$; $p < .01$, respectively). OC spray and Tasers were also less likely to be the last type of force used when more officers were present during the incident ($t = 3.00$; $p < .01$ and $t = 2.04$; $p < .05$, respectively).

To identify more directly the factors that predict the effectiveness of OC spray and Tasers, two logistic regression equations were estimated: one for OC effectiveness the other for Taser effectiveness (see Table 5). For each model, the comparison was between effective versus not effective. There are two primary findings worthy of discussion based on the logistic regression results. First, while the OC model is significant, the Taser model is not. It appears that the Taser is uniformly effective, regardless of the variables included here. Second, of all the variables examined, the only significant predictor of OC spray effectiveness is subject resistance. With more resistance offered, OC spray was 48% less likely to be effective (odds ratio = .515; p = .027).[14] Apparently, OC spray alone is not enough to subdue a subject who is more resistive.

DISCUSSION

Previous research on the use and effectiveness of OC spray and Tasers is characterized by incomplete and conflicting findings. There are simply too few studies from which to draw conclusions. Varying study sites, comparisons, data sources, and measurement schemes certainly contribute to these conflicting findings. Nevertheless, a basic conclusion of previous research is that OC spray and Tasers are used in different circumstances. This study used

[14] Congruent with Kaminski et al. (1999), in each of the logistic regression models, younger and older subjects (under 22 and over 38) were compared to "middle" aged subjects (22-37). The results of the analyses did not change in any meaningful way.

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Figure 1

Description of "Intervention Options" Used in Study Department

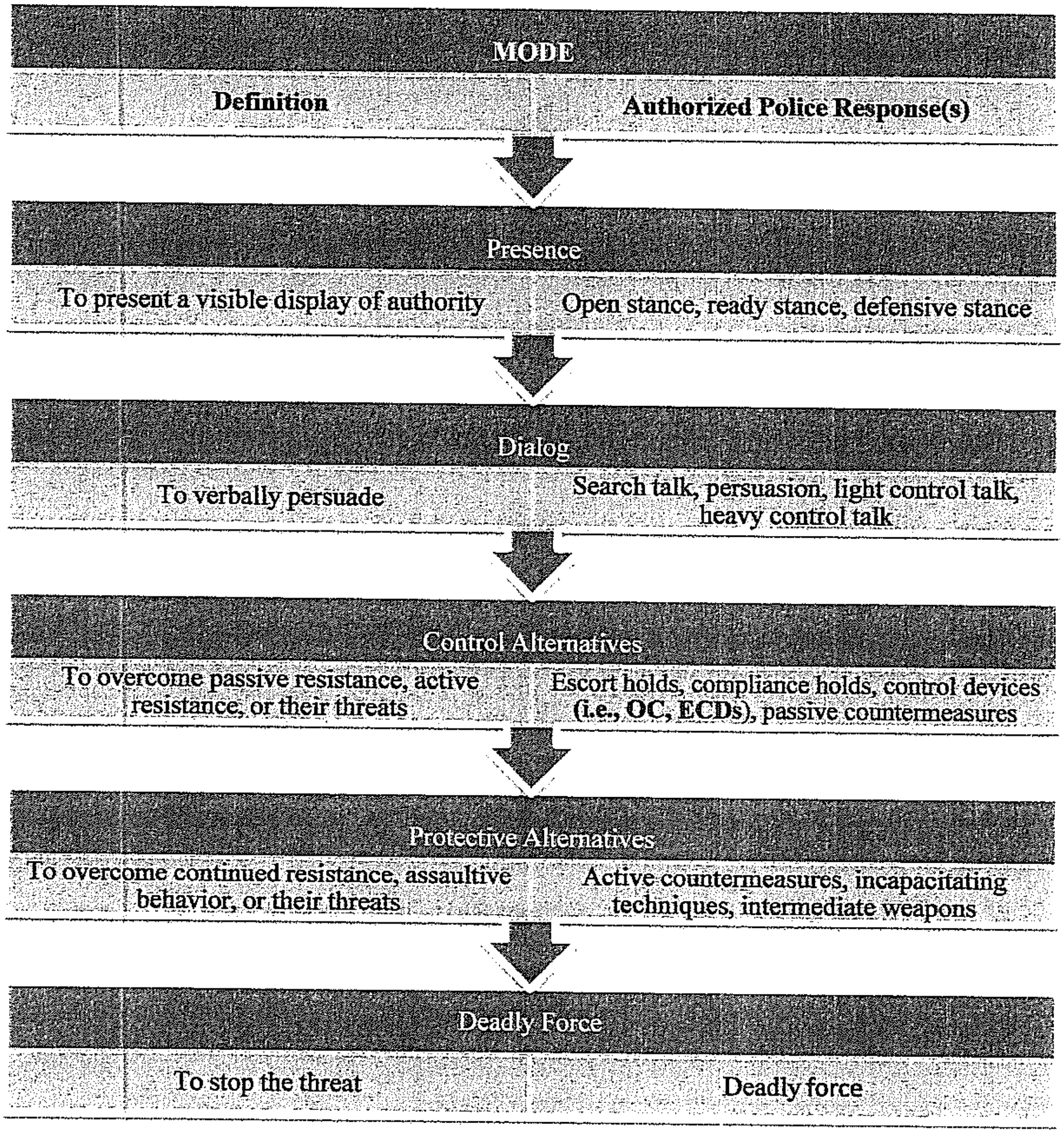

Table 1

OC or Taser Used: Coding and Descriptive Statistics

Variable	Scale	OC Used M	OC Used SD	OC Used N	Taser Used M	Taser Used SD	Taser Used N
Subject Characteristics							
Race	0=minority 1=white	.11	.31	253	.20	.40	241
Age	in years	30.70	11.17	252	30.06	10.65	239
Sex	0=female 1=male	.88	.33	251	.92	.27	240
Height	in inches	69.42	3.28	192	69.81	3.46	186
Weight	in pounds	187.49	40.76	192	188.35	46.91	186
Subject Actions							
Mental Disturbed	0=no 1=yes	.09	.29	259	.23	.42	245
Under Influence	0=no 1=yes	.43	.50	258	.46	.50	244
Believed Armed	0=no 1=yes	.22	.41	259	.40	.49	245
Actually Armed	0=no 1=yes	.08	.28	259	.16	.37	245
Fled Police	0=no 1=yes	.22	.41	259	.38	.49	245
Resistance	0=none 1=passive/verbal 2=defensive 3=active	2.40	.76	258	2.44	.73	245
Assaulted Police	0=no 1=yes	.17	.38	259	.13	.34	245
Controls							
# of Subjects		1.12	.47	259	1.04	.35	245
# of Officers Used Force		1.72	.86	259	1.92	1.12	245
# of Officers Present		2.44	1.16	259	3.37	2.03	245

Table 2

OC or Taser Effective: Coding and Descriptive Statistics

Variable	Scale	OC Effective M	SD	N	Taser Effective M	SD	N
Subject Characteristics							
Race	0=minority 1=white	.12	.32	187	.19	.40	217
Age	in years	30.86	11.47	185	30.02	10.62	215
Sex	0=female 1=male	.86	.35	184	.92	.28	216
Height	in inches	69.29	3.37	140	69.67	3.38	170
Weight	in pounds	184.40	39.78	140	188.05	44.00	170
Subject Actions							
Mental Disturbed	0=no 1=yes	.09	.29	191	.23	.42	221
Under Influence	0=no 1=yes	.42	.50	190	.46	.50	220
Believed Armed	0=no 1=yes	.18	.39	191	.38	.49	221
Actually Armed	0=no 1=yes	.07	.26	191	.15	.36	221
Fled Police	0=no 1=yes	.19	.39	191	.37	.48	221
Resistance	0=none 1=passive/verbal 2=defensive 3=active	2.28	.80	190	2.44	.71	221
Assaulted Police	0=no 1=yes	.14	.34	191	.12	.33	221
Controls							
# of Subjects Force Used Upon		1.14	.49	191	1.04	.37	221
# of Officers Used Force		1.60	.75	191	1.85	1.06	221
# of Officers Present		2.31	1.02	191	3.29	1.92	221

Table 3

Logistic Regression Models of OC or Taser Use

Variable	OC Used B	p	Exp(B)	Taser Used B	p	Exp(B)
	0=no	1=yes		0=no	1=yes	
Subject Race	-.579	.056	.560	.579	.056	1.785
Subject Age	.017	.093	1.017	-.017	.093	.983
Subject Sex	-.076	.836	.927	.076	.836	1.079
Subject Mental Disturbed	-1.193	.000	.303	1.193	.000	3.296
Subject Under Influence	-.316	.150	.729	.316	.150	1.372
Subject Believed Armed	-.619	.023	.538	.619	.023	1.858
Subject Actually Armed	.149	.704	1.160	-.149	.704	.862
Subject Fled Police	-.897	.000	.408	.897	.000	2.452
Subject Resistance	-.199	.207	.819	.199	.207	1.221
Subject Assaulted Police	.527	.079	1.694	-.527	.079	.590
No. of Subjects	.584	.041	1.794	-.584	.041	.558
No. of Officers Used Force	.202	.140	1.224	-.202	.140	.817
No. of Officers Present	-.512	.000	.599	.512	.000	1.668
Constant	1.301	.054	3.673	-1.301	.054	.272
Log likelihood	565.613			565.613		
Model Chi Square	103.617			103.617		
df	13			13		
Significance	.000			.000		
R Squared (Nagelkerke)	.258			.258		
N	483			483		

Notes: B=log odds, p=significance, Exp (B)=odds ratios

Table 4

OC and Taser Effectiveness

OC was Used in 259 incidents (no Taser used)

In 63 incidents only OC used
In 196 incidents OC and other form(s) of force were used

In 128 of the 196 incidents, OC ended the encounter
In 68 of the 196 incidents, another type of force ended encounter
(i.e., bodily force = 63; baton = 5)

63 + 128 = 191 / 259 = OC 73.8% effective rate

Taser was Used in 245 incidents (no OC used)

In 85 incidents only a Taser used
In 160 incidents a Taser and other form(s) of force were used

In 136 of the 160 incidents, a Taser ended the encounter
In 24 of the 160 incidents, another type of force ended encounter
(bodily force = 21; baton = 1; firearm = 2)

85 + 136 = 221 / 245 = Taser 90.2% effective rate

OC and Taser were Used in 24 incidents

In 22 of the 24 incidents, the Taser ended the encounter
In 2 of the 24 incidents, OC ended the encounter

Another Weapon was Used in 45 incidents (no OC or Taser)

In 22 of the 45 incidents, only a firearm was used
In 14 of the 45 incidents, bodily force and a baton were used
In 4 of the 45 incidents, only a baton was used
In 3 of the 45 incidents, bodily force and a firearm were used
In 1 of the 45 incidents, gas and a firearm was used
In 1 of the 45 incidents, bodily force and a flashlight were used

Table 5

Logistic Regression of OC and Taser Effectiveness

Variable	OC Effective 0=no 1=yes B	p	Exp(B)	Taser Effective 0=no 1=yes B	p	Exp(B)
Subject Race	.424	.434	1.528	-.317	.617	.728
Subject Age	.012	.451	1.012	-.014	.557	.986
Subject Sex	-1.433	.076	.239	-.419	.714	.658
Subject Mental Disturbed	-.423	.455	.655	-.001	.999	.999
Subject Under Influence	-.340	.323	.712	.071	.890	1.073
Subject Believed Armed	-.351	.411	.704	-.416	.456	.660
Subject Actually Armed	-.726	.251	.484	-.397	.556	.672
Subject Fled Police	-.265	.483	.767	-.768	.144	.464
Subject Resistance	-.664	.027	.515	.232	.516	1.261
Subject Assaulted Police	-.529	.189	.589	-.754	.255	.470
No. of Subjects	.661	.222	1.037	.657	.697	1.929
No. of Officers Used Force	-.414	.062	.661	-.531	.017	.588
No. of Officers Present	-.174	.286	.840	.000	.998	1.000
Constant	4.651	.001	104.660	3.647	.122	38.343
Log likelihood	244.171			139.531		
Model Chi Square	41.147			15.443		
df	13			13		
Significance	.000			.281		
R Squared (Nagelkerke)	.224			.134		
N	248			235		

Notes: B=log odds, p=significance, Exp(B)=odds ratios

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The Impact of the Taser on Suspect Resistance

Identifying Predictors of Effectiveness

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Despite the Taser's increasing popularity among police agencies, questions have been raised concerning the weapon's use and effectiveness as well as its potential to cause serious injury or death. This article examines all Taser deployments by the New York City Police Department from 2002 to 2005 (N = 375) and uses two multivariate approaches—logistic regression and chi-square automatic interaction detection—to identify predictors of Taser effectiveness, measured as continued suspect resistance and officer satisfaction. Findings indicate that several factors are associated with reduced effectiveness, including suspect body weight (more than 200 pounds), drug and alcohol use, physical violence, and close distance (3 feet or less) between the officer and the suspect. Although this study represents a preliminary effort at identifying predictors of Taser effectiveness, there are clear training and policy implications for police departments.

Keywords: *police use of force; Taser; less-than-lethal weapons; conducted energy device (CED)*

Conducted energy devices (CEDs)—most notably, the Taser—are being adopted and deployed by police agencies on a broad scale across the United States. Taser International, the leading developer of stun device technology, has sold more than 200,000 weapons to more than 9,000 police agencies in the United States (Davis, 2007). The economic trends are perhaps a better indicator of the enormous growth of the Taser; Taser International's revenue grew from approximately \$2.5 million for fiscal year 1999 to an estimated \$67 million in 2004 (McBride & Tedder, 2005).[1] Despite its increasing popularity among police departments and private consumers, questions have been raised concerning the weapon's use and

effectiveness as well as its potential to cause serious injury or death. The following examples illustrate why this topic has become contentious:

- Use: In fall 2005, police officers in Miami used a Taser on a 6-year-old boy who was cutting himself with a piece of glass and on a 12-year-old truant fleeing police.
- Effectiveness: In December 2005, Nashville, Tennessee, police officers used the Taser 19 times on a combative suspect before they were able to take him into custody (Bottoroff, 2005).
- Physiological impact: Amnesty International issued a report in 2004 describing 74 cases in the United States and Canada where a suspect died after being stunned by a Taser. The organization cites these deaths, recent biomedical research, and news reports of incidents involving the questionable use of Tasers to support a moratorium on their use.

Although a growing body of research has examined the physiological effects of the Taser (Ho, Miner, Lakireddy, Bultman, & Heegaard, 2006; Joint Non-Lethal Weapons Human Effects Center of Excellence, 2005; McDonald, Stratbucker, Nerheim, & Brewer, 2005), sparse empirical research has been conducted on the use and effectiveness of the instrument in a field setting. Consequently, our knowledge is largely limited to reports from the CED industry (e.g., Taser International) and police agencies on one side and documents from human rights groups (e.g., Amnesty International and the American Civil Liberties Union) on the other.[2]

This article seeks to add to the scientific knowledge base in this area through an examination of all Taser incidents involving officers in the New York Police Department (NYPD) from 2002 to 2005 ($N = 375$), with an emphasis on identifying predictors of weapon effectiveness. Specifically, the authors use both logistic regression and chi-square automatic interaction detection (CHAID), a form of segmentation modeling, to identify predictors of Taser effectiveness, measured as both the termination of suspect resistance and officer satisfaction with the weapon. The article concludes with a discussion of implications for the ongoing public discourse regarding the Taser as well as for police policy and practice.

Prior Research

Police and the Use of Force

Police officers have legal authority to use force in a wide range of situations, and the nature of this force can entail using empty-hand force and

less lethal weapons (e.g., baton, pepper spray, or CED), depriving an individual of liberty through arrest, and as a last resort, using a firearm to take an individual's life (Walker & Katz, 2002). Bittner (1970) asserts that the capacity to threaten or use physical force is the core function of the police that defines their role and shapes each contact with a citizen or suspect:

> There can be no doubt that this feature of police work is uppermost in the minds of people who solicit police aid or direct the attention of the police to problems, that persons against whom the police proceed have this feature in mind and conduct themselves accordingly, and that every conceivable police intervention projects the message that force may be, and may have to be, used to achieve a desired objective. (p. 40)

Despite its central role in police work, research indicates that police use of force is statistically rare, occurring in only about 1% of all police–citizen encounters (U.S. Bureau of Justice Statistics, 1999).[3] However, because of the sheer volume of police–citizen encounters in a given year (approximately 43 million), an estimated 421,000 use-of-force incidents occur annually, which translates into about 1,100 incidents per day. Rubinstein (1973) clearly illustrates the intrusive, dehumanizing effect that force can have on a citizen:

> [The patrol officer] may not only circumscribe a person's liberty by stopping him on the street, he may also completely violate the suspect's privacy and autonomy by running his hands over the man's entire body. The policeman knows that a frisk is a humiliation people usually accept from him because he can sustain his authority by almost any action he feels necessary. While he does not frisk people often to just humble them, he can do so; when he feels obliged to check someone for a concealed weapon, he is not usually in a position to request their permission, even if this were desirable. (p. 271; see also Skolnick & Fyfe, 1993, p. 94)

The consequences of police use of force can be severe and long lasting, far exceeding the immediate impact on the individual officer and citizen involved. Fyfe (1988) notes that use-of-force incidents have led to civil disorder and riots, the firing of police executives, millions of dollars in litigation, criminal prosecutions, and strained police–community relations. Recent examples include outbreaks of civil disorder in Cincinnati, Ohio, and St. Petersburg, Florida, in the late 1990s as well as the riots after the acquittal of the Los Angeles Police Department officers involved in the Rodney King incident.

Because of the magnitude of this responsibility delegated to the police and its potential consequences, police officers are mandated to use the minimum force necessary to accomplish their objective; force exceeding this minimum standard is considered excessive (Commission on Accreditation for Law Enforcement Agencies, 1999). Police departments closely monitor use of force and provide policy guidelines to officers typically through a "force continuum," which describes verbal and physical actions an officer can take in response to different levels of suspect resistance and behavior. The use-of-force continuum will usually highlight the minimum and maximum recommended force options available to the individual officer. As the subject's resistance or aggression increases, the officer may use greater degrees of force and is allowed to remain one level above the suspect as the interaction progresses (i.e., an officer may be permitted to use a less lethal weapon, such as pepper spray or a CED, in response to physical resistance by a suspect).

The Development of Less Lethal Alternatives

The role of the police in igniting the riots that marked the 1960s led scholars and police practitioners to reevaluate the force options available to patrol officers in responding to varying levels of suspect resistance. Although discussions regarding less lethal alternatives to the firearm date back to the 1920s, the President's Commission on Law Enforcement and the Administration of Justice (1967) brought the issue to the forefront of the policing agenda when it recommended the development and adoption of less lethal alternatives. During the past several decades, advances in technology have led to the development of a range of new alternatives, such as oleoresin capsicum (OC) spray, impact weapons, foams, ballistic rounds, nets, and most recently, CEDs (Wrobeleski & Hess, 2003). These weapons are intended to provide officers with more alternatives when a situation requires the application of force but has not escalated to the point where lethal force is necessary—thereby adding response options to the use-of-force continuum.

During the 1990s, the adoption of OC or pepper spray became commonplace among police agencies, and this trend was accompanied by a sizeable literature on its use, impact, and effectiveness (Smith & Alpert, 2000). The research on OC spray serves as an important backdrop for the current work on CEDs, because many of the same issues and concerns have been raised. Specifically, controversies surrounding the use of OC spray included its use

against passive resisters, disproportionate use against minorities, and potential health risks (Kaminski, Edwards, & Johnson, 1999). A number of studies have examined the effectiveness of OC spray, indicating relatively high rates of suspect incapacitation, reduced officer injuries, and less reliance on other types of force (Gauvin, 1994; Lumb & Friday, 1997; Nowicki, 1993). Using interrupted time-series analysis, Kaminksi, Edwards, and Johnson (1998) concluded that the adoption of OC spray in Baltimore County reduced the number of assaults on police by 15%. Furthermore, Kaminski et al. (1999) found that the effectiveness of OC spray was mitigated by suspect age, weight, distance, and drug use (but not alcohol).

New Technology Emerges: CEDs

For many police agencies, CEDs are more than just the latest novelty in less lethal alternatives; rather, they are becoming what mace was for police departments in the 1960s—an integral tool used in daily police practice. Advantages of CEDs over other less lethal alternatives—such as pepper spray, bean bag guns, and other soft-impact rounds—include the relatively short duration of their recovery time, their reliability at greater distances, their size and utility, and their perceived effectiveness.[4]

Nonetheless, some police departments have been cautious in adopting this technology on a broad scale, and anecdotal evidence suggests that line officers may be reluctant to use the device routinely because of its dubious public image. The Taser, an acronym for Thomas A. Swift Electric Rifle, "is a conducted energy weapon that fires a cartridge with two small probes that stay connected to the weapon by high-voltage, insulated wire" (Wrobeleski & Hess, 2003, p. 87). The M26 and X26 advanced Taser models introduced by Taser International in 1999 and 2003, respectively, are the two common "new generation" CEDs used by police agencies. These weapons discharge two darts to a distance of 21 feet, delivering a 50,000-volt shock in a 5-second cycle. The electrical charge overrides the central nervous system, resulting in the loss of neuromuscular control, which gives the officer time to gain control of the suspect and apply handcuffs, if necessary.

Questions Surrounding the Taser

The controversy regarding the Taser has occurred in the public domain and has been widely publicized. News reports describing incidents in which police officers used the weapon against the elderly, children, and the mentally ill have made national headlines. Favorable and unfavorable

media images of police practices have been competing for public attention and serve as the backdrop against which the Taser is being assessed by the public and government officials (Lovell, 2003). Currently, empirical research is not driving the debate. This is unsettling, considering that mainstream media depictions of the police are often inaccurate or unrealistic (Ian Ross, 2000; Manning, 1977, 1997). The controversy regarding the Taser came to a head in 2004 when Amnesty International issued its report:

> In its recommendations . . . *Amnesty International* is reiterating its call on federal, state and local authorities and law enforcement agencies to suspend all transfers and use of electro-shock weapons, pending an urgent rigorous, independent and impartial inquiry into their use and effects. (Amnesty International, 2004, p. 3).

The conclusions of the Amnesty International report underscored the controversy and ongoing debate between CED manufacturers and human rights organizations about the expanded use of CEDs among police agencies in the United States. The organizations' concerns focused on fatalities occurring after Taser deployment as well as the potential for abuse by police and its use as a routine force option. CED manufacturers argue, however, that the device is a safe alternative to other less lethal weapons that reduces injuries to officers and suspects. More generally, concerns about CEDs have emerged in three critical areas. Each is discussed below.

When is it appropriate to use the device? No consensus exists among police agencies regarding where the Taser should be placed on the force continuum (U.S. Government Accountability Office, 2005). Should CEDs be placed at the same level as pepper spray, or are they more appropriate farther down the use-of-force continuum as a last alternative to the firearm? Should they be used against suspects who are passively resisting an officer (e.g., ignoring verbal commands) or only against individuals who are actively resisting arrest? Is there any justification for using the Taser against a minor, a senior citizen, or a pregnant woman? Police departments have varied considerably in their responses to these questions, and both the International Association of Chiefs of Police (IACP; 2005) and the Police Executive Research Forum (PERF; 2005) have taken action recently by developing training guidelines and model policies to offer guidance to agencies in their deployment of CEDs. For example, both the IACP and PERF suggest that CEDs only be used against those who are actively resisting, that they not be used against children or the elderly except

in emergency situations, and that each deployment is closely supervised and documented.

Does it work effectively? Since January 2000, *The New York Times* has printed nearly 200 news stories describing incidents in which officers across the United States have used the Taser to control or subdue a suspect. A review of these articles reveals an abundance of cases in which the Taser appears not to have the intended physiological effect on a suspect. In some cases, one or both of the prongs missed the target, or the prongs hit the target but failed to penetrate the suspect's clothing. To date, much of the academic research on the effectiveness of CEDs has relied on field reports completed by officers after deploying the weapon, which measure whether the CED functioned properly, enabling the officer to incapacitate or arrest the subject. Field data analyzed by Taser International (2006) and internal evaluations conducted by police agencies (see, e.g., Seattle Police Department, 2004) place the effectiveness rate of the Taser somewhere between 80% and 94%, but there is sparse independent empirical research studying the effectiveness of the device. White and Ready (2007) calculated an effectiveness rating by examining the impact of the Taser on suspect resistance. They found that use of the weapon caused suspects to stop resisting in 86% of all Taser deployments by the study department.

Several police agencies that have implemented CEDs on a broad scale have later reported reductions in injuries sustained during police–citizen contacts. Police departments in Austin, Texas; Putnam County, Florida; and Cincinnati, Ohio, experienced reductions in injuries to both suspects and officers after adopting the Taser (see Putnam County Sheriff's Office, 2005; Taser International, 2006). Although these trends are noteworthy, questions remain concerning the extent to which the Taser contributed to these reductions. Retrospective analysis of injury trends may not account for other variables (e.g., more training, crime trends, new leadership, etc.) that influence yearly injuries sustained during police–citizen encounters. At present, there are no national-level baseline data concerning the number of police agencies that have reported reductions in injuries after adopting the Taser as compared to the number of agencies that have not reported reductions. The degree to which the device is used effectively depends less on the physiological effects of the technology than on the policy guidelines and field training that departments apply to reinforce accepted standards of use.

Proponents in the law enforcement community claim that the Taser can serve as a substitute for lethal force and other forms of less lethal force (e.g., baton) that may result in serious injury or death (Heck, 2003;

McBride & Tedder, 2005; U.S. Bureau of Justice Statistics, 1999). This is an empirical question that has not been tested, and any practical benefits must be balanced against the potentially harmful physiological effects of the device.

What is its impact on the likelihood of serious injury or death to a suspect? As noted earlier, Amnesty International called for a moratorium on police use of the Taser in late 2004, citing 74 deaths that occurred in North America following deployment of the weapon. Although there is no evidence of a direct causal link between use of the Taser and elevated risk of serious injury or death, a review of the Amnesty International report suggests that the risk of death may be greater for those with preexisting medical conditions (particularly heart conditions) as well as those under the influence of drugs or alcohol. Recent studies supported by the federal government have tested the physiological effects of CEDs on healthy adult volunteers (a sample that may be very different than suspects targeted by police officers) and have concluded that no decisive evidence of ventricular fibrillation or other serious medical side effects exists (Ho et al., 2006; Joint Non-Lethal Weapons Human Effects Center of Excellence, 2005; McDonald et al., 2005). The Canadian Police Research Centre (2005) conducted an exhaustive review of existing research and concluded that "definitive research or evidence does not exist that implicates a causal relationship between the use of CEDs and death" (p. ii).

In sum, despite the growing popularity of CEDs in American policing, researchers have failed to keep pace with the diffusion of this rapidly spreading technology. A developing body of scientific research has begun to address the research question relating to the potential for the Taser to cause serious injury or death, but the questions concerning when it is appropriate to deploy the weapon (and against whom) and its degree of effectiveness remain largely unanswered. Guidelines outlined by PERF and IACP have played a critical role in clarifying some of the important issues for police administrators. This article seeks to inform the use and effectiveness dialogue by shifting the emphasis toward prediction; that is, under what circumstances and against what types of suspect behavior is the Taser most likely to be effective? In other words, what are the characteristics of police officers and suspects and incident-related circumstances that increase or reduce the odds that police use of the CED will result in a successful resolution?

Method

NYPD and the Taser

This article examines all Taser incidents involving police officers from the NYPD from January 2002 through December 2005 (N = 375). The NYPD is cautious in its approach to the deployment of Tasers, and its use is closely monitored. The Taser is issued only to officers in the Emergency Service Unit (ESU). The ESU is responsible for situations that require advanced equipment and expertise, such as crisis situations involving the mentally ill, hostages, and suicidal suspects. The unit consists of several hundred officers, which is a relatively small proportion of the 35,000 sworn NYPD officers. Also, supervisors at the rank of sergeant and above are trained to use the Taser, and each precinct is equipped with one or more devices that can be signed out, though they are not required to carry it. The patrol guide details fairly specific circumstances in which it is appropriate to use the device:

> Patrol supervisors or uniformed members of the service assigned to the Emergency Services Unit may utilize a Taser/electronic stun device to assist in restraining emotionally disturbed persons if necessary. The Taser/electronic stun device may be used:
>
> a. To restrain an EDP [emotionally disturbed person] who is evincing behavior that might result in physical injury to himself or others, OR
> b. To restrain person(s) who, through the use of drugs, alcohol, or other mind-altering substances, are evincing behavior that might result in physical injury to himself or others.
>
> Emergency Service Unit personnel will obtain the permission of the Emergency Service Unit Supervisor prior to utilizing a Taser/electronic stun device, except in emergencies. (NYPD, 2000)

As a result, deployment of the Taser is allowed only in situations involving an EDP or person under the influence of drugs or alcohol who is posing a threat of physical injury where either ESU officers are dispatched or a supervisor is present and has a Taser in his or her possession.[5]

The data analyzed for the current study are derived from a "Taser/stun device report," which is completed every time an officer deploys the weapon.[6] The report contains a series of questions that use check boxes to elicit a range of information about demographic characteristics of the suspect, his or her emotional and physical state, behavior and level of resistance,

weapons present, the rank and assignment of the officer, and characteristics of Taser deployment (e.g., distance, effect, etc.). Most items on the report are formatted as multiple-choice questions, with an additional narrative section where the officer is required to describe the incident in detail. From these reports, the authors created a data set in SPSS that captures 40 variables relating to each Taser incident. These independent variables serve as predictors of Taser effectiveness for the multivariate analysis. Though the research was admittedly limited by the information collected on the Taser/stun device report, the authors note the earlier work conducted by Kaminski et al. (1999), which employed a similar design and analysis, with similar variables, for an evaluation of the effectiveness of OC spray.

The Dependent Variable: Measuring Effectiveness

The dependent variables used in the study include three separate but related measures of effectiveness. The first two measures of effectiveness are based on the extent of suspect resistance. Specifically, the field report contains several items that measure whether suspect resistance ended after the Taser was deployed and notes how much time transpired (in seconds) before the suspect was incapacitated. A follow-up item requires the responding officer to indicate whether the suspect was incapacitated at all. The average time to incapacitation was 8.10 seconds, but this measure should be viewed with caution. It is likely that officers at the scene were far more concerned about bringing the suspect under physical control than counting the number of seconds needed to terminate the struggle and apply handcuffs. For this reason, we will focus on the dichotomous measures of resistance for the analysis.

In one third of the cases (33.0%), the suspect continued resisting against the officer after the Taser was deployed. The cases involving continued resistance can be divided into two categories based on the nature and duration of the resistance. In 32 cases, the resistance continued immediately following the Taser deployment because the suspect was not restrained by the weapon; that is, at no point was the subject subdued, and he or she continued to resist (*continual resistance*). The Taser was clearly ineffective during these incidents, perhaps because of loose or heavy clothing blocking the darts from making full contact, mechanical failure, or resilience on the part of the suspect. In the other 65 cases involving continued resistance, the subject was initially incapacitated by the Taser and the officer(s) gained control temporarily; however, the suspect began resisting again at a subsequent

point in time (*any resistance*). The distinction between these two different outcomes draws attention to the temporary impact of the Taser (i.e., the involuntary loss of muscle control is not long term) and shows the importance of carefully observing the suspect's actions immediately after the Taser is deployed. Because of the practical importance of this distinction in resistance, both measures are used as dependent variables in the analysis. The base rates for any subsequent resistance and continual resistance are 33.0% and 10.9%, respectively.[7]

At the end of the Taser/stun device report, the officer is instructed to indicate whether the device performed satisfactorily (yes or no). Police officers' responses to this question serve as the third measure of Taser effectiveness. Officers reported that the Taser performed satisfactorily during 78.7% of the cases. Officer satisfaction is likely related to a host of factors, including the physiological effect on the suspect and the outcome of the deployment taken as a whole. Did the Taser discharge as intended? Did both prongs strike the target, and if so, did they penetrate the suspects' clothing? Did the suspect stop resisting the officer and was he or she subsequently taken into custody? Finally, was anyone seriously injured during the altercation?

Data Analysis

The authors employed two analytic approaches, logistic regression and CHAID (a form of segmentation modeling), to identify predictors of Taser effectiveness. Descriptive analyses were conducted to identify significant relationships at the bivariate level. The bivariate findings, theory, and practical expectations directed the identification of predictors for the multivariate analysis, though all variables were included in the multivariate analysis. Logistic regression is employed because all three measures of effectiveness are dichotomous outcomes with yes-or-no responses. Similar to logistic regression, CHAID predicts the probability of an event's occurring, but the method relies on different assumptions and properties and uses segmentation modeling to accomplish the task. CHAID divides a population into "increasingly homogenous" segments that differ on the basis of the dependent variable; in this case, suspect resistance and officer satisfaction (Jones, Harris, Fader, & Grubstein, 2001, p. 490). The resulting segments are mutually exclusive and exhaustive, and as the analysis proceeds, the best predictor is selected among a particular subgroup of cases based on chi-square analysis.

CHAID analysis is employed in this study because it offers a number of advantages. First, "one significant advantage of this approach is that the model can find different combinations of predictors for different subsets of the population" (Jones et al., 2001, p. 490). This is especially useful if there is reason to suspect that predictors may differ in their impact among subgroups. For example, predictors of suspect resistance may be different for intoxicated and sober suspects, and CHAID facilitates the identification and exploration of these interactions. Second, Jones et al. (2001) point out that numerous studies have examined statistical issues in risk prediction (Gottfredson, 1987; Simon, 1971; Tarling & Perry, 1985), including the use of CHAID and more traditional methods such as logistic regression, and the general consensus is that "no method is consistently better than any other" (Tarling & Perry, 1985, p. 212). With this conclusion in mind, multiple methods allow researchers to either "triangulate" their findings or identify inconsistencies across techniques. Last, an additional benefit of CHAID is the user-friendly visual representation of variables that interact to produce an outcome; in this case, the technique highlights the important situational dynamics of Taser incidents—and how those dynamics relate to outcomes—in a more interpretable manner for practitioners and policy makers.

Limitations and Considerations

Several limitations of this study should be considered. First, the article examines official reports from one police department that has deployed the Taser in a controlled, limited manner. This impairs the generalizability of the findings to other police departments, particularly, those agencies that have issued the Taser to all patrol officers.[8] Second, this study examines only Taser incidents that generated an official police report. There is no indication that officers are not completing the Taser field report on a systematic basis, especially considering that the device tracks each deployment electronically; however, it is possible that some incidents did not result in a report. Third, anecdotal evidence provides some support for a deterrent effect when the Taser is exposed to a potential subject but not used; that is, much like the firearm, suspects may become compliant when confronted with the imminent possibility of being stunned with the Taser. Researchers and police practitioners would consider this type of incident as a successful de-escalation, but these situations are not captured in the data because the NYPD requires a field report after discharge only.

Results

Descriptive Analysis of Taser Incidents

Suspect characteristics. Suspects targeted in the Taser incidents were primarily male (88.8%) with a mean age of 34.9; more than half were African American (52.1%), 18.7% were White, and 27.3% were Hispanic (see Table 1). Most of the suspects did not appear under the influence of drugs or alcohol (87.2%), but the majority exhibited signs of mental illness (92.5%) and were therefore identified by the responding officers as EDPs.[9] About 40% of the subjects were armed with a weapon (39.6%), most commonly, a kitchen knife or cutting instrument (84% of armed suspects, 32% of all cases).[10] The vast majority of suspects (95%) engaged in physical violence. The violent behavior was directed at an officer during more than half of the incidents (53.3%), one fifth involved a threat of suicide or self-harm (18.6%), and the remaining violent individuals (18.9%) directed their aggression toward multiple individuals at the scene.

Officer characteristics. The Taser/stun device report captures limited information regarding the officer who deploys the weapon. More than half of the officers who used the device were detectives (55.5%), and 41.2% were patrol officers. Just 3.2% were supervisors. More than 90% of the officers were assigned to the ESU. In the majority of cases, the officer deploying the Taser was not alone. One or more back-up officers were present during nearly all of the incidents (93.5%), and a supervisor was present in 88.1% of the cases.[11]

At the bivariate level, there are notable differences in officer rank with regard to the outcomes of interest: satisfaction and suspect resistance. During the study period, 12 cases involved supervisors who were not assigned to the ESU (i.e., patrol sergeants). The effectiveness ratings from these supervisors are significantly lower than the ratings from the ESU officers: Any suspect resistance was reported by 54.5% of the supervisors, compared to 26.7% of police officers and 36.3% of detectives; 20.0% of the supervisors reported resistance immediately after the Taser was used, compared to 7.6% of police officers and 12.0% of detectives; and 41.7% of the supervisors reported being satisfied with the Taser, compared to 81.7% of police officers and 79.4% of detectives.[12] These findings may have implications for the NYPD, because supervisors outside of the ESU receive less training in use of the Taser and may also be using an older model of the device.

Table 1
Characteristics of Suspects and Officers Involved in Taser Deployments

	Percentage	n
Suspect characteristics		
Gender		
Male	88.8	332
Female	11.2	42
Total	100.0	374
Racial background		
African American	52.1	189
White	18.7	68
Hispanic	27.3	99
Asian or Other	1.9	7
Total	100.0	363
Mean age = 34.9 years		332
Emotionally disturbed		
No	7.5	28
Yes	92.5	347
Total	100.0	375
Intoxicated		
No	87.2	321
Drugs	7.1	26
Alcohol	4.3	16
Both drugs and alcohol	1.4	5
Total	100.0	368
Armed with a weapon		
No	60.4	217
Yes	39.6	142
Total	100.0	359
Violent behavior		
No	5.2	19
Toward self	18.6	68
Toward officer	53.3	195
Toward other citizens	4.1	15
Toward multiple	18.9	69
Total	100.0	366
Officer characteristics		
Rank		
Patrol officer	41.2	153
Detective	55.5	206
Supervisor	3.2	12
Total	100.0	371
Command		
Emergency Service Unit	91.2	321
Other	8.8	31
Total	100.0	352
Back-up present		
No	6.5	22
Yes	93.5	318
Total	100.0	340
Supervisor Present		
No	11.9	42
Yes	88.1	310
Total	100.0	352

Note: Total numbers are different because of missing data. In some of the study cases, information for one or more variables was missing, and the tables reflect known information only.

Incident characteristics. More than three quarters of the incidents occurred indoors (see Table 2). Per department policy, the majority of suspects (95.6%) were transported to a hospital for a physical examination following the incident. Interestingly, three quarters of the subjects (75.9%) were not arrested after the incident, although many of them were held at the hospital for psychological examination and/or civil commitment. The average distance between the officer and the suspect at the time of deployment is approximately 5.5 feet. In 80.7% of the incidents, the Taser was deployed only once by the officer, and in nearly 80% of the cases, both darts made contact with the suspect as intended. Officers used the device in stun mode in 48 incidents (direct contact to skin, no darts).[13] In 22% of the cases, officers also used another nonlethal device, most typically another type of stun device (14%) or pepper spray (5%). In 86% of the cases, a supervisor indicated that use of the Taser was consistent with departmental policy.[14] Findings with regard to officer satisfaction and suspect resistance—the dependent variables for the multivariate analysis—have been summarized above.

Multivariate Analysis

Logistic regression analysis. Table 3 displays the results of the logistic regression models predicting the three measures of Taser effectiveness. The table provides the logistic regression coefficients, standard errors, and odds ratios for the independent variables in each of the models. The likelihood ratio test for each of the models was statistically significant, and Nagelkerke R^2 estimates suggest that the models predicting any subsequent suspect resistance, resistance immediately after use of the Taser, and officer satisfaction accounted for 23%, 13%, and 21% of the explained variation, respectively.[15] In the first model, statistically significant predictors of any suspect resistance include the following:

- The suspect's body weight is greater than 200 pounds.
- Distance between the officer and the suspect is 3 feet or less.
- The suspect is under the influence of drugs or alcohol.
- The suspect directs violence toward an officer or citizen (as opposed to oneself).
- One or both Taser darts missed the intended target.
- The officer used another nonlethal device before or after using the Taser.[16]

Specifically, when one or both Taser darts miss the suspect, the likelihood of any suspect resistance increases by about 300%. Three predictors—violence directed at an officer or citizen, drug or alcohol intoxication, and

Oleoresin Capsicum Spray and Tasers:

A Comparison of Factors Predicting Use and Effectiveness

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Oleoresin Capsicum Spray and Tasers:

A Comparison of Factors Predicting Use and Effectiveness

ABSTRACT

In the last few decades, several less-lethal forms of force have been introduced, adopted, and deployed by police agencies. Oleoresin capsicum spray is now used in nearly every department across the United States; the Taser is used in the majority of police departments. Despite their widespread use, we still know relatively little about the factors associated with the use of OC spray and Tasers and the effectiveness of these weapons in incapacitating subjects. This paper contributes to that discussion by analyzing 504 use-of-force incidents where the police used OC spray or Tasers during the event. Data were obtained from a large municipal police department on incidents that occurred in 2010 and 2011. Policy implications and directions for further research are discussed.

INTRODUCTION

A fundamental but controversial function of the police is their ability to use coercive force (Bittner, 1970; Klockars, 1985). Force is most likely to be used by the police in situations where they are confronted with non-compliant subjects (Reiss, 1971; Terrill & Mastrofski, 2002). In such situations, police officers have several options. At one end of the spectrum, beyond verbal commands and threats, officers may use bodily force (e.g., decentralizations, focused strikes). Bodily force alone is the most common form of physical force used by police officers (Adams, 1999). At the other end of the spectrum, officers may use their firearms. The use of firearms is considered a last resort; it is only to be used to defend human life. In between bodily force and deadly force, there are several "less-than-lethal" or "less-lethal" options.

In the last few decades, several less-lethal forms of force have been introduced, adopted, and deployed by police agencies. Today, nearly all local departments authorize the use of one or more less-lethal weapons (Reaves, 2010). The most common less-lethal weapon is pepper spray, authorized by 97% of all local departments (Reaves, 2010). Conducted Energy Devices (CEDs)[1], including Tasers[2] and stun guns, are authorized by 60% of all local police agencies (Reaves, 2010). While the number of departments authorizing pepper spray is not much higher than in the year 2000 (91%; Hickman & Reaves, 2003), the number of local police departments that authorize the use of CEDs has dramatically increased since 2000, when just 7% authorized them (Reaves, 2010).

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[1] CEDs are sometimes also known as Electronic Control Devices (ECDs), Conducted Electrical Weapons (CEWs), or Conducted Energy Weapons (CEWs).

[2] The Taser (short for the Thomas A. Swift Electric Rifle) is currently the most popular CED on the market. It is also the CED used by the department in this study. As such, we use the term "Taser" rather than the more general "CED" throughout this paper.

In response to the greater prevalence and use of less-lethal weapons, particularly OC spray and Tasers, a substantial amount of research has been conducted on issues related to them. For instance, researchers have analyzed the frequency with which different types of force are used before, during, and after OC spray or Tasers are introduced in departments (e.g., Lin & Jones, 2010; Lumb & Friday, 1997). Studies have examined the factors associated with the use of OC spray (Morabito & Doerner, 1997) and Tasers (Crow & Adrion, 2011; Gau, Mosher, & Pratt, 2010) as well as officer and citizen injuries associated with their use (e.g., Terrill & Paoline, 2011; Kaminski et al., 2013; Paoline, Terrill, & Ingram, 2012; Kaminski et al., 1999; Smith et al., 2007). Finally, researchers have examined the effectiveness of OC spray (Morabito & Doerner, 1997; Kaminski, Edwards, & Johnson, 1999; Adang et al., 2006) and Tasers (White & Ready, 2010; White & Ready, 2007), defining effectiveness in terms of their ability to induce subject compliance.

While this research has advanced our understanding of the benefits and limitations of OC spray and Tasers, we still know relatively little about the factors associated with the use of OC spray and Tasers and the effectiveness of these weapons in incapacitating subjects. In particular, there are no studies to date that directly compare the use and relative effectiveness of OC spray and the Taser within the same jurisdiction during the same time frame.[3] Some studies examine OC spray, while others examine Tasers. It is difficult, if not impossible, to draw definitive conclusions about the use and relative effectiveness of OC spray and Tasers on the basis of studies that do not include both OC spray and Taser incidents, do not compare OC spray with Tasers, that use different sampling procedures and measurements schemes for critical variables,

[3] An exception is a study performed by TASER International (as cited in White and Ready, 2007). In this study, the effectiveness of the OC spray and the Taser were compared, but only when both were used in the same incident. In these encounters, OC spray was effective 33% of the time while the TASER was effective in 83% of cases (Taser International, 2002).

and that were conducted in different police departments with different use-of-force policies and continuums. As such, we do not know whether Tasers are significantly more (or less) effective than OC spray in similar situations, or whether different factors predict their use and effectiveness. This study examines the factors that predict the use and effectiveness of OC spray (N= 259) and Tasers (N=245) in a single large municipal police department. Data were obtained from official use-of-force reports of the police department on incidents that occurred in 2010 and 2011.

LITERATURE REVIEW

Police use of force, defined as "acts that threaten or inflict physical harm on suspects" (Terrill, 2003, p. 56), has been an important and constant topic of research since the 1970s. This attention is warranted for theoretical and practical reasons. Theoretically, research on police use of force is important because it involves the defining characteristic of policing. In large part, an understanding of the complexities and dilemmas of police work depends on an understanding of police use of force. Practically speaking, research on the control of police use of force is important in that use of force can have devastating—and deadly—consequences. As such, it can dramatically affect police-community relations, public cooperation with the police, and the legitimacy of the police more generally.

Due to the potentially serious consequences of police use of force, police officers are constrained in their ability to use it. Along with legal (*Graham v. Connor*, 490 U.S. 386 1989) and accreditation standards (Commission on Accreditation for Law Enforcement Agencies, 1999), the majority of police departments guide officer behavior with a "continuum of force" or "force continuum" (Terrill & Paoline, 2012). Most often, officers are to base force decisions on

the level of suspect resistance or aggression; force is only escalated to the next level when less forceful actions fail to induce suspect compliance. While OC spray and Tasers are usually placed at the same level on force continuums (Alpert et al., 2011; IACP, 2005), there is little agreement between and among departments where they should be placed. In some departments, OC spray and the Tasers are placed at the lower end of the continuum, authorizing their use against passive resisters; other departments place them closer to lethal force on the continuum, authorizing their use only against active resisters. Where OC spray and Tasers are located on the continuum of force matters when understanding the circumstances in which the weapons are used (Crow & Adrion, 2011; Morabito & Doerner, 1997). In turn, the circumstances in which OC spray and Tasers are used may have implications for their effectiveness in inducing compliance among subjects.

OC SPRAY AND TASERS

Oleoresin capsicum (OC) spray, otherwise known as pepper spray, was introduced to law enforcement in the 1980s. OC is an inflammatory agent naturally found in cayenne peppers. When a person is sprayed with OC spray, the effects are immediate: the respiratory tract becomes inflamed, the individual experiences an intense burning sensation and swelling around the eyes, and the subject's eyes close involuntarily (Lumb & Friday, 1997). Although the subject may be in extreme discomfort, he or she may still be able to resist. Ideally though, the effects of OC spray render a resistive suspect passive and compliant, and the officer is able to take the suspect into custody without further incident.

Once introduced, OC spray immediately demonstrated advantages over other forms of force. The effects of OC spray, while immediate and dramatic, were more temporary than other

forms of chemical gasses used previously (Lumb & Friday, 1997). OC spray proved more effective on intoxicated individuals than mace, and was less prone to secondary contamination (White & Ready, 2007). Finally, OC spray was less likely to cause injury than bodily force, batons, and flashlights (Lumb & Friday, 1997). As summarized by Lumb & Friday (1997):

> ...OC spray is an effective alternative to the more harmful types of weapons available to police. OC causes almost instantaneous incapacitation and leaves no long term residual effects. It allows the officer to stay away from the suspect when affecting a custodial arrest that is being resisted, and there are few problems associated with transporting the person, as OC spray residue dissipates fairly quickly (p. 138).

Today, while OC spray is standard issue in police departments, CEDs, such as the Taser and other stun devices, are still gaining popularity. First introduced in the 1990s, the Taser is a 50,000 volt, 26-watt weapon that uses nitrogen cartridges to fire its probes. Once the probes attach to the suspect, the Taser delivers an electrical current which overrides the central nervous system, causing involuntary muscle contractions and incapacitation (Alpert et al., 2011; Means & Edwards, 2005).

The Taser has advantages over other less-lethal alternatives including their greater reliability at longer distances, the relatively quick recovery time involved, and their perceived effectiveness in inducing suspect compliance (White & Ready 2010). In addition, because Tasers do not rely on pain to induce compliance, ideally they should be more effective on persons who have a higher tolerance of pain, such as people under the influence of drugs or alcohol or who have a mental illness (Means & Edwards, 2005).

Despite their popularity and advantages, OC spray and Tasers are not without controversy. One concern relates to their safety. In the late 1980s and early 1990s, OC spray was claimed to have caused several in-custody deaths (ACLU of Southern California, 1993; Alpert et al., 2011). Twenty years later, the Taser was also alleged to be a proximate cause of in-

custody deaths (Alpert et al., 2011; White & Ready, 2007). Research has shown that most deaths involving OC spray were instead the result of positional asphyxia, pre-existing health conditions, or were drug-related (Granfield, Onnen, & Petty, 1994; Petty, 2004). With regard to Tasers, it has been demonstrated that the risk of death when a Taser is used is less than 0.25 percent (NIJ, 2011), and in those situations the death is likely to be a result of drug intoxication, preexisting heart conditions, and exposure to other forms of nonlethal police force (White & Ready, 2007).

Another concern relates to police overuse of OC spray and Tasers (Alpert et al., 2011). For instance, members of the ACLU and Amnesty International have voiced concern that OC spray and Tasers are used in a disparate fashion against members of minority groups (ACLU of Southern California, 1993; Amnesty International, 2006). A related concern is that police have authorized their use too low on continuums of force and consequently are using them against passive (versus active) resisters (Terrill & Mastrofski, 2002). Finally, there are concerns about the use of OC spray and Tasers with the elderly, children, pregnant women, and persons with medical conditions that put them at greater risk of experiencing dangerous medical side effects (Amnesty International, 2006; Sloane & Vilke, 2006).

A final concern has to do with manufacturer exaggeration of the capabilities and effectiveness of OC spray and Tasers in incapacitating subjects, which, in part, may have contributed to their widespread adoption in police departments. Some early studies reported "effectiveness rates" as high as 100% for OC spray (as cited in Adang et al., 2006) and 94% for the Taser (as cited in White & Ready, 2010). Objective empirical research on the effectiveness of these devices remains rather sparse. Of the independent studies that do exist, effectiveness rates have not been found to be as high as those originally reported by the manufacturers. For

instance, and as discussed below, Kaminski et al. (1999) found an effectiveness rate of 71% for OC spray. White and Ready (2010) found an effectiveness rate of 85% for the Taser.

RESEARCH ON THE USE AND EFFECTIVENESS OF OC SPRAY AND TASERS

While research appears to have ameliorated concerns about OC spray and Tasers causing serious injury and death, there remain concerns about their use and effectiveness. In response, there has been a growing body of literature that examines the use and effectiveness of these weapons. Given the objectives of the current study, we review here the studies that examine the factors associated with the *use* of OC spray and Tasers and the *effectiveness* of OC spray and Tasers (with effectiveness defined in terms their ability to facilitate the arrests of resisting subjects).

The Use of OC Spray

Morabito and Doerner (1997) analyzed OC spray use-of-force reports from the Tallahassee Police Department. They examined characteristics of officers and suspects that were associated with the use of OC spray at two points in time: prior to and after a change in the circumstances in which OC spray was authorized in the department. At Time 1, OC spray was only authorized in cases when the suspect was actively physically resisting police. At Time 2, the threshold for the use of OC spray was reduced from active physical resistance to verbal/passive physical resistance. At Time 1, OC spray use was compared to impact weapons such as batons, flashlights, and stun guns. At Time 2, OC spray use was compared to the use of soft hand techniques (punches, kicks, and pain compliance techniques). The officer characteristics of interest included race, gender, education and experience. Suspect variables

included race, gender, height and weight (relative to the officer's height and weight), suspect intoxication, and whether the suspect was armed or attacked the officer. While none of the predictor variables were significant at Time 1, several factors were associated with OC spray use at Time 2. At Time 2, male, educated, and veteran officers were more likely to use OC spray than soft hand techniques. OC spray was also more likely to be used than soft hand techniques when the suspect was heavier and taller than the officer and when the suspect was armed.

The Use of Tasers

Gau, Mosher, and Pratt (2010) analyzed case file data on Tasers and other types of force used by officers in a state patrol agency from 2005 to 2007. The authors were primarily interested in examining possible racial disparities in the use of a Tasers on subjects. Tasers were used in nearly one-half of all use-of-force incidents. They found that compared to other forms of force, Tasers were equally likely to be used on white, Hispanic, and Black subjects; although when a Taser was used, Hispanic subjects were more likely than White subjects to have a Taser be the first type of force used. The authors also found that females were less likely to be "tased" than males, and that subjects who actively resisted and who were assaultive were *less* likely to be tased than subjects who passively resisted. Finally, white officers were significantly less likely to use a Taser than officers of other races.

Crow and Adrion (2011) analyzed 461 use-of-force incidents (reports) that occurred between 2004 and 2010 in a medium-sized municipal police department. The authors compared incidents where a Taser was used and incidents where "other" types of force were used (takedowns, physical force, pepper foam, impact weapons, police dog, use of a vehicle as a weapon, and firearms). The authors found that a Taser was *less* likely to be used than other forms

of force when subjects physically resisted and when resistance involved a weapon. A Taser was equally likely to be used when resistance was in the form of "presence," "flight," and "verbal" (meanings unspecified). A Taser was more likely to be used than other forms of force on non-white and male subjects. Older officers were significantly more likely to use Tasers. A policy change to restrict the use of Tasers also had its intended affect; after the policy change, Tasers were less likely to be deployed. Call type, time of day of the incident, officer sex, race, age, and rank did not affect the likelihood of Taser use.

The Effectiveness of OC Spray

Three studies have examined the effectiveness of OC spray (Morabito & Doerner, 1997; Adang et al., 2006; Kaminski, Edwards, & Johnson, 1999), generally defined in terms of the extent to which it facilitates the arrests of suspects who resist. As previously noted, Morabito and Doerner (1997) analyzed use of force reports from the Tallahassee Police Department. Although these authors were most concerned with the factors associated with the use of OC spray, they also briefly considered the effectiveness of it. As the authors explained, OC spray "was considered effective if it induced the expected physiological effects and enabled the officer to take the subject into custody without further incident" (p. 690). They calculated a "success rate" of 73% for OC spray and found that OC spray worked "equally well on mentally disturbed subjects, intoxicated subjects, and physically stressed subjects who were involved in either a foot chase or a physical struggle" (p. 690).

Kaminski et al. (1999) analyzed data on incidents where OC spray was used by officers in the Baltimore County Police Department. Based on assessments provided by officers who were involved in the incidents, three measures of OC spray effectiveness were constructed. In

their most conservative measure, they defined effectiveness in terms of whether the use of OC spray incapacitated (fully and immediately immobilized) the suspect (yes/no). According to this measure, OC spray was effective in 71% of cases. Their second measure of effectiveness was also dichotomous, measured as the officer's assessment of whether the use of OC spray eased arrest (yes/no). In this case, the use of OC spray was deemed effective 85% of the time. Their third measure of effectiveness consisted of a 5-point scale ranging from totally effective (i.e., incapacitated suspect) to totally ineffective (i.e., OC spray had no effect). Here, OC spray was considered effective 84% of the time.

Kaminski et al. (1999) examined the effects of suspect characteristics on OC spray effectiveness. In particular, they examined the variables of suspect race, gender, age, weight, height, and condition (i.e., suspect was drinking, mentally disturbed, on drugs, or other). The authors also examined the distance from which OC was sprayed. They found that OC spray was more effective (yes/no) with younger and older suspects (but less effective among middle-aged suspects) and intoxicated suspects. It was less effective when it was used on suspects who were under the influence of drugs and when sprayed from longer distances.

Adang et al. (2006) analyzed data on incidents where OC spray was used by police officers in the Netherlands. They used surveys of officers, supervisors, and prosecutors to measure the effectiveness of OC in several ways: the degree to which the subject was incapacitated (with options ranging from "completely" to "not at all"), the degree to which OC made the arrest easier ("much easier" to "much more difficult"), whether suspects became more or less aggressive after exposure to OC spray ("much more" to "much less"), and how satisfied officers were with the performance of OC spray ("dissatisfied" to "highly satisfied"). Estimates of effectiveness ranged from 69% (suspects who became less aggressive after being sprayed with

OC) to 92% (officers who were satisfied with the performance of OC spray). In the model predicting the extent of suspect incapacitation, four of thirteen independent variables were statistically significant. Specifically, OC spray was less effective when used by less experienced officers, against minority suspects, when suspects were warned beforehand they were going to be sprayed, and when suspects were under the influence of drugs.

The Effectiveness of Tasers

Two studies have examined the effectiveness of Tasers with specific regard to the incapacitation of subjects in arrest situations (White & Ready, 2007; White & Ready, 2010). White and Ready (2007) examined the effects of Tasers based on self-report surveys completed by (primarily SWAT) officers who worked in a large metropolitan police department. They considered the Taser effective if it led to the "successful incapacitation" of the subject. They found that after deploying a Taser, "85% of subjects were subdued by the Taser and taken into custody" (p. 183). The authors developed a multivariate "violence escalation scale" that they used to score each Taser incident. The scale included whether the subject was violent, armed with a weapon (and what type of weapon), under the influence of drugs or alcohol, mentally ill, the weight of the subject, and whether the officer was alone. Although individual analyses were not provided on each variable, the analyses performed on the scale revealed that the Taser was the most effective in the "highest risk" situations.

White and Ready (2010) analyzed Taser deployments from the New York City Police Department; the data were derived from the reports that officers completed subsequent to the deployment of the weapon. Three measures of Taser effectiveness were used in the study. The first measure was the officer's assessment of whether the Taser performed satisfactorily (yes/no).

Officers rated the performance of the Taser as satisfactory in 79% of cases. While this indicator of effectiveness was also used in prior studies (see Adang et al., 2006), the other two are unique in that they measure suspect resistance or, in other words, the *in*effectiveness of the Taser. The authors classified suspect resistance two ways: First, "continual resistance" included those situations where the suspect was not affected at any point by the weapon; the suspect continued to resist after the Taser was deployed. This occurred in 33% of all Taser deployments. In these instances the Taser was clearly ineffective. Second, "any resistance" included those situations where the Taser temporarily resulted in the incapacitation of the suspect, but the suspect resisted again prior to the conclusion of the incident. This occurred in about 11% of Taser deployments.

In their models predicting Taser (in)effectiveness, White and Ready (2010) explored the impact of multiple officer, suspect, and incident characteristics. They found the Taser to be less effective on heavier subjects (i.e., over 200 lbs), subjects who were under the influence of drugs or alcohol, subjects who were violent, when another less lethal weapon was used, when one or both prongs missed the subject, and when the Taser was fired from farther away (i.e., greater than three feet). When effectiveness was based on officer satisfaction, the Taser was also perceived to be more effective when the suspect was armed with a knife or gun.

Conclusions

There are too few studies available to draw confident conclusions about the factors that affect the use and effectiveness of OC spray and Tasers. Other than that males are more likely than females to be subject to a Taser than other forms of force (Gau, Mosher, & Pratt 2010; Crow and Adrion 2011), that OC spray is less likely to be effective on subjects who are under the influence of drugs compared to subjects who are not (Kaminski et al. 1999; Adang et al. 2006),

and that departmental policy affects the use of OC spray and Tasers (Crow & Adrion 2011; Morabito & Doerner, 1997), there is little consistency in findings. There is also little consistency in variables included in previous studies and the measurement of those variables.

It is safe to conclude, however, that estimates regarding the effectiveness of OC and Tasers depend at least in part on the measures used; different definitions of effectiveness produce different rates of effectiveness. In the studies reviewed here, rates of OC effectiveness ranged from 69% to 92% (Adang et al., 2006), while the effectiveness of the Taser ranged from 66% to 89% (White & Ready, 2010). The variation in effectiveness estimates notwithstanding, it appears that most studies show the Taser to be more effective than OC spray.

Our study adds to the discourse on the use and effectiveness of OC spray and the Taser in several ways. First and most importantly, this study is the first that directly compares OC spray with Tasers in terms of their use and their effectiveness, and we do so in the context of the same study site. Second, we include all intentional OC spray and Taser deployments to provide a potentially more inclusive assessment of effectiveness.[4] Lastly, we provide a logical measure of weapon effectiveness that incorporates the dynamic nature of use of force incidents and we use this same measure to evaluate OC spray and Tasers.

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[4] Interestingly, Kaminski et al. (1999) excluded from their analyses incidents where OC was used but where it missed its intended target and incidents where it was used in a crowd situation. The authors also explain that if multiple officers or multiple subjects were involved in the incident, a single officer and/or a single subject was selected for analysis. In addition, it is unknown what, if any, other types of force were used before or after the deployment of OC spray. Adang et al. (2006), like Kaminski et al. (1999), excluded several categories of incidents from their analysis: incidents where officers deployed OC spray but it missed its intended target, where OC was intended to be used but the canister malfunctioned, incidents that involved a crowd situation, and when it was deployed against female subjects. In addition, the authors did not specify what, if any, other types of force were used before or after the deployment of OC spray. It is unknown how these factors may have affected their conclusions about OC spray effectiveness.

METHOD

Data

The data for this study were obtained from a large municipal police department. At the time of the study, the department employed approximately 2,000 sworn officers, about 1,200 of whom were patrol officers. The police department served a population of approximately 600,000; 40% of the population was African American and 10% was Latino.

Analyses were performed on all use of force incidents in 2010 and 2011 where an officer from the department intentionally discharged OC spray (n=259) or deployed a Taser (n=245) against a person. While an additional 24 incidents involved the use of OC and a Taser, and another 45 incidents involved the use of another type of weapon, the analyses conducted here focus on the 504 incidents where OC *or* a Taser was used.

All officers in the department were trained and authorized to carry and use OC spray. During the academy, officers received 4 to 8 hours of instruction on the use of OC spray. Only about 300 officers (approximately 25% of patrol officers) were trained and certified to use a Taser. Further, on each of the three shifts at each of the eight districts, approximately six to eight Tasers were available to be signed out and carried by the certified Taser officers. Therefore, at any given time during the time of this study, there were no more than 68 Tasers actually being carried by officers. With regard to Taser training, officers who volunteered for training first had to be approved by Internal Affairs. Officers who were selected to be Taser trained participated in 16 hours of "new user" training and an additional 8 hours of "refresher" training every 2 years.[5]

At the time of the study, the use of force policy of the department specified OC spray and Tasers as "control devices." According to the policy, "the goal of control devices is to overcome

[5] The only training required by TASER International is the 8 hours of "new user" training.

active resistance or its threat [italics added]." Control devices, escort holds, compliance holds and passive counter measures were more broadly considered "control alternatives." Although a continuum of force was not specified per se, "intervention options" were provided; these options ranged from presence, dialogue, control alternatives, protective alternatives (e.g., focused strikes, vertical stuns), to deadly force (see Figure 1).

Most of the data for the study were obtained from a case management system used by the police department and were converted into a Statistical Package for the Social Sciences (SPSS) data file for analyses. The database was organized with use of force incidents as the unit of analysis. The use of force data were based on reports that were completed by supervisory officers when a use of force incident occurred. According to the official policy of the department at the time of the study, a use of force report was to be completed by a supervisor when an officer: (a) discharged a firearm, (b) used a baton, (c) discharged Oleoresin Capsicum (OC), (d) deployed an Electronic Control Device (Taser), (e) used any other type of force, which resulted in an injury, or a complaint of an injury, to a person, or (f) when a department canine bit a subject in the performance of their duty. Clearly, this is a relatively narrow definition of force as it does not include incidents where only bodily force was used when that force did not result in an injury (or a complaint of an injury) to a subject (or verbal force, see Terrill & Mastrofski, 2002). Nevertheless, that the department policy did not require all bodily force incidents to be reported is of little concern in this study. This study focuses specifically on incidents that involved the use OC spray or a Taser. Departmental policy specified that all such incidents be recorded and all types of force used in those incidents be recorded.

Along with the departmental use of force report, a narrative of the incidents was also written by the supervisory officer and was included in the case management system. For this

study, all of the narratives for incidents that involved the use of OC and/or a Taser were reviewed (787 pages) and additional data were coded from them (e.g., level of subject resistance, the order in which force was used by officers).

Variables

The two primary dependent variables in this study are: 1) the *use of* OC spray and the Taser and 2) the *effectiveness of* OC spray and the Taser. Determining whether or not a particular type of force was used in an incident was relatively straight-forward. If OC was sprayed or a Taser was deployed, OC or the Taser was considered to have been used. If the target was missed, if the weapon malfunctioned, if it was used in a crowd situation, or if it was used against females, the incident was still included. If the incident involved multiple officers and/or multiple subjects, the incident was included. In the few incidents that involved multiple subjects, the characteristics of the person identified as the primary subject in the officer's report was coded.

Determining the effectiveness of OC spray and the Taser was more complicated. As discussed earlier, previous studies have used different measures of effectiveness although each study, in one way or another, examined how well, or to what degree, OC spray or the Taser incapacitated the subject who resisted the police. Of course, the variation in measurement is important to consider when interpreting findings across studies. Ultimately, in a use of force incident, the legitimate objective is to neutralize the threat posed by the subject and gain control over that subject. Most often, practically speaking, "gaining control" means using as much force as necessary in order to place handcuffs on the subject. Many use-of-force situations are

complicated; they unfold, one action leads to another, but ultimately force is used to gain control over the physical actions of the subject.

In this study, we provide a relatively straight-forward, bottom-line, measure of OC and Taser effectiveness. OC spray and/or Tasers were considered effective in two circumstances: First, if OC or a Taser was the *only* type of force that was used in the incident in order to subdue/handcuff the subject, OC or the Taser was considered effective. In these situations, OC spray or the Taser, by itself, led to the legitimate desired outcome; it was effective. Second, if OC or a Taser was the *last* type of force used in the incident prior to the subject being subdued/handcuffed, then OC or the Taser was considered effective. For example, if OC spray was deployed but then some other type of force was necessary in order to gain control over the subject to the point of placing him in handcuffs, then the OC was considered ineffective. OC may, or may not, have had some effect, but ultimately it was not effective in achieving the legitimate objective of the use of force incident—additional force needed to be used.

Of course, one must not lose sight of the possible cumulative effects that various types of force that were used in an incident may have in bringing an incident to an end. Indeed, several of the studies reviewed above simply did not take into account any other types of force that may have been used in the incident. Given the nature of the data analyzed in this study, measuring the precise effect that various forms of force may have had in a use of force incident is difficult, if not impossible. Nevertheless, to the extent possible, and when possible, we consider not only the last type of force used, but all types of force used in the incident. It is also important to highlight that the same criteria are used in measuring the effectiveness of OC and Tasers, providing for an equal ("apples-to-apples") comparison of the effectiveness of the two forms of

force. It is in these ways that an understanding of the relative effectiveness of OC and Tasers can be achieved.

Independent Variables

The independent variables in this study consist of subject characteristics and actions (see Tables 1 and 2 for coding and descriptive statistics). In particular, we focus on: 1) who was the subject? and 2) what did the subject do? Officer characteristics are not included primarily because of the analytic difficulties in doing so.[6] The number of officers who used force in an incident and the number of officers present when force was used were coded and included in the analyses as controls. The number of subjects who had force used upon them was also coded and included as a control.[7]

Data on "who the subject was" (i.e., the characteristics of the subject) were coded according to the supervisor's report. These variables consisted of subject race (white/minority[8]), age, sex, height, and weight.

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[6] Of course, this is a less than optimal solution to the issue; however, previous studies have struggled with the same issue and also resolved it in less than optimal ways. For instance, studies that have included officer characteristics either included only one officer when multiple officers were involved in the incident (Adang et al., 2006; Kaminski et al., 1999), or counted single incidents multiple times if multiple officers used force (White and Ready, 2007). Some studies are unclear about how multiple officer and multiple subject incidents were handled in the analyses (Morabito and Doerner, 1997). Each of these options essentially reduces the complexity of the incidents that are analyzed. None of these options are good, nor is the exclusion of officer characteristics; however, by not including officer characteristics we do not systematically exclude cases. Clearly, there is a trade-off between model error and sample bias.

[7] As noted, in multiple subject incidents, the characteristics of the primary subject, as identified in the police narrative report, were coded and included in the analyses.

[8] Ideally, sub-racial and ethnic groups would be analyzed instead of the "minority" category (Gau et al., 2010). However, too few Hispanics and/or other ethnic/racial group members were included among the incidents. The "minority" group classification consisted of 90% African American subjects (377 out of 419).

Most of the data on "what the subject did" (i.e., how the subject acted) were coded from the narrative reports prepared by supervisory officers and the statements included in the reports. These variables consisted of: whether the subject was mentally disturbed (yes/no), whether the subject was under the influence of drugs or alcohol (yes/no), whether a subject was believed to be armed with a weapon (yes/no), whether a subject was actually armed with a weapon (yes/no),whether a subject fled the police on foot (yes/no), whether a subject assaulted an officer ("yes" if it was stated in the narrative that the subject intentionally hit, kicked, bit, shot, stabbed, or spat upon an officer, "no" otherwise), and the level of resistance offered by the subject (coded on the basis of information provided in the narrative).[9]

RESULTS

Given the purposes of this study, results are organized into two sections: 1) those that relate to the *use* of OC spray and the Taser and 2) those that relate to the *effectiveness* of OC spray and the Taser. We begin with bivariate analyses and multivariate analyses of OC/Taser use and then turn attention to bivariate and multivariate analyses of OC/Taser effectiveness.

The Use of OC Spray and Tasers

How do the 259 incidents where OC spray was used differ from the 245 incidents where a Taser was used? This question was first addressed by calculating statistical differences

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[9] Examples of *passive* resistance included when a subject refused to exit a car, subject went limp, subject refused to move after being ordered to do so, subject refused to show hands after being ordered to do so; examples of *verbal* resistance included when a subject told the officer(s) to leave him/her alone, subject stated he or she will not comply; examples of *defensive* resistance included when subject attempted to or actually fled the police, the subject attempted to hide from the police, subject pulled away from the officer, subject got up after being directed to the ground; examples of *active* resistance included subject fighting with the police, subject lunging at officer, subject attempting to disarm the officer (Terrill and Mastrofski, 2002).

between the variables of interest and OC spray and Taser incidents on the basis of chi-square and t tests (for the sake of space, results are not tabled here). Next, a logistic regression equation was estimated to identify factors that predicted OC spray versus Taser use; these results are shown in Table 3.

In the bivariate analyses, OC spray was significantly more likely than a Taser to be used on minority subjects ($X^2 = 6.82$; $p < .01$); OC spray and a Taser were equally likely to be used regardless of subject age, sex, weight, or height. A Taser was significantly more likely to be used than OC when the subject appeared to be mentally disturbed ($X^2 = 18.61$; $p < .01$), was believed to be armed with a weapon ($X^2 = 19.23$; $p < .01$), when the subject was actually armed with a weapon ($X^2 = 6.52$; $p < .05$), and when the subject fled the police on foot ($X^2 = 16.14$; $p < .01$). OC spray and Tasers were equally likely to be used when the subject was believed to be under the influence of alcohol or drugs, when the subject assaulted a police officer, and regardless of the amount of resistance provided to the police. OC was more likely to be used than a Taser when more than one subject had force used upon them in the incident ($t = -2.03$; $p < .05$); a Taser was more likely to be used than OC when more officers used force in the incident ($t = 2.30$; $p < .05$) and when more officers were present at the incident ($t = 6.39$; $p < .01$).

Table 3 shows the results of the logistic regression analyses performed for OC spray and Taser use. Due to substantial missing data, subject height and weight were not included in the equation. Two models were estimated: one compares those incidents where OC was used to those incidents where a Taser was used ("OC Used"), the other compares Taser use to OC use ("Taser Used"). The independent variables identified as significant in the earlier analyses are similar to those identified as significant here. First, all other variables held constant, when the subject was believed to be mentally disturbed, a Taser was more than two times more likely to be

used than OC spray (odds ratio = 3.296; p = .000). Second, when the subject was believed to be armed, a Taser was significantly more likely to be used than OC spray (odds ratio = 1.858; p = .023). Third, when the subject fled the police on foot, a Taser was significantly more likely to be used on the subject than OC spray (odds ratio = 2.452; p = .000). Fourth, when there were more subjects involved, OC spray was nearly 80% more likely to be used than a Taser (odds ratio = 1.794; p = .04). Finally, when there were more officers present at the incident, a Taser was significantly more likely to be used (odds ratio = 1.668; p = .000).

The Effectiveness of OC Spray and Tasers

Before examining the factors associated with the effectiveness of OC and Tasers spray, it is necessary to calculate an effectiveness rate for OC spray and Tasers (see Table 4). Of the 259 incidents where OC spray was used, 63 involved only the use of OC spray. That no other force was needed to subdue the subject can be considered reasonable evidence that OC spray was effective. In the other 196 incidents, OC spray and some other force were used. In these 196 incidents, the order in which force was applied is meaningful. In 128 of these 196 incidents, OC ended the encounter; presumably OC was used to subdue the subject because the force that was applied prior to the OC did not work, or did not appear to be working, at least in the judgment of the officer who deployed the OC spray.[10] There were 68 incidents where OC was deployed during the incident but some other force ended the encounter.[11] To calculate an effectiveness rate of OC spray, the 63 incidents that only involved OC spray and the 128 incidents where OC

[10] Of the 128 incidents, in 125 of them bodily force was used prior to OC spray; in 3 incidents, bodily force and a baton were used prior to OC.

[11] Of the 68 incidents, 63 ended as a result of bodily force, 5 ended with the use of a baton.

was used last are combined (63 + 128) and divided by the total number of incidents in which a OC spray was used (259). This calculation results in a 73.8% effectiveness rate.

Of the 245 incidents where a Taser was used, in 85 of them, only a Taser was used. In the other 160 incidents, a Taser and some other force were used. In 136 of the 160 incidents, a Taser was the last type of force used.[12] In the other 24 incidents, a Taser was deployed first but some other force ended the encounter.[13] To calculate an effectiveness rate of Tasers, the 85 incidents that only involved a Taser and the 136 incidents where a Taser was used last are combined (85 + 136) and divided by the total number of incidents in which a Taser was used (245). This calculation results in a 90.2% effectiveness rate. Using the same parameters for calculating the effectiveness of OC spray and Tasers, it is clear that Tasers demonstrate a substantially higher effectiveness rate than OC.

As demonstrated in prior studies, OC spray and Tasers may be more effective with some subjects than with others. Again, we calculated statistical differences between the variables of interest and OC spray and Taser incidents on the basis of chi-square and *t* tests (results not tabled). Overall, the results showed that the effectiveness of OC and Tasers did not vary significantly by any of the subject demographic variables included: subject race, age, sex, height, or weight. OC spray was significantly less effective when the subject was believed to be armed ($X^2 = 4.67; p < .05$), when the subject assaulted the police ($X^2 = 5.88; p < .05$), and when the subject provided higher levels of resistance ($X^2 = 16.91; p < .01$). As with OC spray, Tasers

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[12] Of the 136 incidents, in 135 of them bodily force was used prior to the Taser; in 1 incident, bodily force and a baton was used prior to a Taser.

[13] Of the 24 incidents, 21 ended as a result of bodily force, 1 ended with the use of a baton, and 2 ended with the use of a firearm.

were less effective with greater subject resistance ($X^2 = 10.78$; $p < .05$). The results also showed that OC spray and Tasers were less likely to be the last type of force used (less likely to be "effective") when more officers used force in the incident ($t = 3.73$; $p < .01$ and $t = 3.29$; $p < .01$, respectively). OC spray and Tasers were also less likely to be the last type of force used when more officers were present during the incident ($t = 3.00$; $p < .01$ and $t = 2.04$; $p < .05$, respectively).

To identify more directly the factors that predict the effectiveness of OC spray and Tasers, two logistic regression equations were estimated: one for OC effectiveness the other for Taser effectiveness (see Table 5). For each model, the comparison was between effective versus not effective. There are two primary findings worthy of discussion based on the logistic regression results. First, while the OC model is significant, the Taser model is not. It appears that the Taser is uniformly effective, regardless of the variables included here. Second, of all the variables examined, the only significant predictor of OC spray effectiveness is subject resistance. With more resistance offered, OC spray was 48% less likely to be effective (odds ratio = .515; p = .027).[14] Apparently, OC spray alone is not enough to subdue a subject who is more resistive.

DISCUSSION

Previous research on the use and effectiveness of OC spray and Tasers is characterized by incomplete and conflicting findings. There are simply too few studies from which to draw conclusions. Varying study sites, comparisons, data sources, and measurement schemes certainly contribute to these conflicting findings. Nevertheless, a basic conclusion of previous research is that OC spray and Tasers are used in different circumstances. This study used

[14] Congruent with Kaminski et al. (1999), in each of the logistic regression models, younger and older subjects (under 22 and over 38) were compared to "middle" aged subjects (22-37). The results of the analyses did not change in any meaningful way.

OC Spray/Taser Effectiveness

The only significant predictor of OC spray (in)effectiveness was subject resistance. The more a subject resisted the police, the less likely OC spray was to be effective. In particular, when OC spray was used in situations where the subject resisted, it was likely that OC was not the last type of force used. Either the OC spray led to additional resistance that had to be overcome with other force, or OC was not effective in subduing a subject who was already resisting. The model predicting Taser effectiveness was not significant; this suggests that the Taser was effective to the degree that our predictors did not contribute to our understanding of its effectiveness. As noted, the observed level of Taser effectiveness may be a function of the circumstances in which Tasers are used, the amount and quality of training officers received with the Taser, as well as their limited deployment in the study department.

With regard to the effectiveness rates of OC spray and the Taser, and congruent with previous studies, we found that the Taser was substantially more effective than OC spray. Given the research that has been conducted, it is safe to say that Tasers have inherent advantages over OC spray in their ability to incapacitate subjects. However, with this conclusion, it is important not to lose sight of the fact that OC spray and Tasers are simply tools and, like hammers, can be more effectively used by some people than others.

In summary, OC spray and Taser use and effectiveness are clearly different outcomes with different predictors. Overall, suspect behaviors are of value in predicting the *use* of OC and Tasers but not when predicting their *effectiveness*. While suspect behaviors may drive the decision to choose OC spray or the Taser over other forms of force, other factors determine whether OC spray or the Taser actually work to induce suspect compliance. For example, whether OC spray actually works may have less to do with the subject's characteristics and

actions, and more to do with the capabilities of the weapon itself (e.g., amount of OC sprayed, distance between officer and suspect when OC is sprayed). Further research that directly compares OC spray with Tasers may highlight other critical variables that would help explain the use and effectiveness of them.

IMPLICATIONS FOR POLICY AND RESEARCH

Given the relative paucity of research on the use and effectiveness of OC spray and Tasers, specific policy implications are premature. However, when considering the current findings along with the results of prior studies, several policy- and especially research-related questions come to light.

In particular, how Tasers are distributed among officers may have implications for their use and effectiveness in particular police departments. Specifically, are Tasers used at a higher rate if more officers are equipped with them? Is OC spray used at a lower rate if more officers are equipped with Tasers? If more officers are equipped with Tasers, and Tasers are used more frequently, is Taser effectiveness impacted? In addition, does the amount, type, and quality of training received by officers on OC spray and Tasers impact their use and effectiveness? To what extent does organizational policy regarding the use of OC spray and Tasers affect their use and effectiveness? As such, it would be worthwhile and interesting to consider the use and effectiveness of OC and Tasers across similar departments with different deployment arrangements, training standards, and policies regarding the OC and Tasers. Clearly, there is variance between departments in this regard.

It will not be until research accumulates that it will be possible to draw conclusions about the use and effectiveness of OC and Tasers with confidence. Along with factors already mentioned, the effectiveness of OC spray and Tasers are likely to depend on factors not included

in this study or in most others, including the distance from which the weapon was used, the type of clothing worn by the subject (heavy clothing being worn by the subject may inhibit the use of a Taser and/or the effectiveness of it), whether the target was moving at the time of weapon deployment, and the height/weight the subject in relation to the officer.

Another interesting topic for research on the issue is the impact of the *threat* of Taser use on resisting subjects. Adang et al. (2006) examined the impact of threats with respect to OC spray (in their study, OC spray was less effective when suspects were warned beforehand they were going to be sprayed), but no studies have looked at this issue with respect to Tasers; we currently lack information about how often Tasers are threatened to be used (or how often they are even displayed) by officers and the effects of those actions. Such studies could enhance our understanding of the overall effectiveness of the weapons and inform associated policy.

While there is a clear need for additional research on the use of effectiveness of OC spray and Tasers, there is also a need for additional research on the use and effectiveness of bodily force in use of force situations, especially given its frequency. Most use of force incidents begin with bodily force and most injuries to officers and subjects are as a result of bodily force (Adams, 1999). As such, it would be worthwhile for researchers to consider the effectiveness and other issues related to the use of bodily force. What factors predict the effectiveness or ineffectiveness of bodily force? There are many forms of bodily force, what types are most often used and most effective? Answers to these questions may provide insight into situations where bodily force (or certain types of bodily force) should be avoided and OC spray or Tasers used instead.

LIMITATIONS

This study contributes to the discussion about the factors associated with the use and effectiveness of OC spray and Tasers, but it has limitations. First, the data used in the study were collected from police reports which provide the official account of what happened during the use of force incident. Even the order in which force was used, which was critical for the measurement of OC spray and Taser effectiveness in this study, could be misrepresented in the reports. Although there is no evidence of systematic distortion or under-reporting in the reports, the accuracy of the reports could be questioned in this regard. Although many other use-of-force studies, and studies on other topics for that matter, also use official police reports, the veracity of the reports needs to be considered when drawing conclusions on the basis of them.

Second, the generalizability of the findings presented here can be questioned. This department had a unique arrangement for the deployment of Tasers among officers and had a specific policy which guided officer decision making in use of force incidents that involved OC spray and Tasers. Establishing external validity is always an empirical issue; as noted, there is a need for additional research to be conducted on the topic in other police departments.

Finally, this study included a relatively limited range of variables in trying to predict the use and effectiveness of OC spray and Tasers. We would benefit from additional studies that were able to include a wider range of independent variables in the prediction models. By addressing these limitations, a more complete understanding of the factors that predict the use and effectiveness of OC spray and Tasers may be developed.

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Figure 1

Description of "Intervention Options" Used in Study Department

MODE	Definition	Authorized Police Response(s)
Presence	To present a visible display of authority	Open stance, ready stance, defensive stance
Dialog	To verbally persuade	Search talk, persuasion, light control talk, heavy control talk
Control Alternatives	To overcome passive resistance, active resistance, or their threats	Escort holds, compliance holds, control devices **(i.e., OC, ECDs)**, passive countermeasures
Protective Alternatives	To overcome continued resistance, assaultive behavior, or their threats	Active countermeasures, incapacitating techniques, intermediate weapons
Deadly Force	To stop the threat	Deadly force

Table 1

OC or Taser Used: Coding and Descriptive Statistics

Variable	Scale	OC Used			Taser Used		
		M	SD	N	M	SD	N
Subject Characteristics							
Race	0=minority 1=white	.11	.31	253	.20	.40	241
Age	in years	30.70	11.17	252	30.06	10.65	239
Sex	0=female 1=male	.88	.33	251	.92	.27	240
Height	in inches	69.42	3.28	192	69.81	3.46	186
Weight	in pounds	187.49	40.76	192	188.35	46.91	186
Subject Actions							
Mental Disturbed	0=no 1=yes	.09	.29	259	.23	.42	245
Under Influence	0=no 1=yes	.43	.50	258	.46	.50	244
Believed Armed	0=no 1=yes	.22	.41	259	.40	.49	245
Actually Armed	0=no 1=yes	.08	.28	259	.16	.37	245
Fled Police	0=no 1=yes	.22	.41	259	.38	.49	245
Resistance	0=none 1=passive/verbal 2=defensive 3=active	2.40	.76	258	2.44	.73	245
Assaulted Police	0=no 1=yes	.17	.38	259	.13	.34	245
Controls							
# of Subjects		1.12	.47	259	1.04	.35	245
# of Officers Used Force		1.72	.86	259	1.92	1.12	245
# of Officers Present		2.44	1.16	259	3.37	2.03	245

Table 2

OC or Taser Effective: Coding and Descriptive Statistics

Variable	Scale	OC Effective M	SD	N	Taser Effective M	SD	N
Subject Characteristics							
Race	0=minority 1=white	.12	.32	187	.19	.40	217
Age	in years	30.86	11.47	185	30.02	10.62	215
Sex	0=female 1=male	.86	.35	184	.92	.28	216
Height	in inches	69.29	3.37	140	69.67	3.38	170
Weight	in pounds	184.40	39.78	140	188.05	44.00	170
Subject Actions							
Mental Disturbed	0=no 1=yes	.09	.29	191	.23	.42	221
Under Influence	0=no 1=yes	.42	.50	190	.46	.50	220
Believed Armed	0=no 1=yes	.18	.39	191	.38	.49	221
Actually Armed	0=no 1=yes	.07	.26	191	.15	.36	221
Fled Police	0=no 1=yes	.19	.39	191	.37	.48	221
Resistance	0=none 1=passive/verbal 2=defensive 3=active	2.28	.80	190	2.44	.71	221
Assaulted Police	0=no 1=yes	.14	.34	191	.12	.33	221
Controls							
# of Subjects Force Used Upon		1.14	.49	191	1.04	.37	221
# of Officers Used Force		1.60	.75	191	1.85	1.06	221
# of Officers Present		2.31	1.02	191	3.29	1.92	221

Table 3

Logistic Regression Models of OC or Taser Use

Variable	OC Used 0=no 1=yes B	p	Exp(B)	Taser Used 0=no 1=yes B	p	Exp(B)
Subject Race	-.579	.056	.560	.579	.056	1.785
Subject Age	.017	.093	1.017	-.017	.093	.983
Subject Sex	-.076	.836	.927	.076	.836	1.079
Subject Mental Disturbed	-1.193	.000	.303	1.193	.000	3.296
Subject Under Influence	-.316	.150	.729	.316	.150	1.372
Subject Believed Armed	-.619	.023	.538	.619	.023	1.858
Subject Actually Armed	.149	.704	1.160	-.149	.704	.862
Subject Fled Police	-.897	.000	.408	.897	.000	2.452
Subject Resistance	-.199	.207	.819	.199	.207	1.221
Subject Assaulted Police	.527	.079	1.694	-.527	.079	.590
No. of Subjects	.584	.041	1.794	-.584	.041	.558
No. of Officers Used Force	.202	.140	1.224	-.202	.140	.817
No. of Officers Present	-.512	.000	.599	.512	.000	1.668
Constant	1.301	.054	3.673	-1.301	.054	.272
Log likelihood	565.613			565.613		
Model Chi Square	103.617			103.617		
df	13			13		
Significance	.000			.000		
R Squared (Nagelkerke)	.258			.258		
N	483			483		

Notes: B=log odds, p=significance, Exp (B)=odds ratios

Table 4

OC and Taser Effectiveness

OC was Used in 259 incidents (no Taser used)

In 63 incidents only OC used
In 196 incidents OC and other form(s) of force were used

In 128 of the 196 incidents, OC ended the encounter
In 68 of the 196 incidents, another type of force ended encounter
(i.e., bodily force = 63; baton = 5)

63 + 128 = 191 / 259 = OC 73.8% effective rate

Taser was Used in 245 incidents (no OC used)

In 85 incidents only a Taser used
In 160 incidents a Taser and other form(s) of force were used

In 136 of the 160 incidents, a Taser ended the encounter
In 24 of the 160 incidents, another type of force ended encounter
(bodily force = 21; baton = 1; firearm = 2)

85 + 136 = 221 / 245 = Taser 90.2% effective rate

OC and Taser were Used in 24 incidents

In 22 of the 24 incidents, the Taser ended the encounter
In 2 of the 24 incidents, OC ended the encounter

Another Weapon was Used in 45 incidents (no OC or Taser)

In 22 of the 45 incidents, only a firearm was used
In 14 of the 45 incidents, bodily force and a baton were used
In 4 of the 45 incidents, only a baton was used
In 3 of the 45 incidents, bodily force and a firearm were used
In 1 of the 45 incidents, gas and a firearm was used
In 1 of the 45 incidents, bodily force and a flashlight were used

Table 5

Logistic Regression of OC and Taser Effectiveness

	OC Effective			Taser Effective		
	0=no 1=yes			0=no 1=yes		
Variable	B	p	Exp(B)	B	p	Exp(B)
Subject Race	.424	.434	1.528	-.317	.617	.728
Subject Age	.012	.451	1.012	-.014	.557	.986
Subject Sex	-1.433	.076	.239	-.419	.714	.658
Subject Mental Disturbed	-.423	.455	.655	-.001	.999	.999
Subject Under Influence	-.340	.323	.712	.071	.890	1.073
Subject Believed Armed	-.351	.411	.704	-.416	.456	.660
Subject Actually Armed	-.726	.251	.484	-.397	.556	.672
Subject Fled Police	-.265	.483	.767	-.768	.144	.464
Subject Resistance	-.664	.027	.515	.232	.516	1.261
Subject Assaulted Police	-.529	.189	.589	-.754	.255	.470
No. of Subjects	.661	.222	1.037	.657	.697	1.929
No. of Officers Used Force	-.414	.062	.661	-.531	.017	.588
No. of Officers Present	-.174	.286	.840	.000	.998	1.000
Constant	4.651	.001	104.660	3.647	.122	38.343
Log likelihood	244.171			139.531		
Model Chi Square	41.147			15.443		
df	13			13		
Significance	.000			.281		
R Squared (Nagelkerke)	.224			.134		
N	248			235		

Notes: B=log odds, p=significance, Exp(B)=odds ratios

The Impact of the Taser on Suspect Resistance: Identifying Predictors of Effectiveness

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The Impact of the Taser on Suspect Resistance

Identifying Predictors of Effectiveness

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Despite the Taser's increasing popularity among police agencies, questions have been raised concerning the weapon's use and effectiveness as well as its potential to cause serious injury or death. This article examines all Taser deployments by the New York City Police Department from 2002 to 2005 (N = 375) and uses two multivariate approaches—logistic regression and chi-square automatic interaction detection—to identify predictors of Taser effectiveness, measured as continued suspect resistance and officer satisfaction. Findings indicate that several factors are associated with reduced effectiveness, including suspect body weight (more than 200 pounds), drug and alcohol use, physical violence, and close distance (3 feet or less) between the officer and the suspect. Although this study represents a preliminary effort at identifying predictors of Taser effectiveness, there are clear training and policy implications for police departments.

Keywords: *police use of force; Taser; less-than-lethal weapons; conducted energy device (CED)*

Conducted energy devices (CEDs)—most notably, the Taser—are being adopted and deployed by police agencies on a broad scale across the United States. Taser International, the leading developer of stun device technology, has sold more than 200,000 weapons to more than 9,000 police agencies in the United States (Davis, 2007). The economic trends are perhaps a better indicator of the enormous growth of the Taser; Taser International's revenue grew from approximately $2.5 million for fiscal year 1999 to an estimated $67 million in 2004 (McBride & Tedder, 2005).[1] Despite its increasing popularity among police departments and private consumers, questions have been raised concerning the weapon's use and

effectiveness as well as its potential to cause serious injury or death. The following examples illustrate why this topic has become contentious:

- Use: In fall 2005, police officers in Miami used a Taser on a 6-year-old boy who was cutting himself with a piece of glass and on a 12-year-old truant fleeing police.
- Effectiveness: In December 2005, Nashville, Tennessee, police officers used the Taser 19 times on a combative suspect before they were able to take him into custody (Bottoroff, 2005).
- Physiological impact: Amnesty International issued a report in 2004 describing 74 cases in the United States and Canada where a suspect died after being stunned by a Taser. The organization cites these deaths, recent biomedical research, and news reports of incidents involving the questionable use of Tasers to support a moratorium on their use.

Although a growing body of research has examined the physiological effects of the Taser (Ho, Miner, Lakireddy, Bultman, & Heegaard, 2006; Joint Non-Lethal Weapons Human Effects Center of Excellence, 2005; McDonald, Stratbucker, Nerheim, & Brewer, 2005), sparse empirical research has been conducted on the use and effectiveness of the instrument in a field setting. Consequently, our knowledge is largely limited to reports from the CED industry (e.g., Taser International) and police agencies on one side and documents from human rights groups (e.g., Amnesty International and the American Civil Liberties Union) on the other.[2]

This article seeks to add to the scientific knowledge base in this area through an examination of all Taser incidents involving officers in the New York Police Department (NYPD) from 2002 to 2005 (N = 375), with an emphasis on identifying predictors of weapon effectiveness. Specifically, the authors use both logistic regression and chi-square automatic interaction detection (CHAID), a form of segmentation modeling, to identify predictors of Taser effectiveness, measured as both the termination of suspect resistance and officer satisfaction with the weapon. The article concludes with a discussion of implications for the ongoing public discourse regarding the Taser as well as for police policy and practice.

Prior Research

Police and the Use of Force

Police officers have legal authority to use force in a wide range of situations, and the nature of this force can entail using empty-hand force and

less lethal weapons (e.g., baton, pepper spray, or CED), depriving an individual of liberty through arrest, and as a last resort, using a firearm to take an individual's life (Walker & Katz, 2002). Bittner (1970) asserts that the capacity to threaten or use physical force is the core function of the police that defines their role and shapes each contact with a citizen or suspect:

> There can be no doubt that this feature of police work is uppermost in the minds of people who solicit police aid or direct the attention of the police to problems, that persons against whom the police proceed have this feature in mind and conduct themselves accordingly, and that every conceivable police intervention projects the message that force may be, and may have to be, used to achieve a desired objective. (p. 40)

Despite its central role in police work, research indicates that police use of force is statistically rare, occurring in only about 1% of all police–citizen encounters (U.S. Bureau of Justice Statistics, 1999).[3] However, because of the sheer volume of police–citizen encounters in a given year (approximately 43 million), an estimated 421,000 use-of-force incidents occur annually, which translates into about 1,100 incidents per day. Rubinstein (1973) clearly illustrates the intrusive, dehumanizing effect that force can have on a citizen:

> [The patrol officer] may not only circumscribe a person's liberty by stopping him on the street, he may also completely violate the suspect's privacy and autonomy by running his hands over the man's entire body. The policeman knows that a frisk is a humiliation people usually accept from him because he can sustain his authority by almost any action he feels necessary. While he does not frisk people often to just humble them, he can do so; when he feels obliged to check someone for a concealed weapon, he is not usually in a position to request their permission, even if this were desirable. (p. 271; see also Skolnick & Fyfe, 1993, p. 94)

The consequences of police use of force can be severe and long lasting, far exceeding the immediate impact on the individual officer and citizen involved. Fyfe (1988) notes that use-of-force incidents have led to civil disorder and riots, the firing of police executives, millions of dollars in litigation, criminal prosecutions, and strained police–community relations. Recent examples include outbreaks of civil disorder in Cincinnati, Ohio, and St. Petersburg, Florida, in the late 1990s as well as the riots after the acquittal of the Los Angeles Police Department officers involved in the Rodney King incident.

Because of the magnitude of this responsibility delegated to the police and its potential consequences, police officers are mandated to use the minimum force necessary to accomplish their objective; force exceeding this minimum standard is considered excessive (Commission on Accreditation for Law Enforcement Agencies, 1999). Police departments closely monitor use of force and provide policy guidelines to officers typically through a "force continuum," which describes verbal and physical actions an officer can take in response to different levels of suspect resistance and behavior. The use-of-force continuum will usually highlight the minimum and maximum recommended force options available to the individual officer. As the subject's resistance or aggression increases, the officer may use greater degrees of force and is allowed to remain one level above the suspect as the interaction progresses (i.e., an officer may be permitted to use a less lethal weapon, such as pepper spray or a CED, in response to physical resistance by a suspect).

The Development of Less Lethal Alternatives

The role of the police in igniting the riots that marked the 1960s led scholars and police practitioners to reevaluate the force options available to patrol officers in responding to varying levels of suspect resistance. Although discussions regarding less lethal alternatives to the firearm date back to the 1920s, the President's Commission on Law Enforcement and the Administration of Justice (1967) brought the issue to the forefront of the policing agenda when it recommended the development and adoption of less lethal alternatives. During the past several decades, advances in technology have led to the development of a range of new alternatives, such as oleoresin capsicum (OC) spray, impact weapons, foams, ballistic rounds, nets, and most recently, CEDs (Wrobeleski & Hess, 2003). These weapons are intended to provide officers with more alternatives when a situation requires the application of force but has not escalated to the point where lethal force is necessary—thereby adding response options to the use-of-force continuum.

During the 1990s, the adoption of OC or pepper spray became commonplace among police agencies, and this trend was accompanied by a sizeable literature on its use, impact, and effectiveness (Smith & Alpert, 2000). The research on OC spray serves as an important backdrop for the current work on CEDs, because many of the same issues and concerns have been raised. Specifically, controversies surrounding the use of OC spray included its use

against passive resisters, disproportionate use against minorities, and potential health risks (Kaminski, Edwards, & Johnson, 1999). A number of studies have examined the effectiveness of OC spray, indicating relatively high rates of suspect incapacitation, reduced officer injuries, and less reliance on other types of force (Gauvin, 1994; Lumb & Friday, 1997; Nowicki, 1993). Using interrupted time-series analysis, Kaminksi, Edwards, and Johnson (1998) concluded that the adoption of OC spray in Baltimore County reduced the number of assaults on police by 15%. Furthermore, Kaminski et al. (1999) found that the effectiveness of OC spray was mitigated by suspect age, weight, distance, and drug use (but not alcohol).

New Technology Emerges: CEDs

For many police agencies, CEDs are more than just the latest novelty in less lethal alternatives; rather, they are becoming what mace was for police departments in the 1960s—an integral tool used in daily police practice. Advantages of CEDs over other less lethal alternatives—such as pepper spray, bean bag guns, and other soft-impact rounds—include the relatively short duration of their recovery time, their reliability at greater distances, their size and utility, and their perceived effectiveness.[4]

Nonetheless, some police departments have been cautious in adopting this technology on a broad scale, and anecdotal evidence suggests that line officers may be reluctant to use the device routinely because of its dubious public image. The Taser, an acronym for Thomas A. Swift Electric Rifle, "is a conducted energy weapon that fires a cartridge with two small probes that stay connected to the weapon by high-voltage, insulated wire" (Wrobeleski & Hess, 2003, p. 87). The M26 and X26 advanced Taser models introduced by Taser International in 1999 and 2003, respectively, are the two common "new generation" CEDs used by police agencies. These weapons discharge two darts to a distance of 21 feet, delivering a 50,000-volt shock in a 5-second cycle. The electrical charge overrides the central nervous system, resulting in the loss of neuromuscular control, which gives the officer time to gain control of the suspect and apply handcuffs, if necessary.

Questions Surrounding the Taser

The controversy regarding the Taser has occurred in the public domain and has been widely publicized. News reports describing incidents in which police officers used the weapon against the elderly, children, and the mentally ill have made national headlines. Favorable and unfavorable

media images of police practices have been competing for public attention and serve as the backdrop against which the Taser is being assessed by the public and government officials (Lovell, 2003). Currently, empirical research is not driving the debate. This is unsettling, considering that mainstream media depictions of the police are often inaccurate or unrealistic (Ian Ross, 2000; Manning, 1977, 1997). The controversy regarding the Taser came to a head in 2004 when Amnesty International issued its report:

> In its recommendations . . . *Amnesty International* is reiterating its call on federal, state and local authorities and law enforcement agencies to suspend all transfers and use of electro-shock weapons, pending an urgent rigorous, independent and impartial inquiry into their use and effects. (Amnesty International, 2004, p. 3).

The conclusions of the Amnesty International report underscored the controversy and ongoing debate between CED manufacturers and human rights organizations about the expanded use of CEDs among police agencies in the United States. The organizations' concerns focused on fatalities occurring after Taser deployment as well as the potential for abuse by police and its use as a routine force option. CED manufacturers argue, however, that the device is a safe alternative to other less lethal weapons that reduces injuries to officers and suspects. More generally, concerns about CEDs have emerged in three critical areas. Each is discussed below.

When is it appropriate to use the device? No consensus exists among police agencies regarding where the Taser should be placed on the force continuum (U.S. Government Accountability Office, 2005). Should CEDs be placed at the same level as pepper spray, or are they more appropriate farther down the use-of-force continuum as a last alternative to the firearm? Should they be used against suspects who are passively resisting an officer (e.g., ignoring verbal commands) or only against individuals who are actively resisting arrest? Is there any justification for using the Taser against a minor, a senior citizen, or a pregnant woman? Police departments have varied considerably in their responses to these questions, and both the International Association of Chiefs of Police (IACP; 2005) and the Police Executive Research Forum (PERF; 2005) have taken action recently by developing training guidelines and model policies to offer guidance to agencies in their deployment of CEDs. For example, both the IACP and PERF suggest that CEDs only be used against those who are actively resisting, that they not be used against children or the elderly except

in emergency situations, and that each deployment is closely supervised and documented.

Does it work effectively? Since January 2000, *The New York Times* has printed nearly 200 news stories describing incidents in which officers across the United States have used the Taser to control or subdue a suspect. A review of these articles reveals an abundance of cases in which the Taser appears not to have the intended physiological effect on a suspect. In some cases, one or both of the prongs missed the target, or the prongs hit the target but failed to penetrate the suspect's clothing. To date, much of the academic research on the effectiveness of CEDs has relied on field reports completed by officers after deploying the weapon, which measure whether the CED functioned properly, enabling the officer to incapacitate or arrest the subject. Field data analyzed by Taser International (2006) and internal evaluations conducted by police agencies (see, e.g., Seattle Police Department, 2004) place the effectiveness rate of the Taser somewhere between 80% and 94%, but there is sparse independent empirical research studying the effectiveness of the device. White and Ready (2007) calculated an effectiveness rating by examining the impact of the Taser on suspect resistance. They found that use of the weapon caused suspects to stop resisting in 86% of all Taser deployments by the study department.

Several police agencies that have implemented CEDs on a broad scale have later reported reductions in injuries sustained during police–citizen contacts. Police departments in Austin, Texas; Putnam County, Florida; and Cincinnati, Ohio, experienced reductions in injuries to both suspects and officers after adopting the Taser (see Putnam County Sheriff's Office, 2005; Taser International, 2006). Although these trends are noteworthy, questions remain concerning the extent to which the Taser contributed to these reductions. Retrospective analysis of injury trends may not account for other variables (e.g., more training, crime trends, new leadership, etc.) that influence yearly injuries sustained during police–citizen encounters. At present, there are no national-level baseline data concerning the number of police agencies that have reported reductions in injuries after adopting the Taser as compared to the number of agencies that have not reported reductions. The degree to which the device is used effectively depends less on the physiological effects of the technology than on the policy guidelines and field training that departments apply to reinforce accepted standards of use.

Proponents in the law enforcement community claim that the Taser can serve as a substitute for lethal force and other forms of less lethal force (e.g., baton) that may result in serious injury or death (Heck, 2003;

McBride & Tedder, 2005; U.S. Bureau of Justice Statistics, 1999). This is an empirical question that has not been tested, and any practical benefits must be balanced against the potentially harmful physiological effects of the device.

What is its impact on the likelihood of serious injury or death to a suspect? As noted earlier, Amnesty International called for a moratorium on police use of the Taser in late 2004, citing 74 deaths that occurred in North America following deployment of the weapon. Although there is no evidence of a direct causal link between use of the Taser and elevated risk of serious injury or death, a review of the Amnesty International report suggests that the risk of death may be greater for those with preexisting medical conditions (particularly heart conditions) as well as those under the influence of drugs or alcohol. Recent studies supported by the federal government have tested the physiological effects of CEDs on healthy adult volunteers (a sample that may be very different than suspects targeted by police officers) and have concluded that no decisive evidence of ventricular fibrillation or other serious medical side effects exists (Ho et al., 2006; Joint Non-Lethal Weapons Human Effects Center of Excellence, 2005; McDonald et al., 2005). The Canadian Police Research Centre (2005) conducted an exhaustive review of existing research and concluded that "definitive research or evidence does not exist that implicates a causal relationship between the use of CEDs and death" (p. ii).

In sum, despite the growing popularity of CEDs in American policing, researchers have failed to keep pace with the diffusion of this rapidly spreading technology. A developing body of scientific research has begun to address the research question relating to the potential for the Taser to cause serious injury or death, but the questions concerning when it is appropriate to deploy the weapon (and against whom) and its degree of effectiveness remain largely unanswered. Guidelines outlined by PERF and IACP have played a critical role in clarifying some of the important issues for police administrators. This article seeks to inform the use and effectiveness dialogue by shifting the emphasis toward prediction; that is, under what circumstances and against what types of suspect behavior is the Taser most likely to be effective? In other words, what are the characteristics of police officers and suspects and incident-related circumstances that increase or reduce the odds that police use of the CED will result in a successful resolution?

Method

NYPD and the Taser

This article examines all Taser incidents involving police officers from the NYPD from January 2002 through December 2005 (N = 375). The NYPD is cautious in its approach to the deployment of Tasers, and its use is closely monitored. The Taser is issued only to officers in the Emergency Service Unit (ESU). The ESU is responsible for situations that require advanced equipment and expertise, such as crisis situations involving the mentally ill, hostages, and suicidal suspects. The unit consists of several hundred officers, which is a relatively small proportion of the 35,000 sworn NYPD officers. Also, supervisors at the rank of sergeant and above are trained to use the Taser, and each precinct is equipped with one or more devices that can be signed out, though they are not required to carry it. The patrol guide details fairly specific circumstances in which it is appropriate to use the device:

> Patrol supervisors or uniformed members of the service assigned to the Emergency Services Unit may utilize a Taser/electronic stun device to assist in restraining emotionally disturbed persons if necessary. The Taser/electronic stun device may be used:
>
> a. To restrain an EDP [emotionally disturbed person] who is evincing behavior that might result in physical injury to himself or others, OR
> b. To restrain person(s) who, through the use of drugs, alcohol, or other mind-altering substances, are evincing behavior that might result in physical injury to himself or others.
>
> Emergency Service Unit personnel will obtain the permission of the Emergency Service Unit Supervisor prior to utilizing a Taser/electronic stun device, except in emergencies. (NYPD, 2000)

As a result, deployment of the Taser is allowed only in situations involving an EDP or person under the influence of drugs or alcohol who is posing a threat of physical injury where either ESU officers are dispatched or a supervisor is present and has a Taser in his or her possession.[5]

The data analyzed for the current study are derived from a "Taser/stun device report," which is completed every time an officer deploys the weapon.[6] The report contains a series of questions that use check boxes to elicit a range of information about demographic characteristics of the suspect, his or her emotional and physical state, behavior and level of resistance,

weapons present, the rank and assignment of the officer, and characteristics of Taser deployment (e.g., distance, effect, etc.). Most items on the report are formatted as multiple-choice questions, with an additional narrative section where the officer is required to describe the incident in detail. From these reports, the authors created a data set in SPSS that captures 40 variables relating to each Taser incident. These independent variables serve as predictors of Taser effectiveness for the multivariate analysis. Though the research was admittedly limited by the information collected on the Taser/stun device report, the authors note the earlier work conducted by Kaminski et al. (1999), which employed a similar design and analysis, with similar variables, for an evaluation of the effectiveness of OC spray.

The Dependent Variable: Measuring Effectiveness

The dependent variables used in the study include three separate but related measures of effectiveness. The first two measures of effectiveness are based on the extent of suspect resistance. Specifically, the field report contains several items that measure whether suspect resistance ended after the Taser was deployed and notes how much time transpired (in seconds) before the suspect was incapacitated. A follow-up item requires the responding officer to indicate whether the suspect was incapacitated at all. The average time to incapacitation was 8.10 seconds, but this measure should be viewed with caution. It is likely that officers at the scene were far more concerned about bringing the suspect under physical control than counting the number of seconds needed to terminate the struggle and apply handcuffs. For this reason, we will focus on the dichotomous measures of resistance for the analysis.

In one third of the cases (33.0%), the suspect continued resisting against the officer after the Taser was deployed. The cases involving continued resistance can be divided into two categories based on the nature and duration of the resistance. In 32 cases, the resistance continued immediately following the Taser deployment because the suspect was not restrained by the weapon; that is, at no point was the subject subdued, and he or she continued to resist (*continual resistance*). The Taser was clearly ineffective during these incidents, perhaps because of loose or heavy clothing blocking the darts from making full contact, mechanical failure, or resilience on the part of the suspect. In the other 65 cases involving continued resistance, the subject was initially incapacitated by the Taser and the officer(s) gained control temporarily; however, the suspect began resisting again at a subsequent

point in time (*any resistance*). The distinction between these two different outcomes draws attention to the temporary impact of the Taser (i.e., the involuntary loss of muscle control is not long term) and shows the importance of carefully observing the suspect's actions immediately after the Taser is deployed. Because of the practical importance of this distinction in resistance, both measures are used as dependent variables in the analysis. The base rates for any subsequent resistance and continual resistance are 33.0% and 10.9%, respectively.[7]

At the end of the Taser/stun device report, the officer is instructed to indicate whether the device performed satisfactorily (yes or no). Police officers' responses to this question serve as the third measure of Taser effectiveness. Officers reported that the Taser performed satisfactorily during 78.7% of the cases. Officer satisfaction is likely related to a host of factors, including the physiological effect on the suspect and the outcome of the deployment taken as a whole. Did the Taser discharge as intended? Did both prongs strike the target, and if so, did they penetrate the suspects' clothing? Did the suspect stop resisting the officer and was he or she subsequently taken into custody? Finally, was anyone seriously injured during the altercation?

Data Analysis

The authors employed two analytic approaches, logistic regression and CHAID (a form of segmentation modeling), to identify predictors of Taser effectiveness. Descriptive analyses were conducted to identify significant relationships at the bivariate level. The bivariate findings, theory, and practical expectations directed the identification of predictors for the multivariate analysis, though all variables were included in the multivariate analysis. Logistic regression is employed because all three measures of effectiveness are dichotomous outcomes with yes-or-no responses. Similar to logistic regression, CHAID predicts the probability of an event's occurring, but the method relies on different assumptions and properties and uses segmentation modeling to accomplish the task. CHAID divides a population into "increasingly homogenous" segments that differ on the basis of the dependent variable; in this case, suspect resistance and officer satisfaction (Jones, Harris, Fader, & Grubstein, 2001, p. 490). The resulting segments are mutually exclusive and exhaustive, and as the analysis proceeds, the best predictor is selected among a particular subgroup of cases based on chi-square analysis.

CHAID analysis is employed in this study because it offers a number of advantages. First, "one significant advantage of this approach is that the model can find different combinations of predictors for different subsets of the population" (Jones et al., 2001, p. 490). This is especially useful if there is reason to suspect that predictors may differ in their impact among subgroups. For example, predictors of suspect resistance may be different for intoxicated and sober suspects, and CHAID facilitates the identification and exploration of these interactions. Second, Jones et al. (2001) point out that numerous studies have examined statistical issues in risk prediction (Gottfredson, 1987; Simon, 1971; Tarling & Perry, 1985), including the use of CHAID and more traditional methods such as logistic regression, and the general consensus is that "no method is consistently better than any other" (Tarling & Perry, 1985, p. 212). With this conclusion in mind, multiple methods allow researchers to either "triangulate" their findings or identify inconsistencies across techniques. Last, an additional benefit of CHAID is the user-friendly visual representation of variables that interact to produce an outcome; in this case, the technique highlights the important situational dynamics of Taser incidents—and how those dynamics relate to outcomes—in a more interpretable manner for practitioners and policy makers.

Limitations and Considerations

Several limitations of this study should be considered. First, the article examines official reports from one police department that has deployed the Taser in a controlled, limited manner. This impairs the generalizability of the findings to other police departments, particularly, those agencies that have issued the Taser to all patrol officers.[8] Second, this study examines only Taser incidents that generated an official police report. There is no indication that officers are not completing the Taser field report on a systematic basis, especially considering that the device tracks each deployment electronically; however, it is possible that some incidents did not result in a report. Third, anecdotal evidence provides some support for a deterrent effect when the Taser is exposed to a potential subject but not used; that is, much like the firearm, suspects may become compliant when confronted with the imminent possibility of being stunned with the Taser. Researchers and police practitioners would consider this type of incident as a successful de-escalation, but these situations are not captured in the data because the NYPD requires a field report after discharge only.

Results

Descriptive Analysis of Taser Incidents

Suspect characteristics. Suspects targeted in the Taser incidents were primarily male (88.8%) with a mean age of 34.9; more than half were African American (52.1%), 18.7% were White, and 27.3% were Hispanic (see Table 1). Most of the suspects did not appear under the influence of drugs or alcohol (87.2%), but the majority exhibited signs of mental illness (92.5%) and were therefore identified by the responding officers as EDPs.[9] About 40% of the subjects were armed with a weapon (39.6%), most commonly, a kitchen knife or cutting instrument (84% of armed suspects, 32% of all cases).[10] The vast majority of suspects (95%) engaged in physical violence. The violent behavior was directed at an officer during more than half of the incidents (53.3%), one fifth involved a threat of suicide or self-harm (18.6%), and the remaining violent individuals (18.9%) directed their aggression toward multiple individuals at the scene.

Officer characteristics. The Taser/stun device report captures limited information regarding the officer who deploys the weapon. More than half of the officers who used the device were detectives (55.5%), and 41.2% were patrol officers. Just 3.2% were supervisors. More than 90% of the officers were assigned to the ESU. In the majority of cases, the officer deploying the Taser was not alone. One or more back-up officers were present during nearly all of the incidents (93.5%), and a supervisor was present in 88.1% of the cases.[11]

At the bivariate level, there are notable differences in officer rank with regard to the outcomes of interest: satisfaction and suspect resistance. During the study period, 12 cases involved supervisors who were not assigned to the ESU (i.e., patrol sergeants). The effectiveness ratings from these supervisors are significantly lower than the ratings from the ESU officers: Any suspect resistance was reported by 54.5% of the supervisors, compared to 26.7% of police officers and 36.3% of detectives; 20.0% of the supervisors reported resistance immediately after the Taser was used, compared to 7.6% of police officers and 12.0% of detectives; and 41.7% of the supervisors reported being satisfied with the Taser, compared to 81.7% of police officers and 79.4% of detectives.[12] These findings may have implications for the NYPD, because supervisors outside of the ESU receive less training in use of the Taser and may also be using an older model of the device.

Table 1
Characteristics of Suspects and Officers Involved in Taser Deployments

	Percentage	*n*
Suspect characteristics		
Gender		
Male	88.8	332
Female	11.2	42
Total	100.0	374
Racial background		
African American	52.1	189
White	18.7	68
Hispanic	27.3	99
Asian or Other	1.9	7
Total	100.0	363
Mean age = 34.9 years		332
Emotionally disturbed		
No	7.5	28
Yes	92.5	347
Total	100.0	375
Intoxicated		
No	87.2	321
Drugs	7.1	26
Alcohol	4.3	16
Both drugs and alcohol	1.4	5
Total	100.0	368
Armed with a weapon		
No	60.4	217
Yes	39.6	142
Total	100.0	359
Violent behavior		
No	5.2	19
Toward self	18.6	68
Toward officer	53.3	195
Toward other citizens	4.1	15
Toward multiple	18.9	69
Total	100.0	366
Officer characteristics		
Rank		
Patrol officer	41.2	153
Detective	55.5	206
Supervisor	3.2	12
Total	100.0	371
Command		
Emergency Service Unit	91.2	321
Other	8.8	31
Total	100.0	352
Back-up present		
No	6.5	22
Yes	93.5	318
Total	100.0	340
Supervisor Present		
No	11.9	42
Yes	88.1	310
Total	100.0	352

Note: Total numbers are different because of missing data. In some of the study cases, information for one or more variables was missing, and the tables reflect known information only.

Incident characteristics. More than three quarters of the incidents occurred indoors (see Table 2). Per department policy, the majority of suspects (95.6%) were transported to a hospital for a physical examination following the incident. Interestingly, three quarters of the subjects (75.9%) were not arrested after the incident, although many of them were held at the hospital for psychological examination and/or civil commitment. The average distance between the officer and the suspect at the time of deployment is approximately 5.5 feet. In 80.7% of the incidents, the Taser was deployed only once by the officer, and in nearly 80% of the cases, both darts made contact with the suspect as intended. Officers used the device in stun mode in 48 incidents (direct contact to skin, no darts).[13] In 22% of the cases, officers also used another nonlethal device, most typically another type of stun device (14%) or pepper spray (5%). In 86% of the cases, a supervisor indicated that use of the Taser was consistent with departmental policy.[14] Findings with regard to officer satisfaction and suspect resistance—the dependent variables for the multivariate analysis—have been summarized above.

Multivariate Analysis

Logistic regression analysis. Table 3 displays the results of the logistic regression models predicting the three measures of Taser effectiveness. The table provides the logistic regression coefficients, standard errors, and odds ratios for the independent variables in each of the models. The likelihood ratio test for each of the models was statistically significant, and Nagelkerke R^2 estimates suggest that the models predicting any subsequent suspect resistance, resistance immediately after use of the Taser, and officer satisfaction accounted for 23%, 13%, and 21% of the explained variation, respectively.[15] In the first model, statistically significant predictors of any suspect resistance include the following:

- The suspect's body weight is greater than 200 pounds.
- Distance between the officer and the suspect is 3 feet or less.
- The suspect is under the influence of drugs or alcohol.
- The suspect directs violence toward an officer or citizen (as opposed to oneself).
- One or both Taser darts missed the intended target.
- The officer used another nonlethal device before or after using the Taser.[16]

Specifically, when one or both Taser darts miss the suspect, the likelihood of any suspect resistance increases by about 300%. Three predictors—violence directed at an officer or citizen, drug or alcohol intoxication, and

Table 2
Characteristics of Incidents Resulting in Taser Deployments

Incident Characteristic	Percentage	*n*
Location		
Indoors	77.5	286
Outdoors	22.5	83
Total	100.0	369
Suspect arrested		
No	75.9	274
Yes	24.1	87
Total	100.0	361
Suspect transported to hospital		
No	4.4	16
Yes	95.6	346
Total	100.0	362
Number of Taser deployments		
One	80.7	284
More than one	19.3	68
Total	100.0	352
Mean distance between officer and suspect = 5.41 feet		
Darts on target		
Both darts on target	77.7	240
One dart missed	4.5	14
Both darts missed	1.6	5
Darts made contact but fell from clothing	0.6	2
Device used in stun mode	15.5	48
Total	100.0	309
Was suspect incapacitated?		
No	13.2	42
Yes	86.8	277
Total	100.0	319
Mean time to incapacitation = 8.10 seconds		
Did suspect continue to resist?		
No	67.0	235
Yes	33.0	116
Total	100.0	351
Officer satisfied with Taser?		
No	21.3	74
Yes	78.7	273
Total	100.0	347

Note: Total numbers are different because of missing data. In some of the study cases, information for one or more variables was missing, and the tables reflect known information only.

police use of another less lethal weapon—more than double the odds of the occurrence of any suspect resistance during Taser incidents. In addition, suspects who weigh more than 200 pounds are about 84% more likely to resist the officer after the Taser is deployed.

Significant predictors of resistance occurring immediately after deployment of the Taser include the following:

- The suspect's body weight is greater than 200 pounds.
- The suspect is under the influence of drugs or alcohol.
- One or both Taser darts missed the intended target.

Findings for the second model are similar to the model predicting any suspect resistance. Continual resistance immediately after the Taser is deployed is most likely to occur in circumstances where the Taser darts miss a large suspect who is intoxicated.

Results from the model predicting officer satisfaction indicate that the following independent variables are statistically significant:

- The suspect's body weight is 200 pounds or less.
- Distance between the officer and the suspect is greater than 3 feet.
- The suspect is armed with a knife or gun.
- Both Taser darts struck the intended target.[17]

Interestingly, the strongest predictor of officer satisfaction with the Taser is the suspect's being armed with a knife or gun. When the suspect is armed with a weapon, the likelihood of police's reporting that they are satisfied with the Taser is about 200% greater. A possible explanation may be that the likelihood that harmful consequences will occur when the Taser does not work properly is greater when the suspect is armed with a knife or gun: therefore, the sense of relief experienced when the device does perform properly in these volatile situations affects the officer's reporting of satisfaction. The distance between the officer and the suspect during the Taser deployment is also positively associated with officer satisfaction with the device.

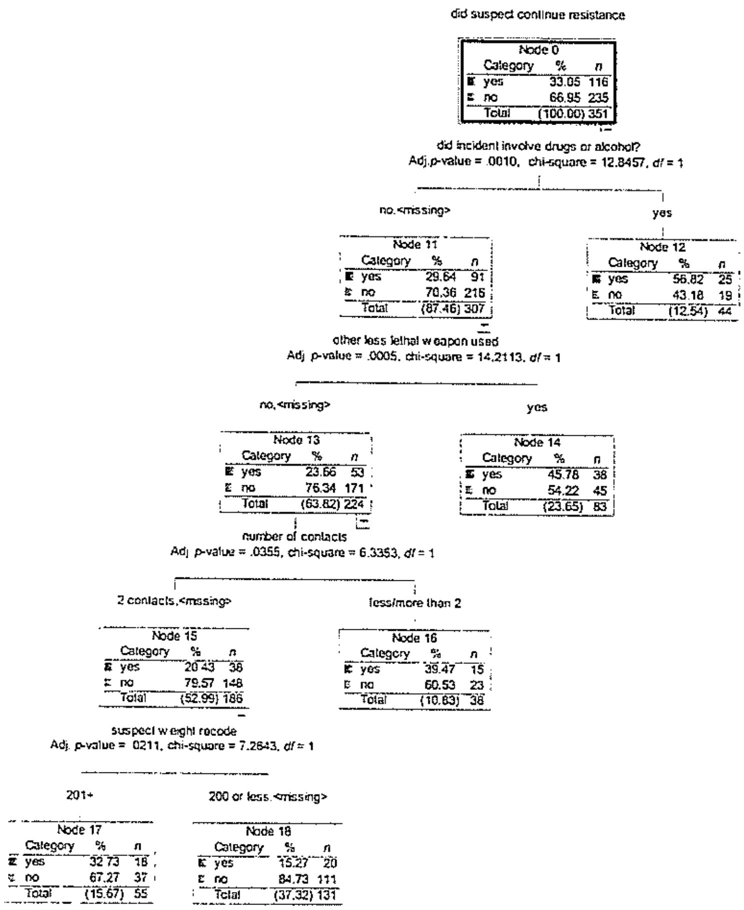
CHAID analysis. Figures 1 to 3 show the results of the CHAID analysis, which uses the same set of variables to predict Taser effectiveness. In Figure 1, the top cell (or root node) in the CHAID tree reflects 33.05% of the cases where any suspect resistance occurred. The initial split was made on the basis of whether the suspect was under the influence of drugs or alcohol, thus separating the 375 Taser cases into two cells: those where the

Table 3
Logistic Regression Predicting Three Measures of Taser Effectiveness

Predictor Variables	*B*	*SE*	Wald	Odds Ratio	*p* Value
Any suspect resistance					
Suspect weight	0.612	.302	4.114	1.844	.043
Distance	−0.667	.306	4.735	0.513	.030
Suspect intoxicated	0.954	.410	5.418	2.596	.020
Suspect violent toward others	0.884	.373	5.617	2.421	.018
One or both prongs miss target	1.393	.531	6.887	4.028	.009
Other less lethal weapon used	1.057	.312	11.445	2.877	.001
Log likelihood	285.065				
R^2 (Nagelkerke)	.227				
Chi-square	46.051				
df	6				
Significance	.000				
n	255				
Resistance immediately after deployment					
Suspect weight	0.882	.416	4.484	2.415	.034
Suspect intoxicated	1.285	.486	6.982	3.614	.008
One or both prongs miss target	1.744	.569	9.379	5.717	.002
Log likelihood	164.691				
R^2 (Nagelkerke)	.130				
Chi-square	17.634				
df	3				
Significance	.001				
n	262				
Officer satisfaction					
Suspect weight	−0.904	.338	7.133	0.405	.008
Distance	0.928	.337	7.586	2.528	.006
Suspect armed with gun or knife	1.111	.422	6.945	3.037	.008
One or both prongs miss target	−2.193	.578	14.408	0.112	.000
Log likelihood	229.067				
R^2 (Nagelkerke)	.213				
Chi-square	37.268				
df	4				
Significance	.000				
n	246				

suspect was not intoxicated (n = 307; 87.46% of the total) and those where the suspect was intoxicated (n = 44; 12.54% of the total). The splits in CHAID are made according to differences in the dependent variable (i.e., any suspect resistance): Of suspects who were intoxicated, 56.8% continued to resist, compared to 29.6% of suspects who were not intoxicated. An additional split was made from the *not intoxicated* cell and is based on

Figure 1
CHAID Analysis Predicting Any Suspect Resistance



Note: CHAID = chi-square automatic interaction detection.

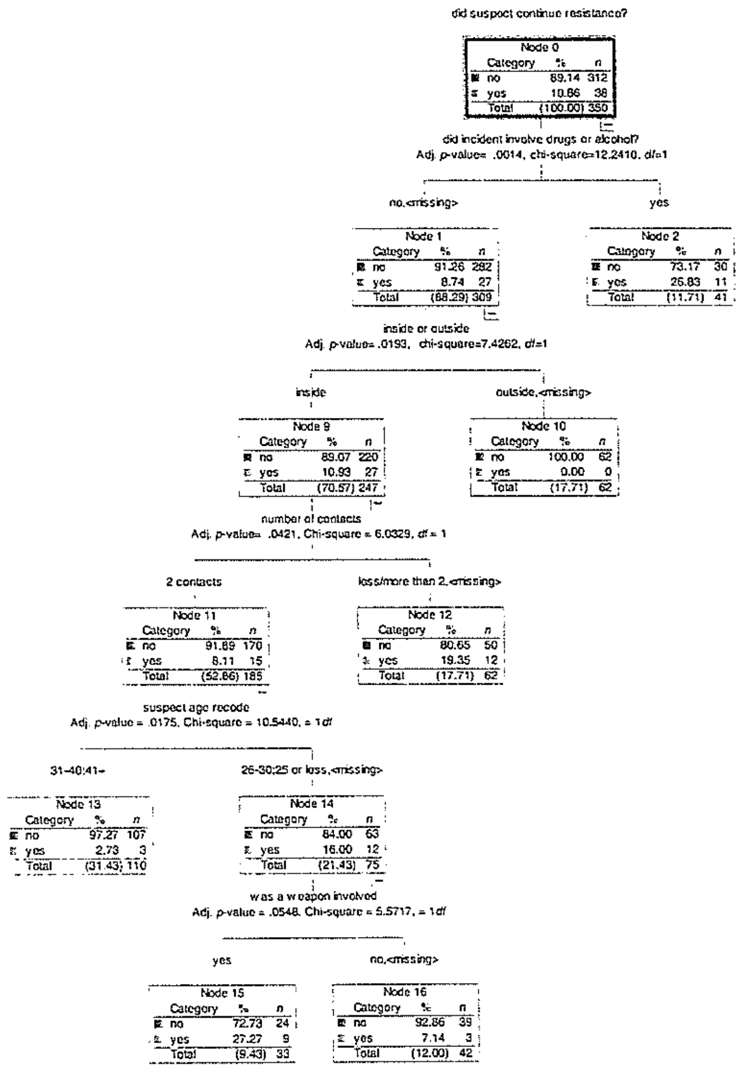
whether police used another less lethal weapon: Suspect resistance occurred in 45.8% of cases where another less lethal weapon was used in addition to the Taser, compared to 23.7% of cases where only the Taser was used. The next split was made from the cell indicating that no other less lethal weapon

was used except the Taser. This split is based on the number of darts that made contact with the suspect: Subjects who were not intoxicated during the encounter, where no other less lethal weapon was used except the Taser, continued to resist during 20.4% of the cases where two darts made contact, compared to 39.5% of the cases where fewer or more than two contacts were made.[18] The final split is made from the cell indicating that two darts made contact and is based on suspect body weight: Suspects in cases where both darts made contact, where no other less lethal weapon was used except the Taser, and where the suspect was not intoxicated were more likely to continue to resist if they weighed more than 200 pounds (32.7% compared to 15.3% for those who weighed 200 pounds or less). Table 4 summarizes the termination cells for the CHAID tree predicting any suspect resistance, which includes the predictors, cell size, percentage of the total cases, and percentage of the dependent variable: any suspect resistance.

Figure 2 displays the CHAID tree predicting continual resistance, and the top cell represents 10.9% of the cases where suspect resistance occurred immediately after the deployment. The initial split is based on the use of drugs or alcohol, as it was for the first CHAID tree: Intoxicated suspects continued to resist immediately after the Taser was deployed in 26.8% of the cases, compared to 8.7% of the cases in which the suspect was not intoxicated. Several additional splits flow from the cell indicating that the suspect was not intoxicated. The next split is based on whether the Taser incident occurred indoors or outside (10.9% suspect resistance inside compared to 0.0% resistance outside). From the cell indicating that the incident occurred indoors, the next split is based on whether the two darts made contact or not (8.1% resistance compared to 19.4%). From the "two contacts" cell, the split is based on whether the suspect was 30 years old or younger (16.0% resistance) as opposed to 31 years old or older (2.7% resistance). The final split flows from the *30 years old or younger* cell and is based on whether the suspect was armed with a weapon (27.3% resistance) or not (7.1% resistance). Termination cell summaries are again shown in Table 4.

Figure 3 shows the CHAID tree for the last measure of effectiveness: officer satisfaction. An initial split is based on the number of darts that made contact—two darts, or fewer or more—with greater officer satisfaction when two darts made contact (83.7% vs. 66.3%). The next split, made from the *two contacts* cell, is based on the distance between the police officer and the suspect. Officer satisfaction is greater when the officers are 4 feet or more away from the target: In this category, 86.7% of the officers reported being satisfied, compared to 72.0% for the officers who were 3 feet away or closer (see Table 4 for summary).

Figure 2
CHAID Analysis Predicting Resistance Immediately After Deployment



Note: CHAID = chi-square automatic interaction detection.

Table 4
Summary of CHAID End Groups

	n	% of Total	% of Suspect Resistance
Any suspect resistance			
Suspect intoxicated	44	12.54	56.82
Suspect not intoxicated (or missing); other less lethal weapon used	83	23.65	45.78
Suspect not intoxicated (or missing); no other less lethal weapon used (or missing); not two contacts	38	10.83	39.47
Suspect not intoxicated (or missing); no other less lethal weapon used (or missing); two contacts (or missing); suspect weighs 201+ pounds	55	15.67	32.73
Suspect not intoxicated (or missing); no other less lethal weapon used (or missing); two contacts (or missing); suspect weighs 200 pounds or less (or missing)	131	37.32	15.27
Total	351	100.00	
Resistance immediately after deployment			
Suspect not intoxicated (or missing); occurred inside; two contacts; suspect 30 or younger (or missing); suspect has weapon	33	9.43	27.27
Suspect intoxicated	41	11.71	26.83
Suspect not intoxicated (or missing); occurred inside; not two contacts (or missing)	62	17.71	19.35
Suspect not intoxicated (or missing); occurred inside; two contacts; suspect 30 or younger (or missing); suspect has no weapon (or missing)	42	12.00	7.14
Suspect not intoxicated (or missing); occurred inside; two contacts; suspect 31 or older	110	31.43	2.73
Suspect not intoxicated (or missing); occurred outside (or missing)	62	17.71	0.00
Total	350	100.00	
Officer satisfaction			
Two contacts; distance 4 feet or more (or missing)	196	56.48	86.73
Two contacts; distance 3 feet or less	50	14.41	72.00
Not two contacts (or missing)	101	29.11	66.34
Total	347	100.00	

Note: CHAID = chi-square automatic interaction detection analysis.

profound implications for police administrators who are responsible for upholding use-of-force standards. This article seeks to contribute to the dialogue on CEDs by identifying predictors of Taser effectiveness.

Findings from the descriptive analysis suggest consistency across the types of incidents (and suspects) in which officers in the NYPD deploy the Taser.

- Most suspects were male, African American or Hispanic, and in their 30s.
- Few suspects were under the influence of alcohol or drugs, but nearly all were identified as exhibiting signs of mental illness.[19]
- Nearly all suspects engaged in violent behavior.
- Just fewer than half of suspects were armed, and among armed suspects, the majority possessed a knife or cutting instrument.
- Nearly all the officers using the Taser in the NYPD were assigned to the ESU.
- Back-up officers and supervisors were present in almost all cases.
- A large majority of suspects were incapacitated by the Taser after the first deployment, and most were incapacitated within 5 seconds.
- Most of the subjects were not arrested on criminal charges, although nearly all were transported to a hospital for physical and/or psychological evaluation.

Findings from the multivariate analyses, both logistic regression and CHAID, are remarkably consistent in predicting the three effectiveness measures:

Any suspect resistance (a measure of ineffectiveness)

- Suspect body weight was over 200 pounds (logistic and CHAID).
- Suspect was intoxicated (logistic and CHAID).
- One or both Taser darts missed the intended target (logistic and CHAID).
- Officer used another less lethal weapon (logistic and CHAID).
- Distance between the officer and the suspect was 3 feet or less (logistic).
- Suspect directed violence toward an officer or citizen (logistic).

Resistance occurring immediately after Taser use (a measure of ineffectiveness)

- Suspect was intoxicated (logistic and CHAID).
- One or both Taser darts missed the intended target (logistic and CHAID).
- Suspect body weight was more than 200 pounds (logistic).
- For a subset of cases, incident occurred indoors, suspect was 30 years old or younger, and suspect was armed (CHAID).

Officer satisfaction (a measure of effectiveness)

- Suspect and officer were more than 3 feet apart (logistic and CHAID).
- Both Taser darts struck the intended target (logistic and CHAID).
- Suspect body weight was 200 pounds or less (logistic).
- Suspect was armed with a gun or knife (logistic).

Three important findings emerge from the analysis. First, the analysis suggests that Taser effectiveness can be modeled using multivariate techniques, as several suspect- and incident-related variables are associated with a greater or lesser likelihood of effectiveness. Considering the paucity of research examining use and effectiveness of the Taser, this finding alone is important. Second, a number of variables were noticeably absent from the statistically significant predictors of Taser effectiveness identified in the multivariate analysis. For example, the race and gender of the suspects were unrelated to any of the three measures of effectiveness. Importantly, whether the suspect was classified as "emotionally disturbed" was also unrelated to Taser effectiveness. Note that only 28 cases did not involve a suspect classified as an EDP, so caution should be used in generalizing to this subgroup. The findings relating to EDPs are particularly important, however, because anecdotal evidence made available by the news media and interest groups suggests that the mentally ill may be more likely to continue to resist the police and to experience serious injury or death when stunned by the Taser. The results of this study indicate that the suspects' mental health at the time of the incident did not affect the effectiveness of the Taser. Additionally, the authors reviewed all news reports ($N = 192$) of Taser incidents printed in *The New York Times* during the study period to become more familiar with the qualitative aspects of the incidents and found evidence of only one case where NYPD deployment of the Taser resulted in the death of an emotionally disturbed suspect.[20]

The third important research finding relates to the variables that were identified as significant predictors in the multivariate analyses, including suspect intoxication, body weight, violence directed at an officer or citizen, and distance between the officer and the suspect. A relatively small proportion of the Taser cases involved an intoxicated suspect—13%, or 46 incidents—but effectiveness dropped significantly for those cases: Intoxicated suspects were twice as likely to exhibit any resistance during the encounter (57% compared to 30%, respectively), they were about 3 times as likely to resist immediately after police deployed the Taser (27% compared to 9%, respectively), and intoxication was associated with lower officer-reported satisfaction with the Taser (67% compared to 80%, respectively).[21] Although the reason for this finding is not clear, one possible explanation relates to

the effect of drugs and alcohol on the suspect's ability to reason and process information. The intoxicated suspects may be less capable of thinking rationally during the police–citizen encounter and therefore less inclined to comply with the officer's instructions after the effects of the Taser wear off. This finding clearly warrants attention from police researchers and practitioners. If it is replicated in other police jurisdictions, with other suspect samples, there are clear policy and training implications. Police field training can highlight the increased likelihood of continued resistance among intoxicated suspects and provide officers with a clear set of guidelines to anticipate and curtail resistance to prevent violence escalation and serious injuries.

The emergence of suspect body weight as a predictor of Taser effectiveness is both interesting and puzzling. Evidence that the weapon is less effective against heavier individuals is not apparent from the CED industry reports or the growing clinical research. This study finds suspect weight—with a cutoff at 200 pounds—a significant predictor of both resistance measures and officer satisfaction. Depending on the degree to which body weight moderates the effects of the Taser, there are implications for Taser use and for police policy and training. Police officers may need to prepare for the greater likelihood of resistance immediately after using the weapon on particularly tall or heavy suspects. Policy should offer guidance on subsequent responses, which may include additional Taser deployments or alternative less lethal weapons. Given the potential relationship between multiple Taser deployments and elevated risk of serious injury or death, police departments may need to craft their policies carefully. Moreover, researchers should consider investigating the potential for an interaction effect between body weight and intoxication. For example, 18 cases in the study data involve an intoxicated suspect who weighs more than 200 pounds, of whom 13 (72%) continued to resist the officer after being stunned with a Taser. This is clearly an important issue that requires further investigation.

Two other suspect-related variables were significant in the multivariate analysis: violent behavior directed at an officer or another person and whether the subject was armed with a weapon. Suspects who were suicidal, engaged in self-harm, or threatened self-harm were less likely to continue resisting after being stunned with the Taser, compared to those who were acting violently toward an officer or citizen. The implications for police are straightforward: Suspects who direct their violence toward others—most notably, the police officer—represent the greatest risk of a physical struggle after being stunned with the Taser, and therefore, officers should remain especially vigilant when using the Taser on subjects that fit this description.

The association between armed suspects and measures of effectiveness indicates that police use of the Taser is most effective in those situations where the potential for serious injury or death is highest. Further research is needed to substantiate this finding, but there are a number of potential explanations:

- High-risk situations could be fundamentally different in ways that affect officer satisfaction.
- The actual physiological effects of the Taser may be different (e.g., more effective) in these types of encounters.
- Police officer performance during and after Taser use may be different in high-risk encounters (e.g., quicker reaction times, better handcuffing, etc.).

Several incident-related characteristics are also associated with the effectiveness measures, notably, distance from the intended target, police use of another less lethal device in addition to the Taser, and the number of darts that make contact with the suspect. The importance of the number of darts that strike the subject and police use of other less lethal weapons is clear. For the Taser to deliver the current, both darts must strike the suspect, penetrate the clothing, and attach to the skin. If this does not occur, the device will not work as intended, and consequently, resistance will be more likely to continue. Although the field report does not specify the order in which multiple weapons are used, the fact that more than one weapon is used implies that one or more instruments were ineffective in curtailing resistance.

The significance of the distance from the suspect as a predictor of effectiveness has both training and policy implications. Taser International offers cartridges with maximum ranges of 15 feet, 21 feet, 25 feet, and even 35 feet. The study findings suggest that the Taser is less effective when used at close range—within 3 feet or less of the target. (Note that distance remained significant when controlling for use of the device in stun mode, i.e., direct contact to the suspect's skin.) The reasons for this are unclear, although use at close range may increase the likelihood that suspect movement could affect the accuracy of the weapon, the suspect could grasp or bump into the weapon at time of discharge, or the darts may not spread out sufficiently to deliver the optimal current. Police agencies may want to consult with each other or the CED manufacturer to determine if this short-range problem has emerged elsewhere. Regardless, maintaining a safe distance whenever possible is of central importance; in fact, the NYPD (2000) patrol guide states that officers should maintain a "zone of safety" of 20 feet and call ESU when

responding to EDPs. Findings from this study suggest that the "safe-distance" principle should be reinforced for ESU as well, particularly when there is reasonable suspicion that a Taser may be deployed.

Conclusion

This article sought to address questions about the use and effectiveness of CEDs by examining all Taser deployments by the NYPD from 2002 to 2005 (N = 375). The authors employ both logistic regression and CHAID analysis to identify predictors of Taser effectiveness, measured as the extent of suspect resistance and officer satisfaction. A number of statistically significant predictors surfaced with policy and training implications, including suspect body weight, drug and alcohol use, violent behavior, and the distance between the responding officer and the suspect. Considering the lack of empirical research predicting Taser effectiveness, this article takes an important step in thinking about the circumstances in which favorable deployment outcomes are likely to occur.

As we suggested earlier, there is an ongoing discourse between civil rights organizations and the CED industry regarding the widespread adoption of these devices. Although this research offers an objective, empirical analysis of Taser deployments, for a number of reasons, it is difficult for the authors to weigh in on this debate. First, much of the debate has focused on the physiological effects of CEDs, which is not a focus of this research. Second, we have examined one police department with a restrictive and closely monitored deployment pattern, which limits the conclusions we can draw. Alternatively, this research shows that the study police department experienced positive outcomes while avoiding the current controversies associated with use and effectiveness. Both PERF and IACP offer detailed guidance on model policy and procedures for the Taser, most of which mirror the NYPD approach. Thus, we can conclude that with regard to the use and effectiveness questions only, this research suggests that departments can successfully deploy the Taser—avoiding problems with misuse and abuse—by implementing and closely monitoring the guidelines developed by PERF and IACP.

Nonetheless, additional research on this topic is necessary not only because the technology is relatively new but also because different agencies are adopting the weapon to varying degrees and developing different standards and expectations concerning its proper use. A multisite analysis of police agencies that have incorporated the Taser into routine practice based on

different approaches would yield valuable comparative data. This type of cross-site approach—coupled with the release of research supported by the National Institute of Justice, particularly, the national-level study being conducted by Alpert and colleagues—will enable researchers to begin asking more complex questions about police use of the Taser, such as to what extent it is used by officers as an alternative to other less lethal weapons (and physical force) and what types of information would be required for a rigorous cost-benefit analysis of the Taser.

Notes

1. There are competitors to Taser, including Stinger Systems and Law Enforcement Associates, but Taser dominates the market with approximately 95% of conducted energy device (CED) sales in the United States. Stinger Systems has sold just 12,000 weapons since 2000. Law Enforcement Associates introduced their CED only recently, in March 2005.

2. Important considerations and limitations associated with these reports include small sampling frames and potentially competing interests among those who carried out the studies. The National Institute of Justice is currently funding several national-level research projects on the Taser, but these studies have just begun.

3. This estimate becomes much greater if handcuffing and verbal commands are included as use of force.

4. For example, the effects of mace and pepper spray are often felt for several hours, and their range of effectiveness is much shorter (which increases the likelihood of other officers' being hit). Beanbag guns and similar impact munitions are often fired from a specialized shotgun that is larger and bulkier than CED.

5. The New York Police Department's (NYPD; 2000) patrol guide also offers a definition of an emotionally disturbed person (EDP):

> A person who appears to be mentally ill or temporarily deranged and is conducting himself in a manner which a police officer reasonably believes is likely to result in serious injury to himself or others. (p. 1)

In situations involving an EDP, officers are instructed to create and maintain a "zone of safety" of approximately 20 feet and to call for the Emergency Service Unit (ESU) and a patrol supervisor as well as an ambulance (NYPD, 2000). Officers are not to attempt to take an EDP into custody unless

- The EDP is unarmed, not violent and is willing to leave voluntarily; OR
- The EDP's actions constitute an immediate threat of serious physical injury or death to himself or others. (NYPD, 2000, p. 1)

6. These reports were provided to the authors by the supervisor of the department's training division. Although the form is used primarily for the Taser, there were 33 forms involving use of another type of nonlethal weapon: either a stun device or other similar alternative. Because the focus of this article is the Taser, these cases were excluded from the analysis.

7. Given that the intent of the Taser is temporary incapacitation only, the latter suspect resistance measure—10.9%—is probably a fairer measure of the Taser's effectiveness. Also, the *any suspect resistance* measure includes both types of resistance (i.e., continual resistance is a subset of the more general resistance measure). Both measures are examined in the multivariate analysis.

8. At the same time, it is worth noting that the limited manner in which the NYPD has implemented the Taser is a practical advantage to police administrators in New York, who have avoided being criticized in the news media for excessive reliance on the Taser.

9. This variable is based on the police officer's assessment of the suspect at the time of the incident. It is not based on more definitive tests, such as a urinalysis or blood or hair analysis. Although this would appear to suggest that police officers in the study department use the Taser disproportionately against the mentally ill in crisis, this finding must be interpreted in the context of how the department has deployed the Taser. Per department policy, the ESU is called when the patrol officers or supervisors on scene determine that the situation involves an EDP who is behaving in a manner that could result in physical injury or death to the EDP or others (NYPD, 2000). Thus, these data are a reflection of the types of suspects typically handled by the ESU—a highly specialized group of officers—not the suspects typically handled by line officers.

10. There were also two cases where the suspect was armed with a gun: In one case, the suspect was threatening to commit suicide, and in the other case, the suspect had taken a hostage and was threatening multiple people (including the hostage and himself). Of the remaining cases involving an armed suspect, the most common weapon was a blunt object, such as a metal pipe, baseball bat, chair, or large stick.

11. The nearly universal presence of back-up officers and supervisors is again dictated by the fact that most of these cases involve the ESU. This unit is typically called to the scene by the first responding officer, and often a supervisor will also respond.

12. Both police officers and detectives are assigned ranks in the ESU. Chi-square values indicate that the satisfaction and any-resistance differences are statistically significant (p = .005 and p = .050, respectively). It may be useful in future research to examine length of time on the job and officer training as factors related to effectiveness. These variables may more accurately capture the relationship between officer's use of the Taser—especially among non-ESU personnel—and effectiveness measures.

13. Information on the number of dart contacts was not reported in 66 cases. Rather than make assumptions about the number of contacts, the authors have proceeded conservatively and coded these cases as missing. This decision, however, reduces the number of cases available for multivariate analysis.

14. In the remaining 14% of the cases (n = 53), the form was not signed and there was no information about whether the use met departmental policy. However, a review of the narrative of those 53 cases suggests that they too conformed with department policy on use of the Taser.

15. Nagelkerke R^2 provides an approximation of the explained variation in a logistic regression model. This measure of model strength is considered slightly more conservative than the R^2 statistic in ordinary least squares regression but less conservative than the Cox and Snell R^2 estimate, which does not have a maximum value of 1.0.

16. Although the "Taser/stun device report" indicates whether another nonlethal device was also used, it does not specify which is used first, the Taser or the alternative.

17. Suspect resistance was also a predictor of officer satisfaction, but it has been excluded from the analyses because it serves as the other effectiveness measure. The authors question the value of a model that uses one outcome measure to predict another.

Oleoresin Capsicum Spray and Tasers:

A Comparison of Factors Predicting Use and Effectiveness

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Oleoresin Capsicum Spray and Tasers:

A Comparison of Factors Predicting Use and Effectiveness

ABSTRACT

In the last few decades, several less-lethal forms of force have been introduced, adopted, and deployed by police agencies. Oleoresin capsicum spray is now used in nearly every department across the United States; the Taser is used in the majority of police departments. Despite their widespread use, we still know relatively little about the factors associated with the use of OC spray and Tasers and the effectiveness of these weapons in incapacitating subjects. This paper contributes to that discussion by analyzing 504 use-of-force incidents where the police used OC spray or Tasers during the event. Data were obtained from a large municipal police department on incidents that occurred in 2010 and 2011. Policy implications and directions for further research are discussed.

INTRODUCTION

A fundamental but controversial function of the police is their ability to use coercive force (Bittner, 1970; Klockars, 1985). Force is most likely to be used by the police in situations where they are confronted with non-compliant subjects (Reiss, 1971; Terrill & Mastrofski, 2002). In such situations, police officers have several options. At one end of the spectrum, beyond verbal commands and threats, officers may use bodily force (e.g., decentralizations, focused strikes). Bodily force alone is the most common form of physical force used by police officers (Adams, 1999). At the other end of the spectrum, officers may use their firearms. The use of firearms is considered a last resort; it is only to be used to defend human life. In between bodily force and deadly force, there are several "less-than-lethal" or "less-lethal" options.

In the last few decades, several less-lethal forms of force have been introduced, adopted, and deployed by police agencies. Today, nearly all local departments authorize the use of one or more less-lethal weapons (Reaves, 2010). The most common less-lethal weapon is pepper spray, authorized by 97% of all local departments (Reaves, 2010). Conducted Energy Devices (CEDs)[1], including Tasers[2] and stun guns, are authorized by 60% of all local police agencies (Reaves, 2010). While the number of departments authorizing pepper spray is not much higher than in the year 2000 (91%; Hickman & Reaves, 2003), the number of local police departments that authorize the use of CEDs has dramatically increased since 2000, when just 7% authorized them (Reaves, 2010).

[1] CEDs are sometimes also known as Electronic Control Devices (ECDs), Conducted Electrical Weapons (CEWs), or Conducted Energy Weapons (CEWs).

[2] The Taser (short for the Thomas A. Swift Electric Rifle) is currently the most popular CED on the market. It is also the CED used by the department in this study. As such, we use the term "Taser" rather than the more general "CED" throughout this paper.

In response to the greater prevalence and use of less-lethal weapons, particularly OC spray and Tasers, a substantial amount of research has been conducted on issues related to them. For instance, researchers have analyzed the frequency with which different types of force are used before, during, and after OC spray or Tasers are introduced in departments (e.g., Lin & Jones, 2010; Lumb & Friday, 1997). Studies have examined the factors associated with the use of OC spray (Morabito & Doerner, 1997) and Tasers (Crow & Adrion, 2011; Gau, Mosher, & Pratt, 2010) as well as officer and citizen injuries associated with their use (e.g., Terrill & Paoline, 2011; Kaminski et al., 2013; Paoline, Terrill, & Ingram, 2012; Kaminski et al., 1999; Smith et al., 2007). Finally, researchers have examined the effectiveness of OC spray (Morabito & Doerner, 1997; Kaminski, Edwards, & Johnson, 1999; Adang et al., 2006) and Tasers (White & Ready, 2010; White & Ready, 2007), defining effectiveness in terms of their ability to induce subject compliance.

While this research has advanced our understanding of the benefits and limitations of OC spray and Tasers, we still know relatively little about the factors associated with the use of OC spray and Tasers and the effectiveness of these weapons in incapacitating subjects. In particular, there are no studies to date that directly compare the use and relative effectiveness of OC spray and the Taser within the same jurisdiction during the same time frame.[3] Some studies examine OC spray, while others examine Tasers. It is difficult, if not impossible, to draw definitive conclusions about the use and relative effectiveness of OC spray and Tasers on the basis of studies that do not include both OC spray and Taser incidents, do not compare OC spray with Tasers, that use different sampling procedures and measurements schemes for critical variables,

[3] An exception is a study performed by TASER International (as cited in White and Ready, 2007). In this study, the effectiveness of the OC spray and the Taser were compared, but only when both were used in the same incident. In these encounters, OC spray was effective 33% of the time while the TASER was effective in 83% of cases (Taser International, 2002).

and that were conducted in different police departments with different use-of-force policies and continuums. As such, we do not know whether Tasers are significantly more (or less) effective than OC spray in similar situations, or whether different factors predict their use and effectiveness. This study examines the factors that predict the use and effectiveness of OC spray (N= 259) and Tasers (N=245) in a single large municipal police department. Data were obtained from official use-of-force reports of the police department on incidents that occurred in 2010 and 2011.

LITERATURE REVIEW

Police use of force, defined as "acts that threaten or inflict physical harm on suspects" (Terrill, 2003, p. 56), has been an important and constant topic of research since the 1970s. This attention is warranted for theoretical and practical reasons. Theoretically, research on police use of force is important because it involves the defining characteristic of policing. In large part, an understanding of the complexities and dilemmas of police work depends on an understanding of police use of force. Practically speaking, research on the control of police use of force is important in that use of force can have devastating—and deadly—consequences. As such, it can dramatically affect police-community relations, public cooperation with the police, and the legitimacy of the police more generally.

Due to the potentially serious consequences of police use of force, police officers are constrained in their ability to use it. Along with legal (*Graham v. Connor*, 490 U.S. 386 1989) and accreditation standards (Commission on Accreditation for Law Enforcement Agencies, 1999), the majority of police departments guide officer behavior with a "continuum of force" or "force continuum" (Terrill & Paoline, 2012). Most often, officers are to base force decisions on

the level of suspect resistance or aggression; force is only escalated to the next level when less forceful actions fail to induce suspect compliance. While OC spray and Tasers are usually placed at the same level on force continuums (Alpert et al., 2011; IACP, 2005), there is little agreement between and among departments where they should be placed. In some departments, OC spray and the Tasers are placed at the lower end of the continuum, authorizing their use against passive resisters; other departments place them closer to lethal force on the continuum, authorizing their use only against active resisters. Where OC spray and Tasers are located on the continuum of force matters when understanding the circumstances in which the weapons are used (Crow & Adrion, 2011; Morabito & Doerner, 1997). In turn, the circumstances in which OC spray and Tasers are used may have implications for their effectiveness in inducing compliance among subjects.

OC SPRAY AND TASERS

Oleoresin capsicum (OC) spray, otherwise known as pepper spray, was introduced to law enforcement in the 1980s. OC is an inflammatory agent naturally found in cayenne peppers. When a person is sprayed with OC spray, the effects are immediate: the respiratory tract becomes inflamed, the individual experiences an intense burning sensation and swelling around the eyes, and the subject's eyes close involuntarily (Lumb & Friday, 1997). Although the subject may be in extreme discomfort, he or she may still be able to resist. Ideally though, the effects of OC spray render a resistive suspect passive and compliant, and the officer is able to take the suspect into custody without further incident.

Once introduced, OC spray immediately demonstrated advantages over other forms of force. The effects of OC spray, while immediate and dramatic, were more temporary than other

forms of chemical gasses used previously (Lumb & Friday, 1997). OC spray proved more effective on intoxicated individuals than mace, and was less prone to secondary contamination (White & Ready, 2007). Finally, OC spray was less likely to cause injury than bodily force, batons, and flashlights (Lumb & Friday, 1997). As summarized by Lumb & Friday (1997):

> ...OC spray is an effective alternative to the more harmful types of weapons available to police. OC causes almost instantaneous incapacitation and leaves no long term residual effects. It allows the officer to stay away from the suspect when affecting a custodial arrest that is being resisted, and there are few problems associated with transporting the person, as OC spray residue dissipates fairly quickly (p. 138).

Today, while OC spray is standard issue in police departments, CEDs, such as the Taser and other stun devices, are still gaining popularity. First introduced in the 1990s, the Taser is a 50,000 volt, 26-watt weapon that uses nitrogen cartridges to fire its probes. Once the probes attach to the suspect, the Taser delivers an electrical current which overrides the central nervous system, causing involuntary muscle contractions and incapacitation (Alpert et al., 2011; Means & Edwards, 2005).

The Taser has advantages over other less-lethal alternatives including their greater reliability at longer distances, the relatively quick recovery time involved, and their perceived effectiveness in inducing suspect compliance (White & Ready 2010). In addition, because Tasers do not rely on pain to induce compliance, ideally they should be more effective on persons who have a higher tolerance of pain, such as people under the influence of drugs or alcohol or who have a mental illness (Means & Edwards, 2005).

Despite their popularity and advantages, OC spray and Tasers are not without controversy. One concern relates to their safety. In the late 1980s and early 1990s, OC spray was claimed to have caused several in-custody deaths (ACLU of Southern California, 1993; Alpert et al., 2011). Twenty years later, the Taser was also alleged to be a proximate cause of in-

custody deaths (Alpert et al., 2011; White & Ready, 2007). Research has shown that most deaths involving OC spray were instead the result of positional asphyxia, pre-existing health conditions, or were drug-related (Granfield, Onnen, & Petty, 1994; Petty, 2004). With regard to Tasers, it has been demonstrated that the risk of death when a Taser is used is less than 0.25 percent (NIJ, 2011), and in those situations the death is likely to be a result of drug intoxication, preexisting heart conditions, and exposure to other forms of nonlethal police force (White & Ready, 2007).

Another concern relates to police overuse of OC spray and Tasers (Alpert et al., 2011). For instance, members of the ACLU and Amnesty International have voiced concern that OC spray and Tasers are used in a disparate fashion against members of minority groups (ACLU of Southern California, 1993; Amnesty International, 2006). A related concern is that police have authorized their use too low on continuums of force and consequently are using them against passive (versus active) resisters (Terrill & Mastrofski, 2002). Finally, there are concerns about the use of OC spray and Tasers with the elderly, children, pregnant women, and persons with medical conditions that put them at greater risk of experiencing dangerous medical side effects (Amnesty International, 2006; Sloane & Vilke, 2006).

A final concern has to do with manufacturer exaggeration of the capabilities and effectiveness of OC spray and Tasers in incapacitating subjects, which, in part, may have contributed to their widespread adoption in police departments. Some early studies reported "effectiveness rates" as high as 100% for OC spray (as cited in Adang et al., 2006) and 94% for the Taser (as cited in White & Ready, 2010). Objective empirical research on the effectiveness of these devices remains rather sparse. Of the independent studies that do exist, effectiveness rates have not been found to be as high as those originally reported by the manufacturers. For

instance, and as discussed below, Kaminski et al. (1999) found an effectiveness rate of 71% for OC spray. White and Ready (2010) found an effectiveness rate of 85% for the Taser.

RESEARCH ON THE USE AND EFFECTIVENESS OF OC SPRAY AND TASERS

While research appears to have ameliorated concerns about OC spray and Tasers causing serious injury and death, there remain concerns about their use and effectiveness. In response, there has been a growing body of literature that examines the use and effectiveness of these weapons. Given the objectives of the current study, we review here the studies that examine the factors associated with the *use* of OC spray and Tasers and the *effectiveness* of OC spray and Tasers (with effectiveness defined in terms their ability to facilitate the arrests of resisting subjects).

The Use of OC Spray

Morabito and Doerner (1997) analyzed OC spray use-of-force reports from the Tallahassee Police Department. They examined characteristics of officers and suspects that were associated with the use of OC spray at two points in time: prior to and after a change in the circumstances in which OC spray was authorized in the department. At Time 1, OC spray was only authorized in cases when the suspect was actively physically resisting police. At Time 2, the threshold for the use of OC spray was reduced from active physical resistance to verbal/passive physical resistance. At Time 1, OC spray use was compared to impact weapons such as batons, flashlights, and stun guns. At Time 2, OC spray use was compared to the use of soft hand techniques (punches, kicks, and pain compliance techniques). The officer characteristics of interest included race, gender, education and experience. Suspect variables

included race, gender, height and weight (relative to the officer's height and weight), suspect intoxication, and whether the suspect was armed or attacked the officer. While none of the predictor variables were significant at Time 1, several factors were associated with OC spray use at Time 2. At Time 2, male, educated, and veteran officers were more likely to use OC spray than soft hand techniques. OC spray was also more likely to be used than soft hand techniques when the suspect was heavier and taller than the officer and when the suspect was armed.

The Use of Tasers

Gau, Mosher, and Pratt (2010) analyzed case file data on Tasers and other types of force used by officers in a state patrol agency from 2005 to 2007. The authors were primarily interested in examining possible racial disparities in the use of a Tasers on subjects. Tasers were used in nearly one-half of all use-of-force incidents. They found that compared to other forms of force, Tasers were equally likely to be used on white, Hispanic, and Black subjects; although when a Taser was used, Hispanic subjects were more likely than White subjects to have a Taser be the first type of force used. The authors also found that females were less likely to be "tased" than males, and that subjects who actively resisted and who were assaultive were *less* likely to be tased than subjects who passively resisted. Finally, white officers were significantly less likely to use a Taser than officers of other races.

Crow and Adrion (2011) analyzed 461 use-of-force incidents (reports) that occurred between 2004 and 2010 in a medium-sized municipal police department. The authors compared incidents where a Taser was used and incidents where "other" types of force were used (takedowns, physical force, pepper foam, impact weapons, police dog, use of a vehicle as a weapon, and firearms). The authors found that a Taser was *less* likely to be used than other forms

of force when subjects physically resisted and when resistance involved a weapon. A Taser was equally likely to be used when resistance was in the form of "presence," "flight," and "verbal" (meanings unspecified). A Taser was more likely to be used than other forms of force on non-white and male subjects. Older officers were significantly more likely to use Tasers. A policy change to restrict the use of Tasers also had its intended affect; after the policy change, Tasers were less likely to be deployed. Call type, time of day of the incident, officer sex, race, age, and rank did not affect the likelihood of Taser use.

The Effectiveness of OC Spray

Three studies have examined the effectiveness of OC spray (Morabito & Doerner, 1997; Adang et al., 2006; Kaminski, Edwards, & Johnson, 1999), generally defined in terms of the extent to which it facilitates the arrests of suspects who resist. As previously noted, Morabito and Doerner (1997) analyzed use of force reports from the Tallahassee Police Department. Although these authors were most concerned with the factors associated with the use of OC spray, they also briefly considered the effectiveness of it. As the authors explained, OC spray "was considered effective if it induced the expected physiological effects and enabled the officer to take the subject into custody without further incident" (p. 690). They calculated a "success rate" of 73% for OC spray and found that OC spray worked "equally well on mentally disturbed subjects, intoxicated subjects, and physically stressed subjects who were involved in either a foot chase or a physical struggle" (p. 690).

Kaminski et al. (1999) analyzed data on incidents where OC spray was used by officers in the Baltimore County Police Department. Based on assessments provided by officers who were involved in the incidents, three measures of OC spray effectiveness were constructed. In

their most conservative measure, they defined effectiveness in terms of whether the use of OC spray incapacitated (fully and immediately immobilized) the suspect (yes/no). According to this measure, OC spray was effective in 71% of cases. Their second measure of effectiveness was also dichotomous, measured as the officer's assessment of whether the use of OC spray eased arrest (yes/no). In this case, the use of OC spray was deemed effective 85% of the time. Their third measure of effectiveness consisted of a 5-point scale ranging from totally effective (i.e., incapacitated suspect) to totally ineffective (i.e., OC spray had no effect). Here, OC spray was considered effective 84% of the time.

Kaminski et al. (1999) examined the effects of suspect characteristics on OC spray effectiveness. In particular, they examined the variables of suspect race, gender, age, weight, height, and condition (i.e., suspect was drinking, mentally disturbed, on drugs, or other). The authors also examined the distance from which OC was sprayed. They found that OC spray was more effective (yes/no) with younger and older suspects (but less effective among middle-aged suspects) and intoxicated suspects. It was less effective when it was used on suspects who were under the influence of drugs and when sprayed from longer distances.

Adang et al. (2006) analyzed data on incidents where OC spray was used by police officers in the Netherlands. They used surveys of officers, supervisors, and prosecutors to measure the effectiveness of OC in several ways: the degree to which the subject was incapacitated (with options ranging from "completely" to "not at all"), the degree to which OC made the arrest easier ("much easier" to "much more difficult"), whether suspects became more or less aggressive after exposure to OC spray ("much more" to "much less"), and how satisfied officers were with the performance of OC spray ("dissatisfied" to "highly satisfied"). Estimates of effectiveness ranged from 69% (suspects who became less aggressive after being sprayed with

OC) to 92% (officers who were satisfied with the performance of OC spray). In the model predicting the extent of suspect incapacitation, four of thirteen independent variables were statistically significant. Specifically, OC spray was less effective when used by less experienced officers, against minority suspects, when suspects were warned beforehand they were going to be sprayed, and when suspects were under the influence of drugs.

The Effectiveness of Tasers

Two studies have examined the effectiveness of Tasers with specific regard to the incapacitation of subjects in arrest situations (White & Ready, 2007; White & Ready, 2010). White and Ready (2007) examined the effects of Tasers based on self-report surveys completed by (primarily SWAT) officers who worked in a large metropolitan police department. They considered the Taser effective if it led to the "successful incapacitation" of the subject. They found that after deploying a Taser, "85% of subjects were subdued by the Taser and taken into custody" (p. 183). The authors developed a multivariate "violence escalation scale" that they used to score each Taser incident. The scale included whether the subject was violent, armed with a weapon (and what type of weapon), under the influence of drugs or alcohol, mentally ill, the weight of the subject, and whether the officer was alone. Although individual analyses were not provided on each variable, the analyses performed on the scale revealed that the Taser was the most effective in the "highest risk" situations.

White and Ready (2010) analyzed Taser deployments from the New York City Police Department; the data were derived from the reports that officers completed subsequent to the deployment of the weapon. Three measures of Taser effectiveness were used in the study. The first measure was the officer's assessment of whether the Taser performed satisfactorily (yes/no).

Officers rated the performance of the Taser as satisfactory in 79% of cases. While this indicator of effectiveness was also used in prior studies (see Adang et al., 2006), the other two are unique in that they measure suspect resistance or, in other words, the *in*effectiveness of the Taser. The authors classified suspect resistance two ways: First, "continual resistance" included those situations where the suspect was not affected at any point by the weapon; the suspect continued to resist after the Taser was deployed. This occurred in 33% of all Taser deployments. In these instances the Taser was clearly ineffective. Second, "any resistance" included those situations where the Taser temporarily resulted in the incapacitation of the suspect, but the suspect resisted again prior to the conclusion of the incident. This occurred in about 11% of Taser deployments.

In their models predicting Taser (in)effectiveness, White and Ready (2010) explored the impact of multiple officer, suspect, and incident characteristics. They found the Taser to be less effective on heavier subjects (i.e., over 200 lbs), subjects who were under the influence of drugs or alcohol, subjects who were violent, when another less lethal weapon was used, when one or both prongs missed the subject, and when the Taser was fired from farther away (i.e., greater than three feet). When effectiveness was based on officer satisfaction, the Taser was also perceived to be more effective when the suspect was armed with a knife or gun.

Conclusions

There are too few studies available to draw confident conclusions about the factors that affect the use and effectiveness of OC spray and Tasers. Other than that males are more likely than females to be subject to a Taser than other forms of force (Gau, Mosher, & Pratt 2010; Crow and Adrion 2011), that OC spray is less likely to be effective on subjects who are under the influence of drugs compared to subjects who are not (Kaminski et al. 1999; Adang et al. 2006),

and that departmental policy affects the use of OC spray and Tasers (Crow & Adrion 2011; Morabito & Doerner, 1997), there is little consistency in findings. There is also little consistency in variables included in previous studies and the measurement of those variables.

It is safe to conclude, however, that estimates regarding the effectiveness of OC and Tasers depend at least in part on the measures used; different definitions of effectiveness produce different rates of effectiveness. In the studies reviewed here, rates of OC effectiveness ranged from 69% to 92% (Adang et al., 2006), while the effectiveness of the Taser ranged from 66% to 89% (White & Ready, 2010). The variation in effectiveness estimates notwithstanding, it appears that most studies show the Taser to be more effective than OC spray.

Our study adds to the discourse on the use and effectiveness of OC spray and the Taser in several ways. First and most importantly, this study is the first that directly compares OC spray with Tasers in terms of their use and their effectiveness, and we do so in the context of the same study site. Second, we include all intentional OC spray and Taser deployments to provide a potentially more inclusive assessment of effectiveness.[4] Lastly, we provide a logical measure of weapon effectiveness that incorporates the dynamic nature of use of force incidents and we use this same measure to evaluate OC spray and Tasers.

[4] Interestingly, Kaminski et al. (1999) excluded from their analyses incidents where OC was used but where it missed its intended target and incidents where it was used in a crowd situation. The authors also explain that if multiple officers or multiple subjects were involved in the incident, a single officer and/or a single subject was selected for analysis. In addition, it is unknown what, if any, other types of force were used before or after the deployment of OC spray. Adang et al. (2006), like Kaminski et al. (1999), excluded several categories of incidents from their analysis: incidents where officers deployed OC spray but it missed its intended target, where OC was intended to be used but the canister malfunctioned, incidents that involved a crowd situation, and when it was deployed against female subjects. In addition, the authors did not specify what, if any, other types of force were used before or after the deployment of OC spray. It is unknown how these factors may have affected their conclusions about OC spray effectiveness.

METHOD

Data

The data for this study were obtained from a large municipal police department. At the time of the study, the department employed approximately 2,000 sworn officers, about 1,200 of whom were patrol officers. The police department served a population of approximately 600,000; 40% of the population was African American and 10% was Latino.

Analyses were performed on all use of force incidents in 2010 and 2011 where an officer from the department intentionally discharged OC spray (n=259) or deployed a Taser (n=245) against a person. While an additional 24 incidents involved the use of OC and a Taser, and another 45 incidents involved the use of another type of weapon, the analyses conducted here focus on the 504 incidents where OC *or* a Taser was used.

All officers in the department were trained and authorized to carry and use OC spray. During the academy, officers received 4 to 8 hours of instruction on the use of OC spray. Only about 300 officers (approximately 25% of patrol officers) were trained and certified to use a Taser. Further, on each of the three shifts at each of the eight districts, approximately six to eight Tasers were available to be signed out and carried by the certified Taser officers. Therefore, at any given time during the time of this study, there were no more than 68 Tasers actually being carried by officers. With regard to Taser training, officers who volunteered for training first had to be approved by Internal Affairs. Officers who were selected to be Taser trained participated in 16 hours of "new user" training and an additional 8 hours of "refresher" training every 2 years.[5]

At the time of the study, the use of force policy of the department specified OC spray and Tasers as "control devices." According to the policy, "the goal of control devices is to overcome

[5] The only training required by TASER International is the 8 hours of "new user" training.

active resistance or its threat [italics added]." Control devices, escort holds, compliance holds and passive counter measures were more broadly considered "control alternatives." Although a continuum of force was not specified per se, "intervention options" were provided; these options ranged from presence, dialogue, control alternatives, protective alternatives (e.g., focused strikes, vertical stuns), to deadly force (see Figure 1).

Most of the data for the study were obtained from a case management system used by the police department and were converted into a Statistical Package for the Social Sciences (SPSS) data file for analyses. The database was organized with use of force incidents as the unit of analysis. The use of force data were based on reports that were completed by supervisory officers when a use of force incident occurred. According to the official policy of the department at the time of the study, a use of force report was to be completed by a supervisor when an officer: (a) discharged a firearm, (b) used a baton, (c) discharged Oleoresin Capsicum (OC), (d) deployed an Electronic Control Device (Taser), (e) used any other type of force, which resulted in an injury, or a complaint of an injury, to a person, or (f) when a department canine bit a subject in the performance of their duty. Clearly, this is a relatively narrow definition of force as it does not include incidents where only bodily force was used when that force did not result in an injury (or a complaint of an injury) to a subject (or verbal force, see Terrill & Mastrofski, 2002). Nevertheless, that the department policy did not require all bodily force incidents to be reported is of little concern in this study. This study focuses specifically on incidents that involved the use OC spray or a Taser. Departmental policy specified that all such incidents be recorded and all types of force used in those incidents be recorded.

Along with the departmental use of force report, a narrative of the incidents was also written by the supervisory officer and was included in the case management system. For this

in this study or in most others, including the distance from which the weapon was used, the type of clothing worn by the subject (heavy clothing being worn by the subject may inhibit the use of a Taser and/or the effectiveness of it), whether the target was moving at the time of weapon deployment, and the height/weight the subject in relation to the officer.

Another interesting topic for research on the issue is the impact of the *threat* of Taser use on resisting subjects. Adang et al. (2006) examined the impact of threats with respect to OC spray (in their study, OC spray was less effective when suspects were warned beforehand they were going to be sprayed), but no studies have looked at this issue with respect to Tasers; we currently lack information about how often Tasers are threatened to be used (or how often they are even displayed) by officers and the effects of those actions. Such studies could enhance our understanding of the overall effectiveness of the weapons and inform associated policy.

While there is a clear need for additional research on the use of effectiveness of OC spray and Tasers, there is also a need for additional research on the use and effectiveness of bodily force in use of force situations, especially given its frequency. Most use of force incidents begin with bodily force and most injuries to officers and subjects are as a result of bodily force (Adams, 1999). As such, it would be worthwhile for researchers to consider the effectiveness and other issues related to the use of bodily force. What factors predict the effectiveness or ineffectiveness of bodily force? There are many forms of bodily force, what types are most often used and most effective? Answers to these questions may provide insight into situations where bodily force (or certain types of bodily force) should be avoided and OC spray or Tasers used instead.

LIMITATIONS

This study contributes to the discussion about the factors associated with the use and effectiveness of OC spray and Tasers, but it has limitations. First, the data used in the study were collected from police reports which provide the official account of what happened during the use of force incident. Even the order in which force was used, which was critical for the measurement of OC spray and Taser effectiveness in this study, could be misrepresented in the reports. Although there is no evidence of systematic distortion or under-reporting in the reports, the accuracy of the reports could be questioned in this regard. Although many other use-of-force studies, and studies on other topics for that matter, also use official police reports, the veracity of the reports needs to be considered when drawing conclusions on the basis of them.

Second, the generalizability of the findings presented here can be questioned. This department had a unique arrangement for the deployment of Tasers among officers and had a specific policy which guided officer decision making in use of force incidents that involved OC spray and Tasers. Establishing external validity is always an empirical issue; as noted, there is a need for additional research to be conducted on the topic in other police departments.

Finally, this study included a relatively limited range of variables in trying to predict the use and effectiveness of OC spray and Tasers. We would benefit from additional studies that were able to include a wider range of independent variables in the prediction models. By addressing these limitations, a more complete understanding of the factors that predict the use and effectiveness of OC spray and Tasers may be developed.

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Figure 1

Description of "Intervention Options" Used in Study Department

MODE	Definition	Authorized Police Response(s)
Presence	To present a visible display of authority	Open stance, ready stance, defensive stance
Dialog	To verbally persuade	Search talk, persuasion, light control talk, heavy control talk
Control Alternatives	To overcome passive resistance, active resistance, or their threats	Escort holds, compliance holds, control devices **(i.e., OC, ECDs)**, passive countermeasures
Protective Alternatives	To overcome continued resistance, assaultive behavior, or their threats	Active countermeasures, incapacitating techniques, intermediate weapons
Deadly Force	To stop the threat	Deadly force

Table 1

OC or Taser Used: Coding and Descriptive Statistics

Variable	Scale	OC Used			Taser Used		
		M	SD	N	M	SD	N
Subject Characteristics							
Race	0=minority 1=white	.11	.31	253	.20	.40	241
Age	in years	30.70	11.17	252	30.06	10.65	239
Sex	0=female 1=male	.88	.33	251	.92	.27	240
Height	in inches	69.42	3.28	192	69.81	3.46	186
Weight	in pounds	187.49	40.76	192	188.35	46.91	186
Subject Actions							
Mental Disturbed	0=no 1=yes	.09	.29	259	.23	.42	245
Under Influence	0=no 1=yes	.43	.50	258	.46	.50	244
Believed Armed	0=no 1=yes	.22	.41	259	.40	.49	245
Actually Armed	0=no 1=yes	.08	.28	259	.16	.37	245
Fled Police	0=no 1=yes	.22	.41	259	.38	.49	245
Resistance	0=none 1=passive/verbal 2=defensive 3=active	2.40	.76	258	2.44	.73	245
Assaulted Police	0=no 1=yes	.17	.38	259	.13	.34	245
Controls							
# of Subjects		1.12	.47	259	1.04	.35	245
# of Officers Used Force		1.72	.86	259	1.92	1.12	245
# of Officers Present		2.44	1.16	259	3.37	2.03	245

Table 2

OC or Taser Effective: Coding and Descriptive Statistics

Variable	Scale	OC Effective M	OC Effective SD	OC Effective N	Taser Effective M	Taser Effective SD	Taser Effective N
Subject Characteristics							
Race	0=minority 1=white	.12	.32	187	.19	.40	217
Age	in years	30.86	11.47	185	30.02	10.62	215
Sex	0=female 1=male	.86	.35	184	.92	.28	216
Height	in inches	69.29	3.37	140	69.67	3.38	170
Weight	in pounds	184.40	39.78	140	188.05	44.00	170
Subject Actions							
Mental Disturbed	0=no 1=yes	.09	.29	191	.23	.42	221
Under Influence	0=no 1=yes	.42	.50	190	.46	.50	220
Believed Armed	0=no 1=yes	.18	.39	191	.38	.49	221
Actually Armed	0=no 1=yes	.07	.26	191	.15	.36	221
Fled Police	0=no 1=yes	.19	.39	191	.37	.48	221
Resistance	0=none 1=passive/verbal 2=defensive 3=active	2.28	.80	190	2.44	.71	221
Assaulted Police	0=no 1=yes	.14	.34	191	.12	.33	221
Controls							
# of Subjects Force Used Upon		1.14	.49	191	1.04	.37	221
# of Officers Used Force		1.60	.75	191	1.85	1.06	221
# of Officers Present		2.31	1.02	191	3.29	1.92	221

Table 3

Logistic Regression Models of OC or Taser Use

Variable	OC Used 0=no 1=yes B	p	Exp(B)	Taser Used 0=no 1=yes B	p	Exp(B)
Subject Race	-.579	.056	.560	.579	.056	1.785
Subject Age	.017	.093	1.017	-.017	.093	.983
Subject Sex	-.076	.836	.927	.076	.836	1.079
Subject Mental Disturbed	-1.193	.000	.303	1.193	.000	3.296
Subject Under Influence	-.316	.150	.729	.316	.150	1.372
Subject Believed Armed	-.619	.023	.538	.619	.023	1.858
Subject Actually Armed	.149	.704	1.160	-.149	.704	.862
Subject Fled Police	-.897	.000	.408	.897	.000	2.452
Subject Resistance	-.199	.207	.819	.199	.207	1.221
Subject Assaulted Police	.527	.079	1.694	-.527	.079	.590
No. of Subjects	.584	.041	1.794	-.584	.041	.558
No. of Officers Used Force	.202	.140	1.224	-.202	.140	.817
No. of Officers Present	-.512	.000	.599	.512	.000	1.668
Constant	1.301	.054	3.673	-1.301	.054	.272
Log likelihood	565.613			565.613		
Model Chi Square	103.617			103.617		
df	13			13		
Significance	.000			.000		
R Squared (Nagelkerke)	.258			.258		
N	483			483		

Notes: B=log odds, p=significance, Exp (B)=odds ratios

Table 4

OC and Taser Effectiveness

OC was Used in 259 incidents (no Taser used)

In 63 incidents only OC used
In 196 incidents OC and other form(s) of force were used

In 128 of the 196 incidents, OC ended the encounter
In 68 of the 196 incidents, another type of force ended encounter
(i.e., bodily force = 63; baton = 5)

63 + 128 = 191 / 259 = OC 73.8% effective rate

Taser was Used in 245 incidents (no OC used)

In 85 incidents only a Taser used
In 160 incidents a Taser and other form(s) of force were used

In 136 of the 160 incidents, a Taser ended the encounter
In 24 of the 160 incidents, another type of force ended encounter
(bodily force = 21; baton = 1; firearm = 2)

85 + 136 = 221 / 245 = Taser 90.2% effective rate

OC and Taser were Used in 24 incidents

In 22 of the 24 incidents, the Taser ended the encounter
In 2 of the 24 incidents, OC ended the encounter

Another Weapon was Used in 45 incidents (no OC or Taser)

In 22 of the 45 incidents, only a firearm was used
In 14 of the 45 incidents, bodily force and a baton were used
In 4 of the 45 incidents, only a baton was used
In 3 of the 45 incidents, bodily force and a firearm were used
In 1 of the 45 incidents, gas and a firearm was used
In 1 of the 45 incidents, bodily force and a flashlight were used

Table 5

Logistic Regression of OC and Taser Effectiveness

Variable	OC Effective 0=no 1=yes B	p	Exp(B)	Taser Effective 0=no 1=yes B	p	Exp(B)
Subject Race	.424	.434	1.528	-.317	.617	.728
Subject Age	.012	.451	1.012	-.014	.557	.986
Subject Sex	-1.433	.076	.239	-.419	.714	.658
Subject Mental Disturbed	-.423	.455	.655	-.001	.999	.999
Subject Under Influence	-.340	.323	.712	.071	.890	1.073
Subject Believed Armed	-.351	.411	.704	-.416	.456	.660
Subject Actually Armed	-.726	.251	.484	-.397	.556	.672
Subject Fled Police	-.265	.483	.767	-.768	.144	.464
Subject Resistance	-.664	.027	.515	.232	.516	1.261
Subject Assaulted Police	-.529	.189	.589	-.754	.255	.470
No. of Subjects	.661	.222	1.037	.657	.697	1.929
No. of Officers Used Force	-.414	.062	.661	-.531	.017	.588
No. of Officers Present	-.174	.286	.840	.000	.998	1.000
Constant	4.651	.001	104.660	3.647	.122	38.343
Log likelihood	244.171			139.531		
Model Chi Square	41.147			15.443		
df	13			13		
Significance	.000			.281		
R Squared (Nagelkerke)	.224			.134		
N	248			235		

Notes: B=log odds, p=significance, Exp(B)=odds ratios

study, all of the narratives for incidents that involved the use of OC and/or a Taser were reviewed (787 pages) and additional data were coded from them (e.g., level of subject resistance, the order in which force was used by officers).

Variables

The two primary dependent variables in this study are: 1) the *use of* OC spray and the Taser and 2) the *effectiveness of* OC spray and the Taser. Determining whether or not a particular type of force was used in an incident was relatively straight-forward. If OC was sprayed or a Taser was deployed, OC or the Taser was considered to have been used. If the target was missed, if the weapon malfunctioned, if it was used in a crowd situation, or if it was used against females, the incident was still included. If the incident involved multiple officers and/or multiple subjects, the incident was included. In the few incidents that involved multiple subjects, the characteristics of the person identified as the primary subject in the officer's report was coded.

Determining the effectiveness of OC spray and the Taser was more complicated. As discussed earlier, previous studies have used different measures of effectiveness although each study, in one way or another, examined how well, or to what degree, OC spray or the Taser incapacitated the subject who resisted the police. Of course, the variation in measurement is important to consider when interpreting findings across studies. Ultimately, in a use of force incident, the legitimate objective is to neutralize the threat posed by the subject and gain control over that subject. Most often, practically speaking, "gaining control" means using as much force as necessary in order to place handcuffs on the subject. Many use-of-force situations are

complicated; they unfold, one action leads to another, but ultimately force is used to gain control over the physical actions of the subject.

In this study, we provide a relatively straight-forward, bottom-line, measure of OC and Taser effectiveness. OC spray and/or Tasers were considered effective in two circumstances: First, if OC or a Taser was the *only* type of force that was used in the incident in order to subdue/handcuff the subject, OC or the Taser was considered effective. In these situations, OC spray or the Taser, by itself, led to the legitimate desired outcome; it was effective. Second, if OC or a Taser was the *last* type of force used in the incident prior to the subject being subdued/handcuffed, then OC or the Taser was considered effective. For example, if OC spray was deployed but then some other type of force was necessary in order to gain control over the subject to the point of placing him in handcuffs, then the OC was considered ineffective. OC may, or may not, have had some effect, but ultimately it was not effective in achieving the legitimate objective of the use of force incident—additional force needed to be used.

Of course, one must not lose sight of the possible cumulative effects that various types of force that were used in an incident may have in bringing an incident to an end. Indeed, several of the studies reviewed above simply did not take into account any other types of force that may have been used in the incident. Given the nature of the data analyzed in this study, measuring the precise effect that various forms of force may have had in a use of force incident is difficult, if not impossible. Nevertheless, to the extent possible, and when possible, we consider not only the last type of force used, but all types of force used in the incident. It is also important to highlight that the same criteria are used in measuring the effectiveness of OC and Tasers, providing for an equal ("apples-to-apples") comparison of the effectiveness of the two forms of

force. It is in these ways that an understanding of the relative effectiveness of OC and Tasers can be achieved.

Independent Variables

The independent variables in this study consist of subject characteristics and actions (see Tables 1 and 2 for coding and descriptive statistics). In particular, we focus on: 1) who was the subject? and 2) what did the subject do? Officer characteristics are not included primarily because of the analytic difficulties in doing so.[6] The number of officers who used force in an incident and the number of officers present when force was used were coded and included in the analyses as controls. The number of subjects who had force used upon them was also coded and included as a control.[7]

Data on "who the subject was" (i.e., the characteristics of the subject) were coded according to the supervisor's report. These variables consisted of subject race (white/minority[8]), age, sex, height, and weight.

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[6] Of course, this is a less than optimal solution to the issue; however, previous studies have struggled with the same issue and also resolved it in less than optimal ways. For instance, studies that have included officer characteristics either included only one officer when multiple officers were involved in the incident (Adang et al., 2006; Kaminski et al., 1999), or counted single incidents multiple times if multiple officers used force (White and Ready, 2007). Some studies are unclear about how multiple officer and multiple subject incidents were handled in the analyses (Morabito and Doerner, 1997). Each of these options essentially reduces the complexity of the incidents that are analyzed. None of these options are good, nor is the exclusion of officer characteristics; however, by not including officer characteristics we do not systematically exclude cases. Clearly, there is a trade-off between model error and sample bias.

[7] As noted, in multiple subject incidents, the characteristics of the primary subject, as identified in the police narrative report, were coded and included in the analyses.

[8] Ideally, sub-racial and ethnic groups would be analyzed instead of the "minority" category (Gau et al., 2010). However, too few Hispanics and/or other ethnic/racial group members were included among the incidents. The "minority" group classification consisted of 90% African American subjects (377 out of 419).

Most of the data on "what the subject did" (i.e., how the subject acted) were coded from the narrative reports prepared by supervisory officers and the statements included in the reports. These variables consisted of: whether the subject was mentally disturbed (yes/no), whether the subject was under the influence of drugs or alcohol (yes/no), whether a subject was believed to be armed with a weapon (yes/no), whether a subject was actually armed with a weapon (yes/no),whether a subject fled the police on foot (yes/no), whether a subject assaulted an officer ("yes" if it was stated in the narrative that the subject intentionally hit, kicked, bit, shot, stabbed, or spat upon an officer, "no" otherwise), and the level of resistance offered by the subject (coded on the basis of information provided in the narrative).[9]

RESULTS

Given the purposes of this study, results are organized into two sections: 1) those that relate to the *use* of OC spray and the Taser and 2) those that relate to the *effectiveness* of OC spray and the Taser. We begin with bivariate analyses and multivariate analyses of OC/Taser use and then turn attention to bivariate and multivariate analyses of OC/Taser effectiveness.

The Use of OC Spray and Tasers

How do the 259 incidents where OC spray was used differ from the 245 incidents where a Taser was used? This question was first addressed by calculating statistical differences

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[9] Examples of *passive* resistance included when a subject refused to exit a car, subject went limp, subject refused to move after being ordered to do so, subject refused to show hands after being ordered to do so; examples of *verbal* resistance included when a subject told the officer(s) to leave him/her alone, subject stated he or she will not comply; examples of *defensive* resistance included when subject attempted to or actually fled the police, the subject attempted to hide from the police, subject pulled away from the officer, subject got up after being directed to the ground; examples of *active* resistance included subject fighting with the police, subject lunging at officer, subject attempting to disarm the officer (Terrill and Mastrofski, 2002).

between the variables of interest and OC spray and Taser incidents on the basis of chi-square and *t* tests (for the sake of space, results are not tabled here). Next, a logistic regression equation was estimated to identify factors that predicted OC spray versus Taser use; these results are shown in Table 3.

In the bivariate analyses, OC spray was significantly more likely than a Taser to be used on minority subjects ($X^2 = 6.82$; $p < .01$); OC spray and a Taser were equally likely to be used regardless of subject age, sex, weight, or height. A Taser was significantly more likely to be used than OC when the subject appeared to be mentally disturbed ($X^2 = 18.61$; $p < .01$), was believed to be armed with a weapon ($X^2 = 19.23$; $p < .01$), when the subject was actually armed with a weapon ($X^2 = 6.52$; $p < .05$), and when the subject fled the police on foot ($X^2 = 16.14$; $p < .01$). OC spray and Tasers were equally likely to be used when the subject was believed to be under the influence of alcohol or drugs, when the subject assaulted a police officer, and regardless of the amount of resistance provided to the police. OC was more likely to be used than a Taser when more than one subject had force used upon them in the incident ($t = -2.03$; $p < .05$); a Taser was more likely to be used than OC when more officers used force in the incident ($t = 2.30$; $p < .05$) and when more officers were present at the incident ($t = 6.39$; $p < .01$).

Table 3 shows the results of the logistic regression analyses performed for OC spray and Taser use. Due to substantial missing data, subject height and weight were not included in the equation. Two models were estimated: one compares those incidents where OC was used to those incidents where a Taser was used ("OC Used"), the other compares Taser use to OC use ("Taser Used"). The independent variables identified as significant in the earlier analyses are similar to those identified as significant here. First, all other variables held constant, when the subject was believed to be mentally disturbed, a Taser was more than two times more likely to be

used than OC spray (odds ratio = 3.296; p = .000). Second, when the subject was believed to be armed, a Taser was significantly more likely to be used than OC spray (odds ratio = 1.858; p = .023). Third, when the subject fled the police on foot, a Taser was significantly more likely to be used on the subject than OC spray (odds ratio = 2.452; p = .000). Fourth, when there were more subjects involved, OC spray was nearly 80% more likely to be used than a Taser (odds ratio = 1.794; p = .04). Finally, when there were more officers present at the incident, a Taser was significantly more likely to be used (odds ratio = 1.668; p = .000).

The Effectiveness of OC Spray and Tasers

Before examining the factors associated with the effectiveness of OC and Tasers spray, it is necessary to calculate an effectiveness rate for OC spray and Tasers (see Table 4). Of the 259 incidents where OC spray was used, 63 involved only the use of OC spray. That no other force was needed to subdue the subject can be considered reasonable evidence that OC spray was effective. In the other 196 incidents, OC spray and some other force were used. In these 196 incidents, the order in which force was applied is meaningful. In 128 of these 196 incidents, OC ended the encounter; presumably OC was used to subdue the subject because the force that was applied prior to the OC did not work, or did not appear to be working, at least in the judgment of the officer who deployed the OC spray.[10] There were 68 incidents where OC was deployed during the incident but some other force ended the encounter.[11] To calculate an effectiveness rate of OC spray, the 63 incidents that only involved OC spray and the 128 incidents where OC

[10] Of the 128 incidents, in 125 of them bodily force was used prior to OC spray; in 3 incidents, bodily force and a baton were used prior to OC.

[11] Of the 68 incidents, 63 ended as a result of bodily force, 5 ended with the use of a baton.

was used last are combined (63 + 128) and divided by the total number of incidents in which a OC spray was used (259). This calculation results in a 73.8% effectiveness rate.

Of the 245 incidents where a Taser was used, in 85 of them, only a Taser was used. In the other 160 incidents, a Taser and some other force were used. In 136 of the 160 incidents, a Taser was the last type of force used.[12] In the other 24 incidents, a Taser was deployed first but some other force ended the encounter.[13] To calculate an effectiveness rate of Tasers, the 85 incidents that only involved a Taser and the 136 incidents where a Taser was used last are combined (85 + 136) and divided by the total number of incidents in which a Taser was used (245). This calculation results in a 90.2% effectiveness rate. Using the same parameters for calculating the effectiveness of OC spray and Tasers, it is clear that Tasers demonstrate a substantially higher effectiveness rate than OC.

As demonstrated in prior studies, OC spray and Tasers may be more effective with some subjects than with others. Again, we calculated statistical differences between the variables of interest and OC spray and Taser incidents on the basis of chi-square and *t* tests (results not tabled). Overall, the results showed that the effectiveness of OC and Tasers did not vary significantly by any of the subject demographic variables included: subject race, age, sex, height, or weight. OC spray was significantly less effective when the subject was believed to be armed ($X^2 = 4.67; p < .05$), when the subject assaulted the police ($X^2 = 5.88; p < .05$), and when the subject provided higher levels of resistance ($X^2 = 16.91; p < .01$). As with OC spray, Tasers

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[12] Of the 136 incidents, in 135 of them bodily force was used prior to the Taser; in 1 incident, bodily force and a baton was used prior to a Taser.

[13] Of the 24 incidents, 21 ended as a result of bodily force, 1 ended with the use of a baton, and 2 ended with the use of a firearm.

were less effective with greater subject resistance ($X^2 = 10.78$; $p < .05$). The results also showed that OC spray and Tasers were less likely to be the last type of force used (less likely to be "effective") when more officers used force in the incident ($t = 3.73$; $p < .01$ and $t = 3.29$; $p < .01$, respectively). OC spray and Tasers were also less likely to be the last type of force used when more officers were present during the incident ($t = 3.00$; $p < .01$ and $t = 2.04$; $p < .05$, respectively).

To identify more directly the factors that predict the effectiveness of OC spray and Tasers, two logistic regression equations were estimated: one for OC effectiveness the other for Taser effectiveness (see Table 5). For each model, the comparison was between effective versus not effective. There are two primary findings worthy of discussion based on the logistic regression results. First, while the OC model is significant, the Taser model is not. It appears that the Taser is uniformly effective, regardless of the variables included here. Second, of all the variables examined, the only significant predictor of OC spray effectiveness is subject resistance. With more resistance offered, OC spray was 48% less likely to be effective (odds ratio = .515; p = .027).[14] Apparently, OC spray alone is not enough to subdue a subject who is more resistive.

DISCUSSION

Previous research on the use and effectiveness of OC spray and Tasers is characterized by incomplete and conflicting findings. There are simply too few studies from which to draw conclusions. Varying study sites, comparisons, data sources, and measurement schemes certainly contribute to these conflicting findings. Nevertheless, a basic conclusion of previous research is that OC spray and Tasers are used in different circumstances. This study used

[14] Congruent with Kaminski et al. (1999), in each of the logistic regression models, younger and older subjects (under 22 and over 38) were compared to "middle" aged subjects (22-37). The results of the analyses did not change in any meaningful way.

OC Spray/Taser Effectiveness

The only significant predictor of OC spray (in)effectiveness was subject resistance. The more a subject resisted the police, the less likely OC spray was to be effective. In particular, when OC spray was used in situations where the subject resisted, it was likely that OC was not the last type of force used. Either the OC spray led to additional resistance that had to be overcome with other force, or OC was not effective in subduing a subject who was already resisting. The model predicting Taser effectiveness was not significant; this suggests that the Taser was effective to the degree that our predictors did not contribute to our understanding of its effectiveness. As noted, the observed level of Taser effectiveness may be a function of the circumstances in which Tasers are used, the amount and quality of training officers received with the Taser, as well as their limited deployment in the study department.

With regard to the effectiveness rates of OC spray and the Taser, and congruent with previous studies, we found that the Taser was substantially more effective than OC spray. Given the research that has been conducted, it is safe to say that Tasers have inherent advantages over OC spray in their ability to incapacitate subjects. However, with this conclusion, it is important not to lose sight of the fact that OC spray and Tasers are simply tools and, like hammers, can be more effectively used by some people than others.

In summary, OC spray and Taser use and effectiveness are clearly different outcomes with different predictors. Overall, suspect behaviors are of value in predicting the *use* of OC and Tasers but not when predicting their *effectiveness*. While suspect behaviors may drive the decision to choose OC spray or the Taser over other forms of force, other factors determine whether OC spray or the Taser actually work to induce suspect compliance. For example, whether OC spray actually works may have less to do with the subject's characteristics and

actions, and more to do with the capabilities of the weapon itself (e.g., amount of OC sprayed, distance between officer and suspect when OC is sprayed). Further research that directly compares OC spray with Tasers may highlight other critical variables that would help explain the use and effectiveness of them.

IMPLICATIONS FOR POLICY AND RESEARCH

Given the relative paucity of research on the use and effectiveness of OC spray and Tasers, specific policy implications are premature. However, when considering the current findings along with the results of prior studies, several policy- and especially research-related questions come to light.

In particular, how Tasers are distributed among officers may have implications for their use and effectiveness in particular police departments. Specifically, are Tasers used at a higher rate if more officers are equipped with them? Is OC spray used at a lower rate if more officers are equipped with Tasers? If more officers are equipped with Tasers, and Tasers are used more frequently, is Taser effectiveness impacted? In addition, does the amount, type, and quality of training received by officers on OC spray and Tasers impact their use and effectiveness? To what extent does organizational policy regarding the use of OC spray and Tasers affect their use and effectiveness? As such, it would be worthwhile and interesting to consider the use and effectiveness of OC and Tasers across similar departments with different deployment arrangements, training standards, and policies regarding the OC and Tasers. Clearly, there is variance between departments in this regard.

It will not be until research accumulates that it will be possible to draw conclusions about the use and effectiveness of OC and Tasers with confidence. Along with factors already mentioned, the effectiveness of OC spray and Tasers are likely to depend on factors not included

Method

NYPD and the Taser

This article examines all Taser incidents involving police officers from the NYPD from January 2002 through December 2005 (N = 375). The NYPD is cautious in its approach to the deployment of Tasers, and its use is closely monitored. The Taser is issued only to officers in the Emergency Service Unit (ESU). The ESU is responsible for situations that require advanced equipment and expertise, such as crisis situations involving the mentally ill, hostages, and suicidal suspects. The unit consists of several hundred officers, which is a relatively small proportion of the 35,000 sworn NYPD officers. Also, supervisors at the rank of sergeant and above are trained to use the Taser, and each precinct is equipped with one or more devices that can be signed out, though they are not required to carry it. The patrol guide details fairly specific circumstances in which it is appropriate to use the device:

> Patrol supervisors or uniformed members of the service assigned to the Emergency Services Unit may utilize a Taser/electronic stun device to assist in restraining emotionally disturbed persons if necessary. The Taser/electronic stun device may be used:
>
> a. To restrain an EDP [emotionally disturbed person] who is evincing behavior that might result in physical injury to himself or others, OR
> b. To restrain person(s) who, through the use of drugs, alcohol, or other mind-altering substances, are evincing behavior that might result in physical injury to himself or others.
>
> Emergency Service Unit personnel will obtain the permission of the Emergency Service Unit Supervisor prior to utilizing a Taser/electronic stun device, except in emergencies. (NYPD, 2000)

As a result, deployment of the Taser is allowed only in situations involving an EDP or person under the influence of drugs or alcohol who is posing a threat of physical injury where either ESU officers are dispatched or a supervisor is present and has a Taser in his or her possession.[5]

The data analyzed for the current study are derived from a "Taser/stun device report," which is completed every time an officer deploys the weapon.[6] The report contains a series of questions that use check boxes to elicit a range of information about demographic characteristics of the suspect, his or her emotional and physical state, behavior and level of resistance,

weapons present, the rank and assignment of the officer, and characteristics of Taser deployment (e.g., distance, effect, etc.). Most items on the report are formatted as multiple-choice questions, with an additional narrative section where the officer is required to describe the incident in detail. From these reports, the authors created a data set in SPSS that captures 40 variables relating to each Taser incident. These independent variables serve as predictors of Taser effectiveness for the multivariate analysis. Though the research was admittedly limited by the information collected on the Taser/stun device report, the authors note the earlier work conducted by Kaminski et al. (1999), which employed a similar design and analysis, with similar variables, for an evaluation of the effectiveness of OC spray.

The Dependent Variable: Measuring Effectiveness

The dependent variables used in the study include three separate but related measures of effectiveness. The first two measures of effectiveness are based on the extent of suspect resistance. Specifically, the field report contains several items that measure whether suspect resistance ended after the Taser was deployed and notes how much time transpired (in seconds) before the suspect was incapacitated. A follow-up item requires the responding officer to indicate whether the suspect was incapacitated at all. The average time to incapacitation was 8.10 seconds, but this measure should be viewed with caution. It is likely that officers at the scene were far more concerned about bringing the suspect under physical control than counting the number of seconds needed to terminate the struggle and apply handcuffs. For this reason, we will focus on the dichotomous measures of resistance for the analysis.

In one third of the cases (33.0%), the suspect continued resisting against the officer after the Taser was deployed. The cases involving continued resistance can be divided into two categories based on the nature and duration of the resistance. In 32 cases, the resistance continued immediately following the Taser deployment because the suspect was not restrained by the weapon; that is, at no point was the subject subdued, and he or she continued to resist (*continual resistance*). The Taser was clearly ineffective during these incidents, perhaps because of loose or heavy clothing blocking the darts from making full contact, mechanical failure, or resilience on the part of the suspect. In the other 65 cases involving continued resistance, the subject was initially incapacitated by the Taser and the officer(s) gained control temporarily; however, the suspect began resisting again at a subsequent

point in time (*any resistance*). The distinction between these two different outcomes draws attention to the temporary impact of the Taser (i.e., the involuntary loss of muscle control is not long term) and shows the importance of carefully observing the suspect's actions immediately after the Taser is deployed. Because of the practical importance of this distinction in resistance, both measures are used as dependent variables in the analysis. The base rates for any subsequent resistance and continual resistance are 33.0% and 10.9%, respectively.[7]

At the end of the Taser/stun device report, the officer is instructed to indicate whether the device performed satisfactorily (yes or no). Police officers' responses to this question serve as the third measure of Taser effectiveness. Officers reported that the Taser performed satisfactorily during 78.7% of the cases. Officer satisfaction is likely related to a host of factors, including the physiological effect on the suspect and the outcome of the deployment taken as a whole. Did the Taser discharge as intended? Did both prongs strike the target, and if so, did they penetrate the suspects' clothing? Did the suspect stop resisting the officer and was he or she subsequently taken into custody? Finally, was anyone seriously injured during the altercation?

Data Analysis

The authors employed two analytic approaches, logistic regression and CHAID (a form of segmentation modeling), to identify predictors of Taser effectiveness. Descriptive analyses were conducted to identify significant relationships at the bivariate level. The bivariate findings, theory, and practical expectations directed the identification of predictors for the multivariate analysis, though all variables were included in the multivariate analysis. Logistic regression is employed because all three measures of effectiveness are dichotomous outcomes with yes-or-no responses. Similar to logistic regression, CHAID predicts the probability of an event's occurring, but the method relies on different assumptions and properties and uses segmentation modeling to accomplish the task. CHAID divides a population into "increasingly homogenous" segments that differ on the basis of the dependent variable; in this case, suspect resistance and officer satisfaction (Jones, Harris, Fader, & Grubstein, 2001, p. 490). The resulting segments are mutually exclusive and exhaustive, and as the analysis proceeds, the best predictor is selected among a particular subgroup of cases based on chi-square analysis.

CHAID analysis is employed in this study because it offers a number of advantages. First, "one significant advantage of this approach is that the model can find different combinations of predictors for different subsets of the population" (Jones et al., 2001, p. 490). This is especially useful if there is reason to suspect that predictors may differ in their impact among subgroups. For example, predictors of suspect resistance may be different for intoxicated and sober suspects, and CHAID facilitates the identification and exploration of these interactions. Second, Jones et al. (2001) point out that numerous studies have examined statistical issues in risk prediction (Gottfredson, 1987; Simon, 1971; Tarling & Perry, 1985), including the use of CHAID and more traditional methods such as logistic regression, and the general consensus is that "no method is consistently better than any other" (Tarling & Perry, 1985, p. 212). With this conclusion in mind, multiple methods allow researchers to either "triangulate" their findings or identify inconsistencies across techniques. Last, an additional benefit of CHAID is the user-friendly visual representation of variables that interact to produce an outcome; in this case, the technique highlights the important situational dynamics of Taser incidents—and how those dynamics relate to outcomes—in a more interpretable manner for practitioners and policy makers.

Limitations and Considerations

Several limitations of this study should be considered. First, the article examines official reports from one police department that has deployed the Taser in a controlled, limited manner. This impairs the generalizability of the findings to other police departments, particularly, those agencies that have issued the Taser to all patrol officers.[8] Second, this study examines only Taser incidents that generated an official police report. There is no indication that officers are not completing the Taser field report on a systematic basis, especially considering that the device tracks each deployment electronically; however, it is possible that some incidents did not result in a report. Third, anecdotal evidence provides some support for a deterrent effect when the Taser is exposed to a potential subject but not used; that is, much like the firearm, suspects may become compliant when confronted with the imminent possibility of being stunned with the Taser. Researchers and police practitioners would consider this type of incident as a successful de-escalation, but these situations are not captured in the data because the NYPD requires a field report after discharge only.

Results

Descriptive Analysis of Taser Incidents

Suspect characteristics. Suspects targeted in the Taser incidents were primarily male (88.8%) with a mean age of 34.9; more than half were African American (52.1%), 18.7% were White, and 27.3% were Hispanic (see Table 1). Most of the suspects did not appear under the influence of drugs or alcohol (87.2%), but the majority exhibited signs of mental illness (92.5%) and were therefore identified by the responding officers as EDPs.[9] About 40% of the subjects were armed with a weapon (39.6%), most commonly, a kitchen knife or cutting instrument (84% of armed suspects, 32% of all cases).[10] The vast majority of suspects (95%) engaged in physical violence. The violent behavior was directed at an officer during more than half of the incidents (53.3%), one fifth involved a threat of suicide or self-harm (18.6%), and the remaining violent individuals (18.9%) directed their aggression toward multiple individuals at the scene.

Officer characteristics. The Taser/stun device report captures limited information regarding the officer who deploys the weapon. More than half of the officers who used the device were detectives (55.5%), and 41.2% were patrol officers. Just 3.2% were supervisors. More than 90% of the officers were assigned to the ESU. In the majority of cases, the officer deploying the Taser was not alone. One or more back-up officers were present during nearly all of the incidents (93.5%), and a supervisor was present in 88.1% of the cases.[11]

At the bivariate level, there are notable differences in officer rank with regard to the outcomes of interest: satisfaction and suspect resistance. During the study period, 12 cases involved supervisors who were not assigned to the ESU (i.e., patrol sergeants). The effectiveness ratings from these supervisors are significantly lower than the ratings from the ESU officers: Any suspect resistance was reported by 54.5% of the supervisors, compared to 26.7% of police officers and 36.3% of detectives; 20.0% of the supervisors reported resistance immediately after the Taser was used, compared to 7.6% of police officers and 12.0% of detectives; and 41.7% of the supervisors reported being satisfied with the Taser, compared to 81.7% of police officers and 79.4% of detectives.[12] These findings may have implications for the NYPD, because supervisors outside of the ESU receive less training in use of the Taser and may also be using an older model of the device.

Table 1
Characteristics of Suspects and Officers Involved in Taser Deployments

	Percentage	n
Suspect characteristics		
Gender		
Male	88.8	332
Female	11.2	42
Total	100.0	374
Racial background		
African American	52.1	189
White	18.7	68
Hispanic	27.3	99
Asian or Other	1.9	7
Total	100.0	363
Mean age = 34.9 years		332
Emotionally disturbed		
No	7.5	28
Yes	92.5	347
Total	100.0	375
Intoxicated		
No	87.2	321
Drugs	7.1	26
Alcohol	4.3	16
Both drugs and alcohol	1.4	5
Total	100.0	368
Armed with a weapon		
No	60.4	217
Yes	39.6	142
Total	100.0	359
Violent behavior		
No	5.2	19
Toward self	18.6	68
Toward officer	53.3	195
Toward other citizens	4.1	15
Toward multiple	18.9	69
Total	100.0	366
Officer characteristics		
Rank		
Patrol officer	41.2	153
Detective	55.5	206
Supervisor	3.2	12
Total	100.0	371
Command		
Emergency Service Unit	91.2	321
Other	8.8	31
Total	100.0	352
Back-up present		
No	6.5	22
Yes	93.5	318
Total	100.0	340
Supervisor Present		
No	11.9	42
Yes	88.1	310
Total	100.0	352

Note: Total numbers are different because of missing data. In some of the study cases, information for one or more variables was missing, and the tables reflect known information only.

Incident characteristics. More than three quarters of the incidents occurred indoors (see Table 2). Per department policy, the majority of suspects (95.6%) were transported to a hospital for a physical examination following the incident. Interestingly, three quarters of the subjects (75.9%) were not arrested after the incident, although many of them were held at the hospital for psychological examination and/or civil commitment. The average distance between the officer and the suspect at the time of deployment is approximately 5.5 feet. In 80.7% of the incidents, the Taser was deployed only once by the officer, and in nearly 80% of the cases, both darts made contact with the suspect as intended. Officers used the device in stun mode in 48 incidents (direct contact to skin, no darts).[13] In 22% of the cases, officers also used another nonlethal device, most typically another type of stun device (14%) or pepper spray (5%). In 86% of the cases, a supervisor indicated that use of the Taser was consistent with departmental policy.[14] Findings with regard to officer satisfaction and suspect resistance—the dependent variables for the multivariate analysis—have been summarized above.

Multivariate Analysis

Logistic regression analysis. Table 3 displays the results of the logistic regression models predicting the three measures of Taser effectiveness. The table provides the logistic regression coefficients, standard errors, and odds ratios for the independent variables in each of the models. The likelihood ratio test for each of the models was statistically significant, and Nagelkerke R^2 estimates suggest that the models predicting any subsequent suspect resistance, resistance immediately after use of the Taser, and officer satisfaction accounted for 23%, 13%, and 21% of the explained variation, respectively.[15] In the first model, statistically significant predictors of any suspect resistance include the following:

- The suspect's body weight is greater than 200 pounds.
- Distance between the officer and the suspect is 3 feet or less.
- The suspect is under the influence of drugs or alcohol.
- The suspect directs violence toward an officer or citizen (as opposed to oneself).
- One or both Taser darts missed the intended target.
- The officer used another nonlethal device before or after using the Taser.[16]

Specifically, when one or both Taser darts miss the suspect, the likelihood of any suspect resistance increases by about 300%. Three predictors—violence directed at an officer or citizen, drug or alcohol intoxication, and

Table 2
Characteristics of Incidents Resulting in Taser Deployments

Incident Characteristic	Percentage	n
Location		
Indoors	77.5	286
Outdoors	22.5	83
Total	100.0	369
Suspect arrested		
No	75.9	274
Yes	24.1	87
Total	100.0	361
Suspect transported to hospital		
No	4.4	16
Yes	95.6	346
Total	100.0	362
Number of Taser deployments		
One	80.7	284
More than one	19.3	68
Total	100.0	352
Mean distance between officer and suspect = 5.41 feet		
Darts on target		
Both darts on target	77.7	240
One dart missed	4.5	14
Both darts missed	1.6	5
Darts made contact but fell from clothing	0.6	2
Device used in stun mode	15.5	48
Total	100.0	309
Was suspect incapacitated?		
No	13.2	42
Yes	86.8	277
Total	100.0	319
Mean time to incapacitation = 8.10 seconds		
Did suspect continue to resist?		
No	67.0	235
Yes	33.0	116
Total	100.0	351
Officer satisfied with Taser?		
No	21.3	74
Yes	78.7	273
Total	100.0	347

Note: Total numbers are different because of missing data. In some of the study cases, information for one or more variables was missing, and the tables reflect known information only.

police use of another less lethal weapon—more than double the odds of the occurrence of any suspect resistance during Taser incidents. In addition, suspects who weigh more than 200 pounds are about 84% more likely to resist the officer after the Taser is deployed.

Significant predictors of resistance occurring immediately after deployment of the Taser include the following:

- The suspect's body weight is greater than 200 pounds.
- The suspect is under the influence of drugs or alcohol.
- One or both Taser darts missed the intended target.

Findings for the second model are similar to the model predicting any suspect resistance. Continual resistance immediately after the Taser is deployed is most likely to occur in circumstances where the Taser darts miss a large suspect who is intoxicated.

Results from the model predicting officer satisfaction indicate that the following independent variables are statistically significant:

- The suspect's body weight is 200 pounds or less.
- Distance between the officer and the suspect is greater than 3 feet.
- The suspect is armed with a knife or gun.
- Both Taser darts struck the intended target.[17]

Interestingly, the strongest predictor of officer satisfaction with the Taser is the suspect's being armed with a knife or gun. When the suspect is armed with a weapon, the likelihood of police's reporting that they are satisfied with the Taser is about 200% greater. A possible explanation may be that the likelihood that harmful consequences will occur when the Taser does not work properly is greater when the suspect is armed with a knife or gun; therefore, the sense of relief experienced when the device does perform properly in these volatile situations affects the officer's reporting of satisfaction. The distance between the officer and the suspect during the Taser deployment is also positively associated with officer satisfaction with the device.

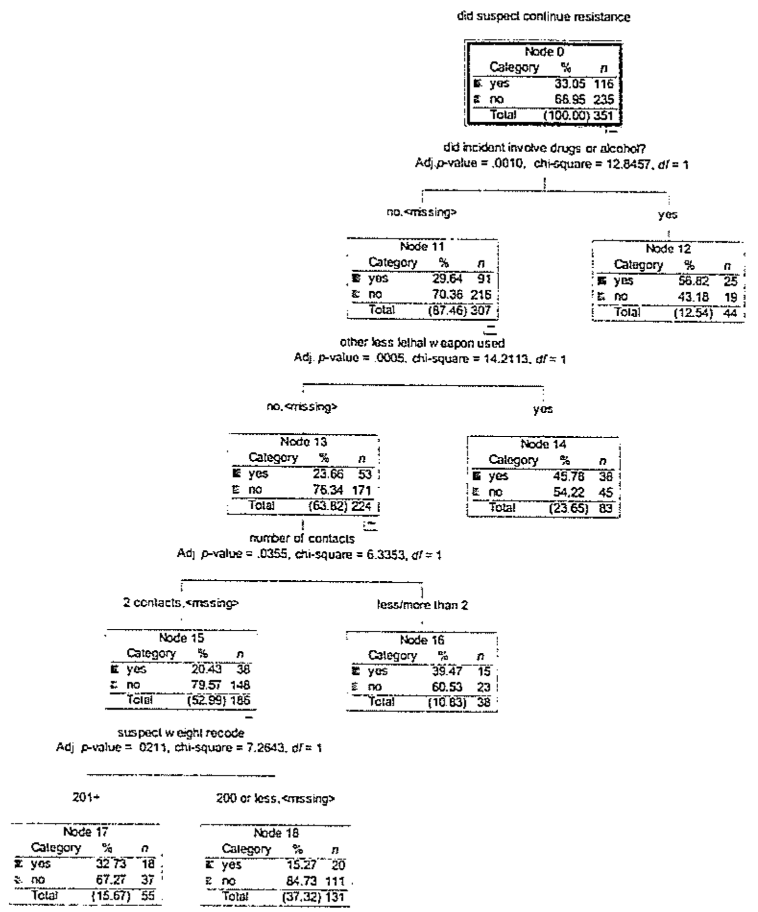
CHAID analysis. Figures 1 to 3 show the results of the CHAID analysis, which uses the same set of variables to predict Taser effectiveness. In Figure 1, the top cell (or root node) in the CHAID tree reflects 33.05% of the cases where any suspect resistance occurred. The initial split was made on the basis of whether the suspect was under the influence of drugs or alcohol, thus separating the 375 Taser cases into two cells: those where the

Table 3
Logistic Regression Predicting Three Measures of Taser Effectiveness

Predictor Variables	B	SE	Wald	Odds Ratio	p Value
Any suspect resistance					
Suspect weight	0.612	.302	4.114	1.844	.043
Distance	−0.667	.306	4.735	0.513	.030
Suspect intoxicated	0.954	.410	5.418	2.596	.020
Suspect violent toward others	0.884	.373	5.617	2.421	.018
One or both prongs miss target	1.393	.531	6.887	4.028	.009
Other less lethal weapon used	1.057	.312	11.445	2.877	.001
Log likelihood	285.065				
R^2 (Nagelkerke)	.227				
Chi-square	46.051				
df	6				
Significance	.000				
n	255				
Resistance immediately after deployment					
Suspect weight	0.882	.416	4.484	2.415	.034
Suspect intoxicated	1.285	.486	6.982	3.614	.008
One or both prongs miss target	1.744	.569	9.379	5.717	.002
Log likelihood	164.691				
R^2 (Nagelkerke)	.130				
Chi-square	17.634				
df	3				
Significance	.001				
n	262				
Officer satisfaction					
Suspect weight	−0.904	.338	7.133	0.405	.008
Distance	0.928	.337	7.586	2.528	.006
Suspect armed with gun or knife	1.111	.422	6.945	3.037	.008
One or both prongs miss target	−2.193	.578	14.408	0.112	.000
Log likelihood	229.067				
R^2 (Nagelkerke)	.213				
Chi-square	37.268				
df	4				
Significance	.000				
n	246				

suspect was not intoxicated (n = 307; 87.46% of the total) and those where the suspect was intoxicated (n = 44; 12.54% of the total). The splits in CHAID are made according to differences in the dependent variable (i.e., any suspect resistance): Of suspects who were intoxicated, 56.8% continued to resist, compared to 29.6% of suspects who were not intoxicated. An additional split was made from the *not intoxicated* cell and is based on

Figure 1
CHAID Analysis Predicting Any Suspect Resistance



Note: CHAID = chi-square automatic interaction detection.

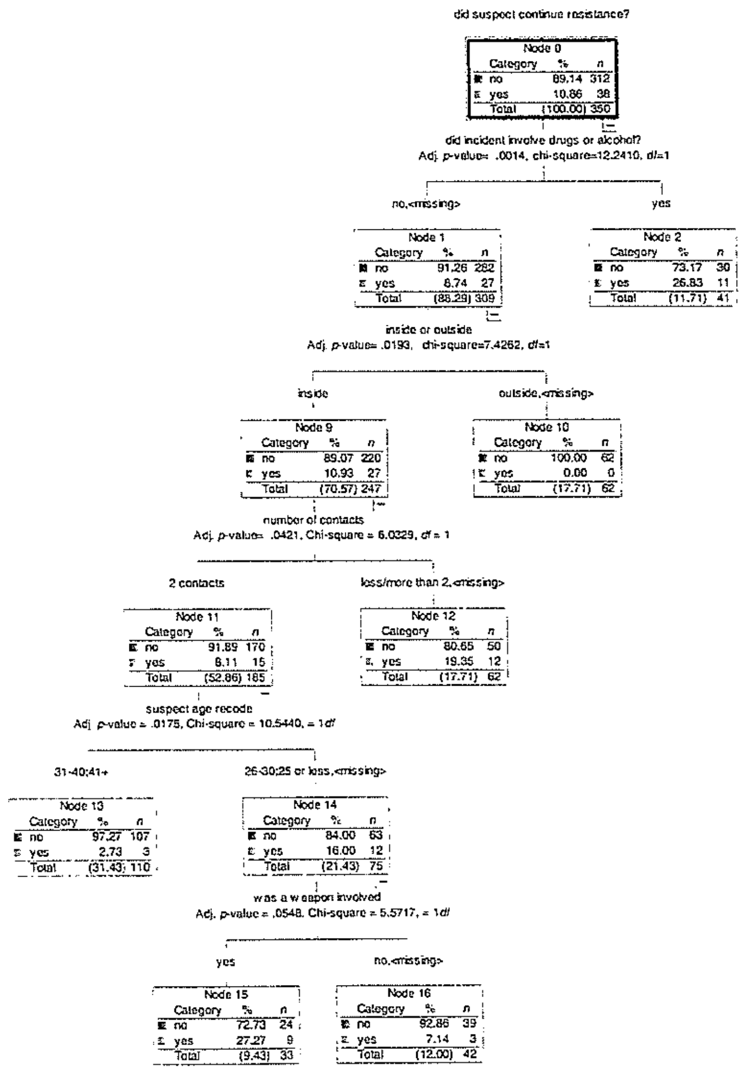
whether police used another less lethal weapon: Suspect resistance occurred in 45.8% of cases where another less lethal weapon was used in addition to the Taser, compared to 23.7% of cases where only the Taser was used. The next split was made from the cell indicating that no other less lethal weapon

was used except the Taser. This split is based on the number of darts that made contact with the suspect: Subjects who were not intoxicated during the encounter, where no other less lethal weapon was used except the Taser, continued to resist during 20.4% of the cases where two darts made contact, compared to 39.5% of the cases where fewer or more than two contacts were made.[18] The final split is made from the cell indicating that two darts made contact and is based on suspect body weight: Suspects in cases where both darts made contact, where no other less lethal weapon was used except the Taser, and where the suspect was not intoxicated were more likely to continue to resist if they weighed more than 200 pounds (32.7% compared to 15.3% for those who weighed 200 pounds or less). Table 4 summarizes the termination cells for the CHAID tree predicting any suspect resistance, which includes the predictors, cell size, percentage of the total cases, and percentage of the dependent variable: any suspect resistance.

Figure 2 displays the CHAID tree predicting continual resistance, and the top cell represents 10.9% of the cases where suspect resistance occurred immediately after the deployment. The initial split is based on the use of drugs or alcohol, as it was for the first CHAID tree: Intoxicated suspects continued to resist immediately after the Taser was deployed in 26.8% of the cases, compared to 8.7% of the cases in which the suspect was not intoxicated. Several additional splits flow from the cell indicating that the suspect was not intoxicated. The next split is based on whether the Taser incident occurred indoors or outside (10.9% suspect resistance inside compared to 0.0% resistance outside). From the cell indicating that the incident occurred indoors, the next split is based on whether the two darts made contact or not (8.1% resistance compared to 19.4%). From the "two contacts" cell, the split is based on whether the suspect was 30 years old or younger (16.0% resistance) as opposed to 31 years old or older (2.7% resistance). The final split flows from the *30 years old or younger* cell and is based on whether the suspect was armed with a weapon (27.3% resistance) or not (7.1% resistance). Termination cell summaries are again shown in Table 4.

Figure 3 shows the CHAID tree for the last measure of effectiveness: officer satisfaction. An initial split is based on the number of darts that made contact—two darts, or fewer or more—with greater officer satisfaction when two darts made contact (83.7% vs. 66.3%). The next split, made from the *two contacts* cell, is based on the distance between the police officer and the suspect. Officer satisfaction is greater when the officers are 4 feet or more away from the target: In this category, 86.7% of the officers reported being satisfied, compared to 72.0% for the officers who were 3 feet away or closer (see Table 4 for summary).

Figure 2
CHAID Analysis Predicting Resistance Immediately After Deployment



Note: CHAID = chi-square automatic interaction detection.

Table 4
Summary of CHAID End Groups

	n	% of Total	% of Suspect Resistance
Any suspect resistance			
Suspect intoxicated	44	12.54	56.82
Suspect not intoxicated (or missing); other less lethal weapon used	83	23.65	45.78
Suspect not intoxicated (or missing); no other less lethal weapon used (or missing); not two contacts	38	10.83	39.47
Suspect not intoxicated (or missing); no other less lethal weapon used (or missing); two contacts (or missing); suspect weighs 201+ pounds	55	15.67	32.73
Suspect not intoxicated (or missing); no other less lethal weapon used (or missing); two contacts (or missing); suspect weighs 200 pounds or less (or missing)	131	37.32	15.27
Total	351	100.00	
Resistance immediately after deployment			
Suspect not intoxicated (or missing); occurred inside; two contacts; suspect 30 or younger (or missing); suspect has weapon	33	9.43	27.27
Suspect intoxicated	41	11.71	26.83
Suspect not intoxicated (or missing); occurred inside; not two contacts (or missing)	62	17.71	19.35
Suspect not intoxicated (or missing); occurred inside; two contacts; suspect 30 or younger (or missing); suspect has no weapon (or missing)	42	12.00	7.14
Suspect not intoxicated (or missing); occurred inside; two contacts; suspect 31 or older	110	31.43	2.73
Suspect not intoxicated (or missing); occurred outside (or missing)	62	17.71	0.00
Total	350	100.00	
Officer satisfaction			
Two contacts; distance 4 feet or more (or missing)	196	56.48	86.73
Two contacts; distance 3 feet or less	50	14.41	72.00
Not two contacts (or missing)	101	29.11	66.34
Total	347	100.00	

Note: CHAID = chi-square automatic interaction detection analysis.

profound implications for police administrators who are responsible for upholding use-of-force standards. This article seeks to contribute to the dialogue on CEDs by identifying predictors of Taser effectiveness.

Findings from the descriptive analysis suggest consistency across the types of incidents (and suspects) in which officers in the NYPD deploy the Taser.

- Most suspects were male, African American or Hispanic, and in their 30s.
- Few suspects were under the influence of alcohol or drugs, but nearly all were identified as exhibiting signs of mental illness.[19]
- Nearly all suspects engaged in violent behavior.
- Just fewer than half of suspects were armed, and among armed suspects, the majority possessed a knife or cutting instrument.
- Nearly all the officers using the Taser in the NYPD were assigned to the ESU.
- Back-up officers and supervisors were present in almost all cases.
- A large majority of suspects were incapacitated by the Taser after the first deployment, and most were incapacitated within 5 seconds.
- Most of the subjects were not arrested on criminal charges, although nearly all were transported to a hospital for physical and/or psychological evaluation.

Findings from the multivariate analyses, both logistic regression and CHAID, are remarkably consistent in predicting the three effectiveness measures:

Any suspect resistance (a measure of ineffectiveness)

- Suspect body weight was over 200 pounds (logistic and CHAID).
- Suspect was intoxicated (logistic and CHAID).
- One or both Taser darts missed the intended target (logistic and CHAID).
- Officer used another less lethal weapon (logistic and CHAID).
- Distance between the officer and the suspect was 3 feet or less (logistic).
- Suspect directed violence toward an officer or citizen (logistic).

Resistance occurring immediately after Taser use (a measure of ineffectiveness)

- Suspect was intoxicated (logistic and CHAID).
- One or both Taser darts missed the intended target (logistic and CHAID).
- Suspect body weight was more than 200 pounds (logistic).
- For a subset of cases, incident occurred indoors, suspect was 30 years old or younger, and suspect was armed (CHAID).

Officer satisfaction (a measure of effectiveness)

- Suspect and officer were more than 3 feet apart (logistic and CHAID).
- Both Taser darts struck the intended target (logistic and CHAID).
- Suspect body weight was 200 pounds or less (logistic).
- Suspect was armed with a gun or knife (logistic).

Three important findings emerge from the analysis. First, the analysis suggests that Taser effectiveness can be modeled using multivariate techniques, as several suspect- and incident-related variables are associated with a greater or lesser likelihood of effectiveness. Considering the paucity of research examining use and effectiveness of the Taser, this finding alone is important. Second, a number of variables were noticeably absent from the statistically significant predictors of Taser effectiveness identified in the multivariate analysis. For example, the race and gender of the suspects were unrelated to any of the three measures of effectiveness. Importantly, whether the suspect was classified as "emotionally disturbed" was also unrelated to Taser effectiveness. Note that only 28 cases did not involve a suspect classified as an EDP, so caution should be used in generalizing to this subgroup. The findings relating to EDPs are particularly important, however, because anecdotal evidence made available by the news media and interest groups suggests that the mentally ill may be more likely to continue to resist the police and to experience serious injury or death when stunned by the Taser. The results of this study indicate that the suspects' mental health at the time of the incident did not affect the effectiveness of the Taser. Additionally, the authors reviewed all news reports ($N = 192$) of Taser incidents printed in *The New York Times* during the study period to become more familiar with the qualitative aspects of the incidents and found evidence of only one case where NYPD deployment of the Taser resulted in the death of an emotionally disturbed suspect.[20]

The third important research finding relates to the variables that were identified as significant predictors in the multivariate analyses, including suspect intoxication, body weight, violence directed at an officer or citizen, and distance between the officer and the suspect. A relatively small proportion of the Taser cases involved an intoxicated suspect—13%, or 46 incidents—but effectiveness dropped significantly for those cases: Intoxicated suspects were twice as likely to exhibit any resistance during the encounter (57% compared to 30%, respectively), they were about 3 times as likely to resist immediately after police deployed the Taser (27% compared to 9%, respectively), and intoxication was associated with lower officer-reported satisfaction with the Taser (67% compared to 80%, respectively).[21] Although the reason for this finding is not clear, one possible explanation relates to

the effect of drugs and alcohol on the suspect's ability to reason and process information. The intoxicated suspects may be less capable of thinking rationally during the police–citizen encounter and therefore less inclined to comply with the officer's instructions after the effects of the Taser wear off. This finding clearly warrants attention from police researchers and practitioners. If it is replicated in other police jurisdictions, with other suspect samples, there are clear policy and training implications. Police field training can highlight the increased likelihood of continued resistance among intoxicated suspects and provide officers with a clear set of guidelines to anticipate and curtail resistance to prevent violence escalation and serious injuries.

The emergence of suspect body weight as a predictor of Taser effectiveness is both interesting and puzzling. Evidence that the weapon is less effective against heavier individuals is not apparent from the CED industry reports or the growing clinical research. This study finds suspect weight—with a cutoff at 200 pounds—a significant predictor of both resistance measures and officer satisfaction. Depending on the degree to which body weight moderates the effects of the Taser, there are implications for Taser use and for police policy and training. Police officers may need to prepare for the greater likelihood of resistance immediately after using the weapon on particularly tall or heavy suspects. Policy should offer guidance on subsequent responses, which may include additional Taser deployments or alternative less lethal weapons. Given the potential relationship between multiple Taser deployments and elevated risk of serious injury or death, police departments may need to craft their policies carefully. Moreover, researchers should consider investigating the potential for an interaction effect between body weight and intoxication. For example, 18 cases in the study data involve an intoxicated suspect who weighs more than 200 pounds, of whom 13 (72%) continued to resist the officer after being stunned with a Taser. This is clearly an important issue that requires further investigation.

Two other suspect-related variables were significant in the multivariate analysis: violent behavior directed at an officer or another person and whether the subject was armed with a weapon. Suspects who were suicidal, engaged in self-harm, or threatened self-harm were less likely to continue resisting after being stunned with the Taser, compared to those who were acting violently toward an officer or citizen. The implications for police are straightforward: Suspects who direct their violence toward others—most notably, the police officer—represent the greatest risk of a physical struggle after being stunned with the Taser, and therefore, officers should remain especially vigilant when using the Taser on subjects that fit this description.

The association between armed suspects and measures of effectiveness indicates that police use of the Taser is most effective in those situations where the potential for serious injury or death is highest. Further research is needed to substantiate this finding, but there are a number of potential explanations:

- High-risk situations could be fundamentally different in ways that affect officer satisfaction.
- The actual physiological effects of the Taser may be different (e.g., more effective) in these types of encounters.
- Police officer performance during and after Taser use may be different in high-risk encounters (e.g., quicker reaction times, better handcuffing, etc.).

Several incident-related characteristics are also associated with the effectiveness measures, notably, distance from the intended target, police use of another less lethal device in addition to the Taser, and the number of darts that make contact with the suspect. The importance of the number of darts that strike the subject and police use of other less lethal weapons is clear. For the Taser to deliver the current, both darts must strike the suspect, penetrate the clothing, and attach to the skin. If this does not occur, the device will not work as intended, and consequently, resistance will be more likely to continue. Although the field report does not specify the order in which multiple weapons are used, the fact that more than one weapon is used implies that one or more instruments were ineffective in curtailing resistance.

The significance of the distance from the suspect as a predictor of effectiveness has both training and policy implications. Taser International offers cartridges with maximum ranges of 15 feet, 21 feet, 25 feet, and even 35 feet. The study findings suggest that the Taser is less effective when used at close range—within 3 feet or less of the target. (Note that distance remained significant when controlling for use of the device in stun mode, i.e., direct contact to the suspect's skin.) The reasons for this are unclear, although use at close range may increase the likelihood that suspect movement could affect the accuracy of the weapon, the suspect could grasp or bump into the weapon at time of discharge, or the darts may not spread out sufficiently to deliver the optimal current. Police agencies may want to consult with each other or the CED manufacturer to determine if this short-range problem has emerged elsewhere. Regardless, maintaining a safe distance whenever possible is of central importance; in fact, the NYPD (2000) patrol guide states that officers should maintain a "zone of safety" of 20 feet and call ESU when

responding to EDPs. Findings from this study suggest that the "safe-distance" principle should be reinforced for ESU as well, particularly when there is reasonable suspicion that a Taser may be deployed.

Conclusion

This article sought to address questions about the use and effectiveness of CEDs by examining all Taser deployments by the NYPD from 2002 to 2005 (N = 375). The authors employ both logistic regression and CHAID analysis to identify predictors of Taser effectiveness, measured as the extent of suspect resistance and officer satisfaction. A number of statistically significant predictors surfaced with policy and training implications, including suspect body weight, drug and alcohol use, violent behavior, and the distance between the responding officer and the suspect. Considering the lack of empirical research predicting Taser effectiveness, this article takes an important step in thinking about the circumstances in which favorable deployment outcomes are likely to occur.

As we suggested earlier, there is an ongoing discourse between civil rights organizations and the CED industry regarding the widespread adoption of these devices. Although this research offers an objective, empirical analysis of Taser deployments, for a number of reasons, it is difficult for the authors to weigh in on this debate. First, much of the debate has focused on the physiological effects of CEDs, which is not a focus of this research. Second, we have examined one police department with a restrictive and closely monitored deployment pattern, which limits the conclusions we can draw. Alternatively, this research shows that the study police department experienced positive outcomes while avoiding the current controversies associated with use and effectiveness. Both PERF and IACP offer detailed guidance on model policy and procedures for the Taser, most of which mirror the NYPD approach. Thus, we can conclude that with regard to the use and effectiveness questions only, this research suggests that departments can successfully deploy the Taser—avoiding problems with misuse and abuse—by implementing and closely monitoring the guidelines developed by PERF and IACP.

Nonetheless, additional research on this topic is necessary not only because the technology is relatively new but also because different agencies are adopting the weapon to varying degrees and developing different standards and expectations concerning its proper use. A multisite analysis of police agencies that have incorporated the Taser into routine practice based on

different approaches would yield valuable comparative data. This type of cross-site approach—coupled with the release of research supported by the National Institute of Justice, particularly, the national-level study being conducted by Alpert and colleagues—will enable researchers to begin asking more complex questions about police use of the Taser, such as to what extent it is used by officers as an alternative to other less lethal weapons (and physical force) and what types of information would be required for a rigorous cost-benefit analysis of the Taser.

Notes

1. There are competitors to Taser, including Stinger Systems and Law Enforcement Associates, but Taser dominates the market with approximately 95% of conducted energy device (CED) sales in the United States. Stinger Systems has sold just 12,000 weapons since 2000. Law Enforcement Associates introduced their CED only recently, in March 2005.

2. Important considerations and limitations associated with these reports include small sampling frames and potentially competing interests among those who carried out the studies. The National Institute of Justice is currently funding several national-level research projects on the Taser, but these studies have just begun.

3. This estimate becomes much greater if handcuffing and verbal commands are included as use of force.

4. For example, the effects of mace and pepper spray are often felt for several hours, and their range of effectiveness is much shorter (which increases the likelihood of other officers' being hit). Beanbag guns and similar impact munitions are often fired from a specialized shotgun that is larger and bulkier than CED.

5. The New York Police Department's (NYPD; 2000) patrol guide also offers a definition of an emotionally disturbed person (EDP):

> A person who appears to be mentally ill or temporarily deranged and is conducting himself in a manner which a police officer reasonably believes is likely to result in serious injury to himself or others. (p. 1)

In situations involving an EDP, officers are instructed to create and maintain a "zone of safety" of approximately 20 feet and to call for the Emergency Service Unit (ESU) and a patrol supervisor as well as an ambulance (NYPD, 2000). Officers are not to attempt to take an EDP into custody unless

- The EDP is unarmed, not violent and is willing to leave voluntarily; OR
- The EDP's actions constitute an immediate threat of serious physical injury or death to himself or others. (NYPD, 2000, p. 1)

6. These reports were provided to the authors by the supervisor of the department's training division. Although the form is used primarily for the Taser, there were 33 forms involving use of another type of nonlethal weapon: either a stun device or other similar alternative. Because the focus of this article is the Taser, these cases were excluded from the analysis.

7. Given that the intent of the Taser is temporary incapacitation only, the latter suspect resistance measure—10.9%—is probably a fairer measure of the Taser's effectiveness. Also, the *any suspect resistance* measure includes both types of resistance (i.e., continual resistance is a subset of the more general resistance measure). Both measures are examined in the multivariate analysis.

8. At the same time, it is worth noting that the limited manner in which the NYPD has implemented the Taser is a practical advantage to police administrators in New York, who have avoided being criticized in the news media for excessive reliance on the Taser.

9. This variable is based on the police officer's assessment of the suspect at the time of the incident. It is not based on more definitive tests, such as a urinalysis or blood or hair analysis. Although this would appear to suggest that police officers in the study department use the Taser disproportionately against the mentally ill in crisis, this finding must be interpreted in the context of how the department has deployed the Taser. Per department policy, the ESU is called when the patrol officers or supervisors on scene determine that the situation involves an EDP who is behaving in a manner that could result in physical injury or death to the EDP or others (NYPD, 2000). Thus, these data are a reflection of the types of suspects typically handled by the ESU—a highly specialized group of officers—not the suspects typically handled by line officers.

10. There were also two cases where the suspect was armed with a gun: In one case, the suspect was threatening to commit suicide, and in the other case, the suspect had taken a hostage and was threatening multiple people (including the hostage and himself). Of the remaining cases involving an armed suspect, the most common weapon was a blunt object, such as a metal pipe, baseball bat, chair, or large stick.

11. The nearly universal presence of back-up officers and supervisors is again dictated by the fact that most of these cases involve the ESU. This unit is typically called to the scene by the first responding officer, and often a supervisor will also respond.

12. Both police officers and detectives are assigned ranks in the ESU. Chi-square values indicate that the satisfaction and any-resistance differences are statistically significant (p = .005 and p = .050, respectively). It may be useful in future research to examine length of time on the job and officer training as factors related to effectiveness. These variables may more accurately capture the relationship between officer's use of the Taser—especially among non-ESU personnel—and effectiveness measures.

13. Information on the number of dart contacts was not reported in 66 cases. Rather than make assumptions about the number of contacts, the authors have proceeded conservatively and coded these cases as missing. This decision, however, reduces the number of cases available for multivariate analysis.

14. In the remaining 14% of the cases (n = 53), the form was not signed and there was no information about whether the use met departmental policy. However, a review of the narrative of those 53 cases suggests that they too conformed with department policy on use of the Taser.

15. Nagelkerke R^2 provides an approximation of the explained variation in a logistic regression model. This measure of model strength is considered slightly more conservative than the R^2 statistic in ordinary least squares regression but less conservative than the Cox and Snell R^2 estimate, which does not have a maximum value of 1.0.

16. Although the "Taser/stun device report" indicates whether another nonlethal device was also used, it does not specify which is used first, the Taser or the alternative.

17. Suspect resistance was also a predictor of officer satisfaction, but it has been excluded from the analyses because it serves as the other effectiveness measure. The authors question the value of a model that uses one outcome measure to predict another.

Oleoresin Capsicum Spray and Tasers:

A Comparison of Factors Predicting Use and Effectiveness

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Oleoresin Capsicum Spray and Tasers:

A Comparison of Factors Predicting Use and Effectiveness

ABSTRACT

In the last few decades, several less-lethal forms of force have been introduced, adopted, and deployed by police agencies. Oleoresin capsicum spray is now used in nearly every department across the United States; the Taser is used in the majority of police departments. Despite their widespread use, we still know relatively little about the factors associated with the use of OC spray and Tasers and the effectiveness of these weapons in incapacitating subjects. This paper contributes to that discussion by analyzing 504 use-of-force incidents where the police used OC spray or Tasers during the event. Data were obtained from a large municipal police department on incidents that occurred in 2010 and 2011. Policy implications and directions for further research are discussed.

INTRODUCTION

A fundamental but controversial function of the police is their ability to use coercive force (Bittner, 1970; Klockars, 1985). Force is most likely to be used by the police in situations where they are confronted with non-compliant subjects (Reiss, 1971; Terrill & Mastrofski, 2002). In such situations, police officers have several options. At one end of the spectrum, beyond verbal commands and threats, officers may use bodily force (e.g., decentralizations, focused strikes). Bodily force alone is the most common form of physical force used by police officers (Adams, 1999). At the other end of the spectrum, officers may use their firearms. The use of firearms is considered a last resort; it is only to be used to defend human life. In between bodily force and deadly force, there are several "less-than-lethal" or "less-lethal" options.

In the last few decades, several less-lethal forms of force have been introduced, adopted, and deployed by police agencies. Today, nearly all local departments authorize the use of one or more less-lethal weapons (Reaves, 2010). The most common less-lethal weapon is pepper spray, authorized by 97% of all local departments (Reaves, 2010). Conducted Energy Devices (CEDs)[1], including Tasers[2] and stun guns, are authorized by 60% of all local police agencies (Reaves, 2010). While the number of departments authorizing pepper spray is not much higher than in the year 2000 (91%; Hickman & Reaves, 2003), the number of local police departments that authorize the use of CEDs has dramatically increased since 2000, when just 7% authorized them (Reaves, 2010).

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[1] CEDs are sometimes also known as Electronic Control Devices (ECDs), Conducted Electrical Weapons (CEWs), or Conducted Energy Weapons (CEWs).

[2] The Taser (short for the Thomas A. Swift Electric Rifle) is currently the most popular CED on the market. It is also the CED used by the department in this study. As such, we use the term "Taser" rather than the more general "CED" throughout this paper.

In response to the greater prevalence and use of less-lethal weapons, particularly OC spray and Tasers, a substantial amount of research has been conducted on issues related to them. For instance, researchers have analyzed the frequency with which different types of force are used before, during, and after OC spray or Tasers are introduced in departments (e.g., Lin & Jones, 2010; Lumb & Friday, 1997). Studies have examined the factors associated with the use of OC spray (Morabito & Doerner, 1997) and Tasers (Crow & Adrion, 2011; Gau, Mosher, & Pratt, 2010) as well as officer and citizen injuries associated with their use (e.g., Terrill & Paoline, 2011; Kaminski et al., 2013; Paoline, Terrill, & Ingram, 2012; Kaminski et al., 1999; Smith et al., 2007). Finally, researchers have examined the effectiveness of OC spray (Morabito & Doerner, 1997; Kaminski, Edwards, & Johnson, 1999; Adang et al., 2006) and Tasers (White & Ready, 2010; White & Ready, 2007), defining effectiveness in terms of their ability to induce subject compliance.

While this research has advanced our understanding of the benefits and limitations of OC spray and Tasers, we still know relatively little about the factors associated with the use of OC spray and Tasers and the effectiveness of these weapons in incapacitating subjects. In particular, there are no studies to date that directly compare the use and relative effectiveness of OC spray and the Taser within the same jurisdiction during the same time frame.[3] Some studies examine OC spray, while others examine Tasers. It is difficult, if not impossible, to draw definitive conclusions about the use and relative effectiveness of OC spray and Tasers on the basis of studies that do not include both OC spray and Taser incidents, do not compare OC spray with Tasers, that use different sampling procedures and measurements schemes for critical variables,

[3] An exception is a study performed by TASER International (as cited in White and Ready, 2007). In this study, the effectiveness of the OC spray and the Taser were compared, but only when both were used in the same incident. In these encounters, OC spray was effective 33% of the time while the TASER was effective in 83% of cases (Taser International, 2002).

and that were conducted in different police departments with different use-of-force policies and continuums. As such, we do not know whether Tasers are significantly more (or less) effective than OC spray in similar situations, or whether different factors predict their use and effectiveness. This study examines the factors that predict the use and effectiveness of OC spray (N= 259) and Tasers (N=245) in a single large municipal police department. Data were obtained from official use-of-force reports of the police department on incidents that occurred in 2010 and 2011.

LITERATURE REVIEW

Police use of force, defined as "acts that threaten or inflict physical harm on suspects" (Terrill, 2003, p. 56), has been an important and constant topic of research since the 1970s. This attention is warranted for theoretical and practical reasons. Theoretically, research on police use of force is important because it involves the defining characteristic of policing. In large part, an understanding of the complexities and dilemmas of police work depends on an understanding of police use of force. Practically speaking, research on the control of police use of force is important in that use of force can have devastating—and deadly—consequences. As such, it can dramatically affect police-community relations, public cooperation with the police, and the legitimacy of the police more generally.

Due to the potentially serious consequences of police use of force, police officers are constrained in their ability to use it. Along with legal (*Graham v. Connor*, 490 U.S. 386 1989) and accreditation standards (Commission on Accreditation for Law Enforcement Agencies, 1999), the majority of police departments guide officer behavior with a "continuum of force" or "force continuum" (Terrill & Paoline, 2012). Most often, officers are to base force decisions on

the level of suspect resistance or aggression; force is only escalated to the next level when less forceful actions fail to induce suspect compliance. While OC spray and Tasers are usually placed at the same level on force continuums (Alpert et al., 2011; IACP, 2005), there is little agreement between and among departments where they should be placed. In some departments, OC spray and the Tasers are placed at the lower end of the continuum, authorizing their use against passive resisters; other departments place them closer to lethal force on the continuum, authorizing their use only against active resisters. Where OC spray and Tasers are located on the continuum of force matters when understanding the circumstances in which the weapons are used (Crow & Adrion, 2011; Morabito & Doerner, 1997). In turn, the circumstances in which OC spray and Tasers are used may have implications for their effectiveness in inducing compliance among subjects.

OC SPRAY AND TASERS

Oleoresin capsicum (OC) spray, otherwise known as pepper spray, was introduced to law enforcement in the 1980s. OC is an inflammatory agent naturally found in cayenne peppers. When a person is sprayed with OC spray, the effects are immediate: the respiratory tract becomes inflamed, the individual experiences an intense burning sensation and swelling around the eyes, and the subject's eyes close involuntarily (Lumb & Friday, 1997). Although the subject may be in extreme discomfort, he or she may still be able to resist. Ideally though, the effects of OC spray render a resistive suspect passive and compliant, and the officer is able to take the suspect into custody without further incident.

Once introduced, OC spray immediately demonstrated advantages over other forms of force. The effects of OC spray, while immediate and dramatic, were more temporary than other

forms of chemical gasses used previously (Lumb & Friday, 1997). OC spray proved more effective on intoxicated individuals than mace, and was less prone to secondary contamination (White & Ready, 2007). Finally, OC spray was less likely to cause injury than bodily force, batons, and flashlights (Lumb & Friday, 1997). As summarized by Lumb & Friday (1997):

> ...OC spray is an effective alternative to the more harmful types of weapons available to police. OC causes almost instantaneous incapacitation and leaves no long term residual effects. It allows the officer to stay away from the suspect when affecting a custodial arrest that is being resisted, and there are few problems associated with transporting the person, as OC spray residue dissipates fairly quickly (p. 138).

Today, while OC spray is standard issue in police departments, CEDs, such as the Taser and other stun devices, are still gaining popularity. First introduced in the 1990s, the Taser is a 50,000 volt, 26-watt weapon that uses nitrogen cartridges to fire its probes. Once the probes attach to the suspect, the Taser delivers an electrical current which overrides the central nervous system, causing involuntary muscle contractions and incapacitation (Alpert et al., 2011; Means & Edwards, 2005).

The Taser has advantages over other less-lethal alternatives including their greater reliability at longer distances, the relatively quick recovery time involved, and their perceived effectiveness in inducing suspect compliance (White & Ready 2010). In addition, because Tasers do not rely on pain to induce compliance, ideally they should be more effective on persons who have a higher tolerance of pain, such as people under the influence of drugs or alcohol or who have a mental illness (Means & Edwards, 2005).

Despite their popularity and advantages, OC spray and Tasers are not without controversy. One concern relates to their safety. In the late 1980s and early 1990s, OC spray was claimed to have caused several in-custody deaths (ACLU of Southern California, 1993; Alpert et al., 2011). Twenty years later, the Taser was also alleged to be a proximate cause of in-

custody deaths (Alpert et al., 2011; White & Ready, 2007). Research has shown that most deaths involving OC spray were instead the result of positional asphyxia, pre-existing health conditions, or were drug-related (Granfield, Onnen, & Petty, 1994; Petty, 2004). With regard to Tasers, it has been demonstrated that the risk of death when a Taser is used is less than 0.25 percent (NIJ, 2011), and in those situations the death is likely to be a result of drug intoxication, preexisting heart conditions, and exposure to other forms of nonlethal police force (White & Ready, 2007).

Another concern relates to police overuse of OC spray and Tasers (Alpert et al., 2011). For instance, members of the ACLU and Amnesty International have voiced concern that OC spray and Tasers are used in a disparate fashion against members of minority groups (ACLU of Southern California, 1993; Amnesty International, 2006). A related concern is that police have authorized their use too low on continuums of force and consequently are using them against passive (versus active) resisters (Terrill & Mastrofski, 2002). Finally, there are concerns about the use of OC spray and Tasers with the elderly, children, pregnant women, and persons with medical conditions that put them at greater risk of experiencing dangerous medical side effects (Amnesty International, 2006; Sloane & Vilke, 2006).

A final concern has to do with manufacturer exaggeration of the capabilities and effectiveness of OC spray and Tasers in incapacitating subjects, which, in part, may have contributed to their widespread adoption in police departments. Some early studies reported "effectiveness rates" as high as 100% for OC spray (as cited in Adang et al., 2006) and 94% for the Taser (as cited in White & Ready, 2010). Objective empirical research on the effectiveness of these devices remains rather sparse. Of the independent studies that do exist, effectiveness rates have not been found to be as high as those originally reported by the manufacturers. For

instance, and as discussed below, Kaminski et al. (1999) found an effectiveness rate of 71% for OC spray. White and Ready (2010) found an effectiveness rate of 85% for the Taser.

RESEARCH ON THE USE AND EFFECTIVENESS OF OC SPRAY AND TASERS

While research appears to have ameliorated concerns about OC spray and Tasers causing serious injury and death, there remain concerns about their use and effectiveness. In response, there has been a growing body of literature that examines the use and effectiveness of these weapons. Given the objectives of the current study, we review here the studies that examine the factors associated with the *use* of OC spray and Tasers and the *effectiveness* of OC spray and Tasers (with effectiveness defined in terms their ability to facilitate the arrests of resisting subjects).

The Use of OC Spray

Morabito and Doerner (1997) analyzed OC spray use-of-force reports from the Tallahassee Police Department. They examined characteristics of officers and suspects that were associated with the use of OC spray at two points in time: prior to and after a change in the circumstances in which OC spray was authorized in the department. At Time 1, OC spray was only authorized in cases when the suspect was actively physically resisting police. At Time 2, the threshold for the use of OC spray was reduced from active physical resistance to verbal/passive physical resistance. At Time 1, OC spray use was compared to impact weapons such as batons, flashlights, and stun guns. At Time 2, OC spray use was compared to the use of soft hand techniques (punches, kicks, and pain compliance techniques). The officer characteristics of interest included race, gender, education and experience. Suspect variables

included race, gender, height and weight (relative to the officer's height and weight), suspect intoxication, and whether the suspect was armed or attacked the officer. While none of the predictor variables were significant at Time 1, several factors were associated with OC spray use at Time 2. At Time 2, male, educated, and veteran officers were more likely to use OC spray than soft hand techniques. OC spray was also more likely to be used than soft hand techniques when the suspect was heavier and taller than the officer and when the suspect was armed.

The Use of Tasers

Gau, Mosher, and Pratt (2010) analyzed case file data on Tasers and other types of force used by officers in a state patrol agency from 2005 to 2007. The authors were primarily interested in examining possible racial disparities in the use of a Tasers on subjects. Tasers were used in nearly one-half of all use-of-force incidents. They found that compared to other forms of force, Tasers were equally likely to be used on white, Hispanic, and Black subjects; although when a Taser was used, Hispanic subjects were more likely than White subjects to have a Taser be the first type of force used. The authors also found that females were less likely to be "tased" than males, and that subjects who actively resisted and who were assaultive were *less* likely to be tased than subjects who passively resisted. Finally, white officers were significantly less likely to use a Taser than officers of other races.

Crow and Adrion (2011) analyzed 461 use-of-force incidents (reports) that occurred between 2004 and 2010 in a medium-sized municipal police department. The authors compared incidents where a Taser was used and incidents where "other" types of force were used (takedowns, physical force, pepper foam, impact weapons, police dog, use of a vehicle as a weapon, and firearms). The authors found that a Taser was *less* likely to be used than other forms

of force when subjects physically resisted and when resistance involved a weapon. A Taser was equally likely to be used when resistance was in the form of "presence," "flight," and "verbal" (meanings unspecified). A Taser was more likely to be used than other forms of force on non-white and male subjects. Older officers were significantly more likely to use Tasers. A policy change to restrict the use of Tasers also had its intended affect; after the policy change, Tasers were less likely to be deployed. Call type, time of day of the incident, officer sex, race, age, and rank did not affect the likelihood of Taser use.

The Effectiveness of OC Spray

Three studies have examined the effectiveness of OC spray (Morabito & Doerner, 1997; Adang et al., 2006; Kaminski, Edwards, & Johnson, 1999), generally defined in terms of the extent to which it facilitates the arrests of suspects who resist. As previously noted, Morabito and Doerner (1997) analyzed use of force reports from the Tallahassee Police Department. Although these authors were most concerned with the factors associated with the use of OC spray, they also briefly considered the effectiveness of it. As the authors explained, OC spray "was considered effective if it induced the expected physiological effects and enabled the officer to take the subject into custody without further incident" (p. 690). They calculated a "success rate" of 73% for OC spray and found that OC spray worked "equally well on mentally disturbed subjects, intoxicated subjects, and physically stressed subjects who were involved in either a foot chase or a physical struggle" (p. 690).

Kaminski et al. (1999) analyzed data on incidents where OC spray was used by officers in the Baltimore County Police Department. Based on assessments provided by officers who were involved in the incidents, three measures of OC spray effectiveness were constructed. In

their most conservative measure, they defined effectiveness in terms of whether the use of OC spray incapacitated (fully and immediately immobilized) the suspect (yes/no). According to this measure, OC spray was effective in 71% of cases. Their second measure of effectiveness was also dichotomous, measured as the officer's assessment of whether the use of OC spray eased arrest (yes/no). In this case, the use of OC spray was deemed effective 85% of the time. Their third measure of effectiveness consisted of a 5-point scale ranging from totally effective (i.e., incapacitated suspect) to totally ineffective (i.e., OC spray had no effect). Here, OC spray was considered effective 84% of the time.

Kaminski et al. (1999) examined the effects of suspect characteristics on OC spray effectiveness. In particular, they examined the variables of suspect race, gender, age, weight, height, and condition (i.e., suspect was drinking, mentally disturbed, on drugs, or other). The authors also examined the distance from which OC was sprayed. They found that OC spray was more effective (yes/no) with younger and older suspects (but less effective among middle-aged suspects) and intoxicated suspects. It was less effective when it was used on suspects who were under the influence of drugs and when sprayed from longer distances.

Adang et al. (2006) analyzed data on incidents where OC spray was used by police officers in the Netherlands. They used surveys of officers, supervisors, and prosecutors to measure the effectiveness of OC in several ways: the degree to which the subject was incapacitated (with options ranging from "completely" to "not at all"), the degree to which OC made the arrest easier ("much easier" to "much more difficult"), whether suspects became more or less aggressive after exposure to OC spray ("much more" to "much less"), and how satisfied officers were with the performance of OC spray ("dissatisfied" to "highly satisfied"). Estimates of effectiveness ranged from 69% (suspects who became less aggressive after being sprayed with

OC) to 92% (officers who were satisfied with the performance of OC spray). In the model predicting the extent of suspect incapacitation, four of thirteen independent variables were statistically significant. Specifically, OC spray was less effective when used by less experienced officers, against minority suspects, when suspects were warned beforehand they were going to be sprayed, and when suspects were under the influence of drugs.

The Effectiveness of Tasers

Two studies have examined the effectiveness of Tasers with specific regard to the incapacitation of subjects in arrest situations (White & Ready, 2007; White & Ready, 2010). White and Ready (2007) examined the effects of Tasers based on self-report surveys completed by (primarily SWAT) officers who worked in a large metropolitan police department. They considered the Taser effective if it led to the "successful incapacitation" of the subject. They found that after deploying a Taser, "85% of subjects were subdued by the Taser and taken into custody" (p. 183). The authors developed a multivariate "violence escalation scale" that they used to score each Taser incident. The scale included whether the subject was violent, armed with a weapon (and what type of weapon), under the influence of drugs or alcohol, mentally ill, the weight of the subject, and whether the officer was alone. Although individual analyses were not provided on each variable, the analyses performed on the scale revealed that the Taser was the most effective in the "highest risk" situations.

White and Ready (2010) analyzed Taser deployments from the New York City Police Department; the data were derived from the reports that officers completed subsequent to the deployment of the weapon. Three measures of Taser effectiveness were used in the study. The first measure was the officer's assessment of whether the Taser performed satisfactorily (yes/no).

Officers rated the performance of the Taser as satisfactory in 79% of cases. While this indicator of effectiveness was also used in prior studies (see Adang et al., 2006), the other two are unique in that they measure suspect resistance or, in other words, the *in*effectiveness of the Taser. The authors classified suspect resistance two ways: First, "continual resistance" included those situations where the suspect was not affected at any point by the weapon; the suspect continued to resist after the Taser was deployed. This occurred in 33% of all Taser deployments. In these instances the Taser was clearly ineffective. Second, "any resistance" included those situations where the Taser temporarily resulted in the incapacitation of the suspect, but the suspect resisted again prior to the conclusion of the incident. This occurred in about 11% of Taser deployments.

In their models predicting Taser (in)effectiveness, White and Ready (2010) explored the impact of multiple officer, suspect, and incident characteristics. They found the Taser to be less effective on heavier subjects (i.e., over 200 lbs), subjects who were under the influence of drugs or alcohol, subjects who were violent, when another less lethal weapon was used, when one or both prongs missed the subject, and when the Taser was fired from farther away (i.e., greater than three feet). When effectiveness was based on officer satisfaction, the Taser was also perceived to be more effective when the suspect was armed with a knife or gun.

Conclusions

There are too few studies available to draw confident conclusions about the factors that affect the use and effectiveness of OC spray and Tasers. Other than that males are more likely than females to be subject to a Taser than other forms of force (Gau, Mosher, & Pratt 2010; Crow and Adrion 2011), that OC spray is less likely to be effective on subjects who are under the influence of drugs compared to subjects who are not (Kaminski et al. 1999; Adang et al. 2006),

and that departmental policy affects the use of OC spray and Tasers (Crow & Adrion 2011; Morabito & Doerner, 1997), there is little consistency in findings. There is also little consistency in variables included in previous studies and the measurement of those variables.

It is safe to conclude, however, that estimates regarding the effectiveness of OC and Tasers depend at least in part on the measures used; different definitions of effectiveness produce different rates of effectiveness. In the studies reviewed here, rates of OC effectiveness ranged from 69% to 92% (Adang et al., 2006), while the effectiveness of the Taser ranged from 66% to 89% (White & Ready, 2010). The variation in effectiveness estimates notwithstanding, it appears that most studies show the Taser to be more effective than OC spray.

Our study adds to the discourse on the use and effectiveness of OC spray and the Taser in several ways. First and most importantly, this study is the first that directly compares OC spray with Tasers in terms of their use and their effectiveness, and we do so in the context of the same study site. Second, we include all intentional OC spray and Taser deployments to provide a potentially more inclusive assessment of effectiveness.[4] Lastly, we provide a logical measure of weapon effectiveness that incorporates the dynamic nature of use of force incidents and we use this same measure to evaluate OC spray and Tasers.

[4] Interestingly, Kaminski et al. (1999) excluded from their analyses incidents where OC was used but where it missed its intended target and incidents where it was used in a crowd situation. The authors also explain that if multiple officers or multiple subjects were involved in the incident, a single officer and/or a single subject was selected for analysis. In addition, it is unknown what, if any, other types of force were used before or after the deployment of OC spray. Adang et al. (2006), like Kaminski et al. (1999), excluded several categories of incidents from their analysis: incidents where officers deployed OC spray but it missed its intended target, where OC was intended to be used but the canister malfunctioned, incidents that involved a crowd situation, and when it was deployed against female subjects. In addition, the authors did not specify what, if any, other types of force were used before or after the deployment of OC spray. It is unknown how these factors may have affected their conclusions about OC spray effectiveness.

METHOD

Data

The data for this study were obtained from a large municipal police department. At the time of the study, the department employed approximately 2,000 sworn officers, about 1,200 of whom were patrol officers. The police department served a population of approximately 600,000; 40% of the population was African American and 10% was Latino.

Analyses were performed on all use of force incidents in 2010 and 2011 where an officer from the department intentionally discharged OC spray (n=259) or deployed a Taser (n=245) against a person. While an additional 24 incidents involved the use of OC and a Taser, and another 45 incidents involved the use of another type of weapon, the analyses conducted here focus on the 504 incidents where OC *or* a Taser was used.

All officers in the department were trained and authorized to carry and use OC spray. During the academy, officers received 4 to 8 hours of instruction on the use of OC spray. Only about 300 officers (approximately 25% of patrol officers) were trained and certified to use a Taser. Further, on each of the three shifts at each of the eight districts, approximately six to eight Tasers were available to be signed out and carried by the certified Taser officers. Therefore, at any given time during the time of this study, there were no more than 68 Tasers actually being carried by officers. With regard to Taser training, officers who volunteered for training first had to be approved by Internal Affairs. Officers who were selected to be Taser trained participated in 16 hours of "new user" training and an additional 8 hours of "refresher" training every 2 years.[5]

At the time of the study, the use of force policy of the department specified OC spray and Tasers as "control devices." According to the policy, "the goal of control devices is to overcome

[5] The only training required by TASER International is the 8 hours of "new user" training.

active resistance or its threat [italics added]." Control devices, escort holds, compliance holds and passive counter measures were more broadly considered "control alternatives." Although a continuum of force was not specified per se, "intervention options" were provided; these options ranged from presence, dialogue, control alternatives, protective alternatives (e.g., focused strikes, vertical stuns), to deadly force (see Figure 1).

Most of the data for the study were obtained from a case management system used by the police department and were converted into a Statistical Package for the Social Sciences (SPSS) data file for analyses. The database was organized with use of force incidents as the unit of analysis. The use of force data were based on reports that were completed by supervisory officers when a use of force incident occurred. According to the official policy of the department at the time of the study, a use of force report was to be completed by a supervisor when an officer: (a) discharged a firearm, (b) used a baton, (c) discharged Oleoresin Capsicum (OC), (d) deployed an Electronic Control Device (Taser), (e) used any other type of force, which resulted in an injury, or a complaint of an injury, to a person, or (f) when a department canine bit a subject in the performance of their duty. Clearly, this is a relatively narrow definition of force as it does not include incidents where only bodily force was used when that force did not result in an injury (or a complaint of an injury) to a subject (or verbal force, see Terrill & Mastrofski, 2002). Nevertheless, that the department policy did not require all bodily force incidents to be reported is of little concern in this study. This study focuses specifically on incidents that involved the use OC spray or a Taser. Departmental policy specified that all such incidents be recorded and all types of force used in those incidents be recorded.

Along with the departmental use of force report, a narrative of the incidents was also written by the supervisory officer and was included in the case management system. For this

study, all of the narratives for incidents that involved the use of OC and/or a Taser were reviewed (787 pages) and additional data were coded from them (e.g., level of subject resistance, the order in which force was used by officers).

Variables

The two primary dependent variables in this study are: 1) the *use of* OC spray and the Taser and 2) the *effectiveness of* OC spray and the Taser. Determining whether or not a particular type of force was used in an incident was relatively straight-forward. If OC was sprayed or a Taser was deployed, OC or the Taser was considered to have been used. If the target was missed, if the weapon malfunctioned, if it was used in a crowd situation, or if it was used against females, the incident was still included. If the incident involved multiple officers and/or multiple subjects, the incident was included. In the few incidents that involved multiple subjects, the characteristics of the person identified as the primary subject in the officer's report was coded.

Determining the effectiveness of OC spray and the Taser was more complicated. As discussed earlier, previous studies have used different measures of effectiveness although each study, in one way or another, examined how well, or to what degree, OC spray or the Taser incapacitated the subject who resisted the police. Of course, the variation in measurement is important to consider when interpreting findings across studies. Ultimately, in a use of force incident, the legitimate objective is to neutralize the threat posed by the subject and gain control over that subject. Most often, practically speaking, "gaining control" means using as much force as necessary in order to place handcuffs on the subject. Many use-of-force situations are

complicated; they unfold, one action leads to another, but ultimately force is used to gain control over the physical actions of the subject.

In this study, we provide a relatively straight-forward, bottom-line, measure of OC and Taser effectiveness. OC spray and/or Tasers were considered effective in two circumstances: First, if OC or a Taser was the *only* type of force that was used in the incident in order to subdue/handcuff the subject, OC or the Taser was considered effective. In these situations, OC spray or the Taser, by itself, led to the legitimate desired outcome; it was effective. Second, if OC or a Taser was the *last* type of force used in the incident prior to the subject being subdued/handcuffed, then OC or the Taser was considered effective. For example, if OC spray was deployed but then some other type of force was necessary in order to gain control over the subject to the point of placing him in handcuffs, then the OC was considered ineffective. OC may, or may not, have had some effect, but ultimately it was not effective in achieving the legitimate objective of the use of force incident—additional force needed to be used.

Of course, one must not lose sight of the possible cumulative effects that various types of force that were used in an incident may have in bringing an incident to an end. Indeed, several of the studies reviewed above simply did not take into account any other types of force that may have been used in the incident. Given the nature of the data analyzed in this study, measuring the precise effect that various forms of force may have had in a use of force incident is difficult, if not impossible. Nevertheless, to the extent possible, and when possible, we consider not only the last type of force used, but all types of force used in the incident. It is also important to highlight that the same criteria are used in measuring the effectiveness of OC and Tasers, providing for an equal ("apples-to-apples") comparison of the effectiveness of the two forms of

force. It is in these ways that an understanding of the relative effectiveness of OC and Tasers can be achieved.

Independent Variables

The independent variables in this study consist of subject characteristics and actions (see Tables 1 and 2 for coding and descriptive statistics). In particular, we focus on: 1) who was the subject? and 2) what did the subject do? Officer characteristics are not included primarily because of the analytic difficulties in doing so.[6] The number of officers who used force in an incident and the number of officers present when force was used were coded and included in the analyses as controls. The number of subjects who had force used upon them was also coded and included as a control.[7]

Data on "who the subject was" (i.e., the characteristics of the subject) were coded according to the supervisor's report. These variables consisted of subject race (white/minority[8]), age, sex, height, and weight.

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[6] Of course, this is a less than optimal solution to the issue; however, previous studies have struggled with the same issue and also resolved it in less than optimal ways. For instance, studies that have included officer characteristics either included only one officer when multiple officers were involved in the incident (Adang et al., 2006; Kaminski et al., 1999), or counted single incidents multiple times if multiple officers used force (White and Ready, 2007). Some studies are unclear about how multiple officer and multiple subject incidents were handled in the analyses (Morabito and Doerner, 1997). Each of these options essentially reduces the complexity of the incidents that are analyzed. None of these options are good, nor is the exclusion of officer characteristics; however, by not including officer characteristics we do not systematically exclude cases. Clearly, there is a trade-off between model error and sample bias.

[7] As noted, in multiple subject incidents, the characteristics of the primary subject, as identified in the police narrative report, were coded and included in the analyses.

[8] Ideally, sub-racial and ethnic groups would be analyzed instead of the "minority" category (Gau et al., 2010). However, too few Hispanics and/or other ethnic/racial group members were included among the incidents. The "minority" group classification consisted of 90% African American subjects (377 out of 419).

Most of the data on "what the subject did" (i.e., how the subject acted) were coded from the narrative reports prepared by supervisory officers and the statements included in the reports. These variables consisted of: whether the subject was mentally disturbed (yes/no), whether the subject was under the influence of drugs or alcohol (yes/no), whether a subject was believed to be armed with a weapon (yes/no), whether a subject was actually armed with a weapon (yes/no),whether a subject fled the police on foot (yes/no), whether a subject assaulted an officer ("yes" if it was stated in the narrative that the subject intentionally hit, kicked, bit, shot, stabbed, or spat upon an officer, "no" otherwise), and the level of resistance offered by the subject (coded on the basis of information provided in the narrative).[9]

RESULTS

Given the purposes of this study, results are organized into two sections: 1) those that relate to the *use* of OC spray and the Taser and 2) those that relate to the *effectiveness* of OC spray and the Taser. We begin with bivariate analyses and multivariate analyses of OC/Taser use and then turn attention to bivariate and multivariate analyses of OC/Taser effectiveness.

The Use of OC Spray and Tasers

How do the 259 incidents where OC spray was used differ from the 245 incidents where a Taser was used? This question was first addressed by calculating statistical differences

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[9] Examples of *passive* resistance included when a subject refused to exit a car, subject went limp, subject refused to move after being ordered to do so, subject refused to show hands after being ordered to do so; examples of *verbal* resistance included when a subject told the officer(s) to leave him/her alone, subject stated he or she will not comply; examples of *defensive* resistance included when subject attempted to or actually fled the police, the subject attempted to hide from the police, subject pulled away from the officer, subject got up after being directed to the ground; examples of *active* resistance included subject fighting with the police, subject lunging at officer, subject attempting to disarm the officer (Terrill and Mastrofski, 2002).

between the variables of interest and OC spray and Taser incidents on the basis of chi-square and *t* tests (for the sake of space, results are not tabled here). Next, a logistic regression equation was estimated to identify factors that predicted OC spray versus Taser use; these results are shown in Table 3.

In the bivariate analyses, OC spray was significantly more likely than a Taser to be used on minority subjects ($X^2 = 6.82$; $p < .01$); OC spray and a Taser were equally likely to be used regardless of subject age, sex, weight, or height. A Taser was significantly more likely to be used than OC when the subject appeared to be mentally disturbed ($X^2 = 18.61$; $p < .01$), was believed to be armed with a weapon ($X^2 = 19.23$; $p < .01$), when the subject was actually armed with a weapon ($X^2 = 6.52$; $p < .05$), and when the subject fled the police on foot ($X^2 = 16.14$; $p < .01$). OC spray and Tasers were equally likely to be used when the subject was believed to be under the influence of alcohol or drugs, when the subject assaulted a police officer, and regardless of the amount of resistance provided to the police. OC was more likely to be used than a Taser when more than one subject had force used upon them in the incident ($t = -2.03$; $p < .05$); a Taser was more likely to be used than OC when more officers used force in the incident ($t = 2.30$; $p < .05$) and when more officers were present at the incident ($t = 6.39$; $p < .01$).

Table 3 shows the results of the logistic regression analyses performed for OC spray and Taser use. Due to substantial missing data, subject height and weight were not included in the equation. Two models were estimated: one compares those incidents where OC was used to those incidents where a Taser was used ("OC Used"), the other compares Taser use to OC use ("Taser Used"). The independent variables identified as significant in the earlier analyses are similar to those identified as significant here. First, all other variables held constant, when the subject was believed to be mentally disturbed, a Taser was more than two times more likely to be

used than OC spray (odds ratio = 3.296; p = .000). Second, when the subject was believed to be armed, a Taser was significantly more likely to be used than OC spray (odds ratio = 1.858; p = .023). Third, when the subject fled the police on foot, a Taser was significantly more likely to be used on the subject than OC spray (odds ratio = 2.452; p = .000). Fourth, when there were more subjects involved, OC spray was nearly 80% more likely to be used than a Taser (odds ratio = 1.794; p = .04). Finally, when there were more officers present at the incident, a Taser was significantly more likely to be used (odds ratio = 1.668; p = .000).

The Effectiveness of OC Spray and Tasers

Before examining the factors associated with the effectiveness of OC and Tasers spray, it is necessary to calculate an effectiveness rate for OC spray and Tasers (see Table 4). Of the 259 incidents where OC spray was used, 63 involved only the use of OC spray. That no other force was needed to subdue the subject can be considered reasonable evidence that OC spray was effective. In the other 196 incidents, OC spray and some other force were used. In these 196 incidents, the order in which force was applied is meaningful. In 128 of these 196 incidents, OC ended the encounter; presumably OC was used to subdue the subject because the force that was applied prior to the OC did not work, or did not appear to be working, at least in the judgment of the officer who deployed the OC spray.[10] There were 68 incidents where OC was deployed during the incident but some other force ended the encounter.[11] To calculate an effectiveness rate of OC spray, the 63 incidents that only involved OC spray and the 128 incidents where OC

[10] Of the 128 incidents, in 125 of them bodily force was used prior to OC spray; in 3 incidents, bodily force and a baton were used prior to OC.

[11] Of the 68 incidents, 63 ended as a result of bodily force, 5 ended with the use of a baton.

was used last are combined (63 + 128) and divided by the total number of incidents in which a OC spray was used (259). This calculation results in a 73.8% effectiveness rate.

Of the 245 incidents where a Taser was used, in 85 of them, only a Taser was used. In the other 160 incidents, a Taser and some other force were used. In 136 of the 160 incidents, a Taser was the last type of force used.[12] In the other 24 incidents, a Taser was deployed first but some other force ended the encounter.[13] To calculate an effectiveness rate of Tasers, the 85 incidents that only involved a Taser and the 136 incidents where a Taser was used last are combined (85 + 136) and divided by the total number of incidents in which a Taser was used (245). This calculation results in a 90.2% effectiveness rate. Using the same parameters for calculating the effectiveness of OC spray and Tasers, it is clear that Tasers demonstrate a substantially higher effectiveness rate than OC.

As demonstrated in prior studies, OC spray and Tasers may be more effective with some subjects than with others. Again, we calculated statistical differences between the variables of interest and OC spray and Taser incidents on the basis of chi-square and *t* tests (results not tabled). Overall, the results showed that the effectiveness of OC and Tasers did not vary significantly by any of the subject demographic variables included: subject race, age, sex, height, or weight. OC spray was significantly less effective when the subject was believed to be armed ($X^2 = 4.67; p < .05$), when the subject assaulted the police ($X^2 = 5.88; p < .05$), and when the subject provided higher levels of resistance ($X^2 = 16.91; p < .01$). As with OC spray, Tasers

[12] Of the 136 incidents, in 135 of them bodily force was used prior to the Taser; in 1 incident, bodily force and a baton was used prior to a Taser.

[13] Of the 24 incidents, 21 ended as a result of bodily force, 1 ended with the use of a baton, and 2 ended with the use of a firearm.

were less effective with greater subject resistance ($X^2 = 10.78$; $p < .05$). The results also showed that OC spray and Tasers were less likely to be the last type of force used (less likely to be "effective") when more officers used force in the incident ($t = 3.73$; $p < .01$ and $t = 3.29$; $p < .01$, respectively). OC spray and Tasers were also less likely to be the last type of force used when more officers were present during the incident ($t = 3.00$; $p < .01$ and $t = 2.04$; $p < .05$, respectively).

To identify more directly the factors that predict the effectiveness of OC spray and Tasers, two logistic regression equations were estimated: one for OC effectiveness the other for Taser effectiveness (see Table 5). For each model, the comparison was between effective versus not effective. There are two primary findings worthy of discussion based on the logistic regression results. First, while the OC model is significant, the Taser model is not. It appears that the Taser is uniformly effective, regardless of the variables included here. Second, of all the variables examined, the only significant predictor of OC spray effectiveness is subject resistance. With more resistance offered, OC spray was 48% less likely to be effective (odds ratio = .515; p = .027).[14] Apparently, OC spray alone is not enough to subdue a subject who is more resistive.

DISCUSSION

Previous research on the use and effectiveness of OC spray and Tasers is characterized by incomplete and conflicting findings. There are simply too few studies from which to draw conclusions. Varying study sites, comparisons, data sources, and measurement schemes certainly contribute to these conflicting findings. Nevertheless, a basic conclusion of previous research is that OC spray and Tasers are used in different circumstances. This study used

[14] Congruent with Kaminski et al. (1999), in each of the logistic regression models, younger and older subjects (under 22 and over 38) were compared to "middle" aged subjects (22-37). The results of the analyses did not change in any meaningful way.

OC Spray/Taser Effectiveness

The only significant predictor of OC spray (in)effectiveness was subject resistance. The more a subject resisted the police, the less likely OC spray was to be effective. In particular, when OC spray was used in situations where the subject resisted, it was likely that OC was not the last type of force used. Either the OC spray led to additional resistance that had to be overcome with other force, or OC was not effective in subduing a subject who was already resisting. The model predicting Taser effectiveness was not significant; this suggests that the Taser was effective to the degree that our predictors did not contribute to our understanding of its effectiveness. As noted, the observed level of Taser effectiveness may be a function of the circumstances in which Tasers are used, the amount and quality of training officers received with the Taser, as well as their limited deployment in the study department.

With regard to the effectiveness rates of OC spray and the Taser, and congruent with previous studies, we found that the Taser was substantially more effective than OC spray. Given the research that has been conducted, it is safe to say that Tasers have inherent advantages over OC spray in their ability to incapacitate subjects. However, with this conclusion, it is important not to lose sight of the fact that OC spray and Tasers are simply tools and, like hammers, can be more effectively used by some people than others.

In summary, OC spray and Taser use and effectiveness are clearly different outcomes with different predictors. Overall, suspect behaviors are of value in predicting the *use* of OC and Tasers but not when predicting their *effectiveness*. While suspect behaviors may drive the decision to choose OC spray or the Taser over other forms of force, other factors determine whether OC spray or the Taser actually work to induce suspect compliance. For example, whether OC spray actually works may have less to do with the subject's characteristics and

actions, and more to do with the capabilities of the weapon itself (e.g., amount of OC sprayed, distance between officer and suspect when OC is sprayed). Further research that directly compares OC spray with Tasers may highlight other critical variables that would help explain the use and effectiveness of them.

IMPLICATIONS FOR POLICY AND RESEARCH

Given the relative paucity of research on the use and effectiveness of OC spray and Tasers, specific policy implications are premature. However, when considering the current findings along with the results of prior studies, several policy- and especially research-related questions come to light.

In particular, how Tasers are distributed among officers may have implications for their use and effectiveness in particular police departments. Specifically, are Tasers used at a higher rate if more officers are equipped with them? Is OC spray used at a lower rate if more officers are equipped with Tasers? If more officers are equipped with Tasers, and Tasers are used more frequently, is Taser effectiveness impacted? In addition, does the amount, type, and quality of training received by officers on OC spray and Tasers impact their use and effectiveness? To what extent does organizational policy regarding the use of OC spray and Tasers affect their use and effectiveness? As such, it would be worthwhile and interesting to consider the use and effectiveness of OC and Tasers across similar departments with different deployment arrangements, training standards, and policies regarding the OC and Tasers. Clearly, there is variance between departments in this regard.

It will not be until research accumulates that it will be possible to draw conclusions about the use and effectiveness of OC and Tasers with confidence. Along with factors already mentioned, the effectiveness of OC spray and Tasers are likely to depend on factors not included

in this study or in most others, including the distance from which the weapon was used, the type of clothing worn by the subject (heavy clothing being worn by the subject may inhibit the use of a Taser and/or the effectiveness of it), whether the target was moving at the time of weapon deployment, and the height/weight the subject in relation to the officer.

Another interesting topic for research on the issue is the impact of the *threat* of Taser use on resisting subjects. Adang et al. (2006) examined the impact of threats with respect to OC spray (in their study, OC spray was less effective when suspects were warned beforehand they were going to be sprayed), but no studies have looked at this issue with respect to Tasers; we currently lack information about how often Tasers are threatened to be used (or how often they are even displayed) by officers and the effects of those actions. Such studies could enhance our understanding of the overall effectiveness of the weapons and inform associated policy.

While there is a clear need for additional research on the use of effectiveness of OC spray and Tasers, there is also a need for additional research on the use and effectiveness of bodily force in use of force situations, especially given its frequency. Most use of force incidents begin with bodily force and most injuries to officers and subjects are as a result of bodily force (Adams, 1999). As such, it would be worthwhile for researchers to consider the effectiveness and other issues related to the use of bodily force. What factors predict the effectiveness or ineffectiveness of bodily force? There are many forms of bodily force, what types are most often used and most effective? Answers to these questions may provide insight into situations where bodily force (or certain types of bodily force) should be avoided and OC spray or Tasers used instead.

LIMITATIONS

This study contributes to the discussion about the factors associated with the use and effectiveness of OC spray and Tasers, but it has limitations. First, the data used in the study were collected from police reports which provide the official account of what happened during the use of force incident. Even the order in which force was used, which was critical for the measurement of OC spray and Taser effectiveness in this study, could be misrepresented in the reports. Although there is no evidence of systematic distortion or under-reporting in the reports, the accuracy of the reports could be questioned in this regard. Although many other use-of-force studies, and studies on other topics for that matter, also use official police reports, the veracity of the reports needs to be considered when drawing conclusions on the basis of them.

Second, the generalizability of the findings presented here can be questioned. This department had a unique arrangement for the deployment of Tasers among officers and had a specific policy which guided officer decision making in use of force incidents that involved OC spray and Tasers. Establishing external validity is always an empirical issue; as noted, there is a need for additional research to be conducted on the topic in other police departments.

Finally, this study included a relatively limited range of variables in trying to predict the use and effectiveness of OC spray and Tasers. We would benefit from additional studies that were able to include a wider range of independent variables in the prediction models. By addressing these limitations, a more complete understanding of the factors that predict the use and effectiveness of OC spray and Tasers may be developed.

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Figure 1

Description of "Intervention Options" Used in Study Department

MODE	Definition	Authorized Police Response(s)
Presence	To present a visible display of authority	Open stance, ready stance, defensive stance
Dialog	To verbally persuade	Search talk, persuasion, light control talk, heavy control talk
Control Alternatives	To overcome passive resistance, active resistance, or their threats	Escort holds, compliance holds, control devices **(i.e., OC, ECDs)**, passive countermeasures
Protective Alternatives	To overcome continued resistance, assaultive behavior, or their threats	Active countermeasures, incapacitating techniques, intermediate weapons
Deadly Force	To stop the threat	Deadly force

Table 1

OC or Taser Used: Coding and Descriptive Statistics

Variable	Scale	OC Used M	OC Used SD	OC Used N	Taser Used M	Taser Used SD	Taser Used N
Subject Characteristics							
Race	0=minority 1=white	.11	.31	253	.20	.40	241
Age	in years	30.70	11.17	252	30.06	10.65	239
Sex	0=female 1=male	.88	.33	251	.92	.27	240
Height	in inches	69.42	3.28	192	69.81	3.46	186
Weight	in pounds	187.49	40.76	192	188.35	46.91	186
Subject Actions							
Mental Disturbed	0=no 1=yes	.09	.29	259	.23	.42	245
Under Influence	0=no 1=yes	.43	.50	258	.46	.50	244
Believed Armed	0=no 1=yes	.22	.41	259	.40	.49	245
Actually Armed	0=no 1=yes	.08	.28	259	.16	.37	245
Fled Police	0=no 1=yes	.22	.41	259	.38	.49	245
Resistance	0=none 1=passive/verbal 2=defensive 3=active	2.40	.76	258	2.44	.73	245
Assaulted Police	0=no 1=yes	.17	.38	259	.13	.34	245
Controls							
# of Subjects		1.12	.47	259	1.04	.35	245
# of Officers Used Force		1.72	.86	259	1.92	1.12	245
# of Officers Present		2.44	1.16	259	3.37	2.03	245

Table 2

OC or Taser Effective: Coding and Descriptive Statistics

Variable	Scale	OC Effective M	SD	N	Taser Effective M	SD	N
Subject Characteristics							
Race	0=minority 1=white	.12	.32	187	.19	.40	217
Age	in years	30.86	11.47	185	30.02	10.62	215
Sex	0=female 1=male	.86	.35	184	.92	.28	216
Height	in inches	69.29	3.37	140	69.67	3.38	170
Weight	in pounds	184.40	39.78	140	188.05	44.00	170
Subject Actions							
Mental Disturbed	0=no 1=yes	.09	.29	191	.23	.42	221
Under Influence	0=no 1=yes	.42	.50	190	.46	.50	220
Believed Armed	0=no 1=yes	.18	.39	191	.38	.49	221
Actually Armed	0=no 1=yes	.07	.26	191	.15	.36	221
Fled Police	0=no 1=yes	.19	.39	191	.37	.48	221
Resistance	0=none 1=passive/verbal 2=defensive 3=active	2.28	.80	190	2.44	.71	221
Assaulted Police	0=no 1=yes	.14	.34	191	.12	.33	221
Controls							
# of Subjects Force Used Upon		1.14	.49	191	1.04	.37	221
# of Officers Used Force		1.60	.75	191	1.85	1.06	221
# of Officers Present		2.31	1.02	191	3.29	1.92	221

Table 3

Logistic Regression Models of OC or Taser Use

Variable	OC Used 0=no 1=yes B	p	Exp(B)	Taser Used 0=no 1=yes B	p	Exp(B)
Subject Race	-.579	.056	.560	.579	.056	1.785
Subject Age	.017	.093	1.017	-.017	.093	.983
Subject Sex	-.076	.836	.927	.076	.836	1.079
Subject Mental Disturbed	-1.193	.000	.303	1.193	.000	3.296
Subject Under Influence	-.316	.150	.729	.316	.150	1.372
Subject Believed Armed	-.619	.023	.538	.619	.023	1.858
Subject Actually Armed	.149	.704	1.160	-.149	.704	.862
Subject Fled Police	-.897	.000	.408	.897	.000	2.452
Subject Resistance	-.199	.207	.819	.199	.207	1.221
Subject Assaulted Police	.527	.079	1.694	-.527	.079	.590
No. of Subjects	.584	.041	1.794	-.584	.041	.558
No. of Officers Used Force	.202	.140	1.224	-.202	.140	.817
No. of Officers Present	-.512	.000	.599	.512	.000	1.668
Constant	1.301	.054	3.673	-1.301	.054	.272
Log likelihood	565.613			565.613		
Model Chi Square	103.617			103.617		
df	13			13		
Significance	.000			.000		
R Squared (Nagelkerke)	.258			.258		
N	483			483		

Notes: B=log odds, p=significance, Exp (B)=odds ratios

Table 4

OC and Taser Effectiveness

OC was Used in 259 incidents (no Taser used)

In 63 incidents only OC used
In 196 incidents OC and other form(s) of force were used

In 128 of the 196 incidents, OC ended the encounter
In 68 of the 196 incidents, another type of force ended encounter
(i.e., bodily force = 63; baton = 5)

63 + 128 = 191 / 259 = OC 73.8% effective rate

Taser was Used in 245 incidents (no OC used)

In 85 incidents only a Taser used
In 160 incidents a Taser and other form(s) of force were used

In 136 of the 160 incidents, a Taser ended the encounter
In 24 of the 160 incidents, another type of force ended encounter
(bodily force = 21; baton = 1; firearm = 2)

85 + 136 = 221 / 245 = Taser 90.2% effective rate

OC and Taser were Used in 24 incidents

In 22 of the 24 incidents, the Taser ended the encounter
In 2 of the 24 incidents, OC ended the encounter

Another Weapon was Used in 45 incidents (no OC or Taser)

In 22 of the 45 incidents, only a firearm was used
In 14 of the 45 incidents, bodily force and a baton were used
In 4 of the 45 incidents, only a baton was used
In 3 of the 45 incidents, bodily force and a firearm were used
In 1 of the 45 incidents, gas and a firearm was used
In 1 of the 45 incidents, bodily force and a flashlight were used

Table 5

Logistic Regression of OC and Taser Effectiveness

	OC Effective			Taser Effective		
	0=no 1=yes			0=no 1=yes		
Variable	B	p	Exp(B)	B	p	Exp(B)
Subject Race	.424	.434	1.528	-.317	.617	.728
Subject Age	.012	.451	1.012	-.014	.557	.986
Subject Sex	-1.433	.076	.239	-.419	.714	.658
Subject Mental Disturbed	-.423	.455	.655	-.001	.999	.999
Subject Under Influence	-.340	.323	.712	.071	.890	1.073
Subject Believed Armed	-.351	.411	.704	-.416	.456	.660
Subject Actually Armed	-.726	.251	.484	-.397	.556	.672
Subject Fled Police	-.265	.483	.767	-.768	.144	.464
Subject Resistance	-.664	.027	.515	.232	.516	1.261
Subject Assaulted Police	-.529	.189	.589	-.754	.255	.470
No. of Subjects	.661	.222	1.037	.657	.697	1.929
No. of Officers Used Force	-.414	.062	.661	-.531	.017	.588
No. of Officers Present	-.174	.286	.840	.000	.998	1.000
Constant	4.651	.001	104.660	3.647	.122	38.343
Log likelihood	244.171			139.531		
Model Chi Square	41.147			15.443		
df	13			13		
Significance	.000			.281		
R Squared (Nagelkerke)	.224			.134		
N	248			235		

Notes: B=log odds, p=significance, Exp(B)=odds ratios

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The Impact of the Taser on Suspect Resistance

Identifying Predictors of Effectiveness

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Despite the Taser's increasing popularity among police agencies, questions have been raised concerning the weapon's use and effectiveness as well as its potential to cause serious injury or death. This article examines all Taser deployments by the New York City Police Department from 2002 to 2005 (N = 375) and uses two multivariate approaches—logistic regression and chi-square automatic interaction detection—to identify predictors of Taser effectiveness, measured as continued suspect resistance and officer satisfaction. Findings indicate that several factors are associated with reduced effectiveness, including suspect body weight (more than 200 pounds), drug and alcohol use, physical violence, and close distance (3 feet or less) between the officer and the suspect. Although this study represents a preliminary effort at identifying predictors of Taser effectiveness, there are clear training and policy implications for police departments.

Keywords: *police use of force; Taser; less-than-lethal weapons; conducted energy device (CED)*

Conducted energy devices (CEDs)—most notably, the Taser—are being adopted and deployed by police agencies on a broad scale across the United States. Taser International, the leading developer of stun device technology, has sold more than 200,000 weapons to more than 9,000 police agencies in the United States (Davis, 2007). The economic trends are perhaps a better indicator of the enormous growth of the Taser; Taser International's revenue grew from approximately $2.5 million for fiscal year 1999 to an estimated $67 million in 2004 (McBride & Tedder, 2005).[1] Despite its increasing popularity among police departments and private consumers, questions have been raised concerning the weapon's use and

effectiveness as well as its potential to cause serious injury or death. The following examples illustrate why this topic has become contentious:

- Use: In fall 2005, police officers in Miami used a Taser on a 6-year-old boy who was cutting himself with a piece of glass and on a 12-year-old truant fleeing police.
- Effectiveness: In December 2005, Nashville, Tennessee, police officers used the Taser 19 times on a combative suspect before they were able to take him into custody (Bottoroff, 2005).
- Physiological impact: Amnesty International issued a report in 2004 describing 74 cases in the United States and Canada where a suspect died after being stunned by a Taser. The organization cites these deaths, recent biomedical research, and news reports of incidents involving the questionable use of Tasers to support a moratorium on their use.

Although a growing body of research has examined the physiological effects of the Taser (Ho, Miner, Lakireddy, Bultman, & Heegaard, 2006; Joint Non-Lethal Weapons Human Effects Center of Excellence, 2005; McDonald, Stratbucker, Nerheim, & Brewer, 2005), sparse empirical research has been conducted on the use and effectiveness of the instrument in a field setting. Consequently, our knowledge is largely limited to reports from the CED industry (e.g., Taser International) and police agencies on one side and documents from human rights groups (e.g., Amnesty International and the American Civil Liberties Union) on the other.[2]

This article seeks to add to the scientific knowledge base in this area through an examination of all Taser incidents involving officers in the New York Police Department (NYPD) from 2002 to 2005 (N = 375), with an emphasis on identifying predictors of weapon effectiveness. Specifically, the authors use both logistic regression and chi-square automatic interaction detection (CHAID), a form of segmentation modeling, to identify predictors of Taser effectiveness, measured as both the termination of suspect resistance and officer satisfaction with the weapon. The article concludes with a discussion of implications for the ongoing public discourse regarding the Taser as well as for police policy and practice.

Prior Research

Police and the Use of Force

Police officers have legal authority to use force in a wide range of situations, and the nature of this force can entail using empty-hand force and

less lethal weapons (e.g., baton, pepper spray, or CED), depriving an individual of liberty through arrest, and as a last resort, using a firearm to take an individual's life (Walker & Katz, 2002). Bittner (1970) asserts that the capacity to threaten or use physical force is the core function of the police that defines their role and shapes each contact with a citizen or suspect:

> There can be no doubt that this feature of police work is uppermost in the minds of people who solicit police aid or direct the attention of the police to problems, that persons against whom the police proceed have this feature in mind and conduct themselves accordingly, and that every conceivable police intervention projects the message that force may be, and may have to be, used to achieve a desired objective. (p. 40)

Despite its central role in police work, research indicates that police use of force is statistically rare, occurring in only about 1% of all police–citizen encounters (U.S. Bureau of Justice Statistics, 1999).[3] However, because of the sheer volume of police–citizen encounters in a given year (approximately 43 million), an estimated 421,000 use-of-force incidents occur annually, which translates into about 1,100 incidents per day. Rubinstein (1973) clearly illustrates the intrusive, dehumanizing effect that force can have on a citizen:

> [The patrol officer] may not only circumscribe a person's liberty by stopping him on the street, he may also completely violate the suspect's privacy and autonomy by running his hands over the man's entire body. The policeman knows that a frisk is a humiliation people usually accept from him because he can sustain his authority by almost any action he feels necessary. While he does not frisk people often to just humble them, he can do so; when he feels obliged to check someone for a concealed weapon, he is not usually in a position to request their permission, even if this were desirable. (p. 271; see also Skolnick & Fyfe, 1993, p. 94)

The consequences of police use of force can be severe and long lasting, far exceeding the immediate impact on the individual officer and citizen involved. Fyfe (1988) notes that use-of-force incidents have led to civil disorder and riots, the firing of police executives, millions of dollars in litigation, criminal prosecutions, and strained police–community relations. Recent examples include outbreaks of civil disorder in Cincinnati, Ohio, and St. Petersburg, Florida, in the late 1990s as well as the riots after the acquittal of the Los Angeles Police Department officers involved in the Rodney King incident.

Because of the magnitude of this responsibility delegated to the police and its potential consequences, police officers are mandated to use the minimum force necessary to accomplish their objective; force exceeding this minimum standard is considered excessive (Commission on Accreditation for Law Enforcement Agencies, 1999). Police departments closely monitor use of force and provide policy guidelines to officers typically through a "force continuum," which describes verbal and physical actions an officer can take in response to different levels of suspect resistance and behavior. The use-of-force continuum will usually highlight the minimum and maximum recommended force options available to the individual officer. As the subject's resistance or aggression increases, the officer may use greater degrees of force and is allowed to remain one level above the suspect as the interaction progresses (i.e., an officer may be permitted to use a less lethal weapon, such as pepper spray or a CED, in response to physical resistance by a suspect).

The Development of Less Lethal Alternatives

The role of the police in igniting the riots that marked the 1960s led scholars and police practitioners to reevaluate the force options available to patrol officers in responding to varying levels of suspect resistance. Although discussions regarding less lethal alternatives to the firearm date back to the 1920s, the President's Commission on Law Enforcement and the Administration of Justice (1967) brought the issue to the forefront of the policing agenda when it recommended the development and adoption of less lethal alternatives. During the past several decades, advances in technology have led to the development of a range of new alternatives, such as oleoresin capsicum (OC) spray, impact weapons, foams, ballistic rounds, nets, and most recently, CEDs (Wrobeleski & Hess, 2003). These weapons are intended to provide officers with more alternatives when a situation requires the application of force but has not escalated to the point where lethal force is necessary—thereby adding response options to the use-of-force continuum.

During the 1990s, the adoption of OC or pepper spray became commonplace among police agencies, and this trend was accompanied by a sizeable literature on its use, impact, and effectiveness (Smith & Alpert, 2000). The research on OC spray serves as an important backdrop for the current work on CEDs, because many of the same issues and concerns have been raised. Specifically, controversies surrounding the use of OC spray included its use

against passive resisters, disproportionate use against minorities, and potential health risks (Kaminski, Edwards, & Johnson, 1999). A number of studies have examined the effectiveness of OC spray, indicating relatively high rates of suspect incapacitation, reduced officer injuries, and less reliance on other types of force (Gauvin, 1994; Lumb & Friday, 1997; Nowicki, 1993). Using interrupted time-series analysis, Kaminksi, Edwards, and Johnson (1998) concluded that the adoption of OC spray in Baltimore County reduced the number of assaults on police by 15%. Furthermore, Kaminski et al. (1999) found that the effectiveness of OC spray was mitigated by suspect age, weight, distance, and drug use (but not alcohol).

New Technology Emerges: CEDs

For many police agencies, CEDs are more than just the latest novelty in less lethal alternatives; rather, they are becoming what mace was for police departments in the 1960s—an integral tool used in daily police practice. Advantages of CEDs over other less lethal alternatives—such as pepper spray, bean bag guns, and other soft-impact rounds—include the relatively short duration of their recovery time, their reliability at greater distances, their size and utility, and their perceived effectiveness.[4]

Nonetheless, some police departments have been cautious in adopting this technology on a broad scale, and anecdotal evidence suggests that line officers may be reluctant to use the device routinely because of its dubious public image. The Taser, an acronym for Thomas A. Swift Electric Rifle, "is a conducted energy weapon that fires a cartridge with two small probes that stay connected to the weapon by high-voltage, insulated wire" (Wrobeleski & Hess, 2003, p. 87). The M26 and X26 advanced Taser models introduced by Taser International in 1999 and 2003, respectively, are the two common "new generation" CEDs used by police agencies. These weapons discharge two darts to a distance of 21 feet, delivering a 50,000-volt shock in a 5-second cycle. The electrical charge overrides the central nervous system, resulting in the loss of neuromuscular control, which gives the officer time to gain control of the suspect and apply handcuffs, if necessary.

Questions Surrounding the Taser

The controversy regarding the Taser has occurred in the public domain and has been widely publicized. News reports describing incidents in which police officers used the weapon against the elderly, children, and the mentally ill have made national headlines. Favorable and unfavorable

media images of police practices have been competing for public attention and serve as the backdrop against which the Taser is being assessed by the public and government officials (Lovell, 2003). Currently, empirical research is not driving the debate. This is unsettling, considering that mainstream media depictions of the police are often inaccurate or unrealistic (Ian Ross, 2000; Manning, 1977, 1997). The controversy regarding the Taser came to a head in 2004 when Amnesty International issued its report:

> In its recommendations . . . *Amnesty International* is reiterating its call on federal, state and local authorities and law enforcement agencies to suspend all transfers and use of electro-shock weapons, pending an urgent rigorous, independent and impartial inquiry into their use and effects. (Amnesty International, 2004, p. 3).

The conclusions of the Amnesty International report underscored the controversy and ongoing debate between CED manufacturers and human rights organizations about the expanded use of CEDs among police agencies in the United States. The organizations' concerns focused on fatalities occurring after Taser deployment as well as the potential for abuse by police and its use as a routine force option. CED manufacturers argue, however, that the device is a safe alternative to other less lethal weapons that reduces injuries to officers and suspects. More generally, concerns about CEDs have emerged in three critical areas. Each is discussed below.

When is it appropriate to use the device? No consensus exists among police agencies regarding where the Taser should be placed on the force continuum (U.S. Government Accountability Office, 2005). Should CEDs be placed at the same level as pepper spray, or are they more appropriate farther down the use-of-force continuum as a last alternative to the firearm? Should they be used against suspects who are passively resisting an officer (e.g., ignoring verbal commands) or only against individuals who are actively resisting arrest? Is there any justification for using the Taser against a minor, a senior citizen, or a pregnant woman? Police departments have varied considerably in their responses to these questions, and both the International Association of Chiefs of Police (IACP; 2005) and the Police Executive Research Forum (PERF; 2005) have taken action recently by developing training guidelines and model policies to offer guidance to agencies in their deployment of CEDs. For example, both the IACP and PERF suggest that CEDs only be used against those who are actively resisting, that they not be used against children or the elderly except

in emergency situations, and that each deployment is closely supervised and documented.

Does it work effectively? Since January 2000, *The New York Times* has printed nearly 200 news stories describing incidents in which officers across the United States have used the Taser to control or subdue a suspect. A review of these articles reveals an abundance of cases in which the Taser appears not to have the intended physiological effect on a suspect. In some cases, one or both of the prongs missed the target, or the prongs hit the target but failed to penetrate the suspect's clothing. To date, much of the academic research on the effectiveness of CEDs has relied on field reports completed by officers after deploying the weapon, which measure whether the CED functioned properly, enabling the officer to incapacitate or arrest the subject. Field data analyzed by Taser International (2006) and internal evaluations conducted by police agencies (see, e.g., Seattle Police Department, 2004) place the effectiveness rate of the Taser somewhere between 80% and 94%, but there is sparse independent empirical research studying the effectiveness of the device. White and Ready (2007) calculated an effectiveness rating by examining the impact of the Taser on suspect resistance. They found that use of the weapon caused suspects to stop resisting in 86% of all Taser deployments by the study department.

Several police agencies that have implemented CEDs on a broad scale have later reported reductions in injuries sustained during police–citizen contacts. Police departments in Austin, Texas; Putnam County, Florida; and Cincinnati, Ohio, experienced reductions in injuries to both suspects and officers after adopting the Taser (see Putnam County Sheriff's Office, 2005; Taser International, 2006). Although these trends are noteworthy, questions remain concerning the extent to which the Taser contributed to these reductions. Retrospective analysis of injury trends may not account for other variables (e.g., more training, crime trends, new leadership, etc.) that influence yearly injuries sustained during police–citizen encounters. At present, there are no national-level baseline data concerning the number of police agencies that have reported reductions in injuries after adopting the Taser as compared to the number of agencies that have not reported reductions. The degree to which the device is used effectively depends less on the physiological effects of the technology than on the policy guidelines and field training that departments apply to reinforce accepted standards of use.

Proponents in the law enforcement community claim that the Taser can serve as a substitute for lethal force and other forms of less lethal force (e.g., baton) that may result in serious injury or death (Heck, 2003;

McBride & Tedder, 2005; U.S. Bureau of Justice Statistics, 1999). This is an empirical question that has not been tested, and any practical benefits must be balanced against the potentially harmful physiological effects of the device.

What is its impact on the likelihood of serious injury or death to a suspect? As noted earlier, Amnesty International called for a moratorium on police use of the Taser in late 2004, citing 74 deaths that occurred in North America following deployment of the weapon. Although there is no evidence of a direct causal link between use of the Taser and elevated risk of serious injury or death, a review of the Amnesty International report suggests that the risk of death may be greater for those with preexisting medical conditions (particularly heart conditions) as well as those under the influence of drugs or alcohol. Recent studies supported by the federal government have tested the physiological effects of CEDs on healthy adult volunteers (a sample that may be very different than suspects targeted by police officers) and have concluded that no decisive evidence of ventricular fibrillation or other serious medical side effects exists (Ho et al., 2006; Joint Non-Lethal Weapons Human Effects Center of Excellence, 2005; McDonald et al., 2005). The Canadian Police Research Centre (2005) conducted an exhaustive review of existing research and concluded that "definitive research or evidence does not exist that implicates a causal relationship between the use of CEDs and death" (p. ii).

In sum, despite the growing popularity of CEDs in American policing, researchers have failed to keep pace with the diffusion of this rapidly spreading technology. A developing body of scientific research has begun to address the research question relating to the potential for the Taser to cause serious injury or death, but the questions concerning when it is appropriate to deploy the weapon (and against whom) and its degree of effectiveness remain largely unanswered. Guidelines outlined by PERF and IACP have played a critical role in clarifying some of the important issues for police administrators. This article seeks to inform the use and effectiveness dialogue by shifting the emphasis toward prediction; that is, under what circumstances and against what types of suspect behavior is the Taser most likely to be effective? In other words, what are the characteristics of police officers and suspects and incident-related circumstances that increase or reduce the odds that police use of the CED will result in a successful resolution?

Method

NYPD and the Taser

This article examines all Taser incidents involving police officers from the NYPD from January 2002 through December 2005 (N = 375). The NYPD is cautious in its approach to the deployment of Tasers, and its use is closely monitored. The Taser is issued only to officers in the Emergency Service Unit (ESU). The ESU is responsible for situations that require advanced equipment and expertise, such as crisis situations involving the mentally ill, hostages, and suicidal suspects. The unit consists of several hundred officers, which is a relatively small proportion of the 35,000 sworn NYPD officers. Also, supervisors at the rank of sergeant and above are trained to use the Taser, and each precinct is equipped with one or more devices that can be signed out, though they are not required to carry it. The patrol guide details fairly specific circumstances in which it is appropriate to use the device:

> Patrol supervisors or uniformed members of the service assigned to the Emergency Services Unit may utilize a Taser/electronic stun device to assist in restraining emotionally disturbed persons if necessary. The Taser/electronic stun device may be used:
>
> a. To restrain an EDP [emotionally disturbed person] who is evincing behavior that might result in physical injury to himself or others, OR
> b. To restrain person(s) who, through the use of drugs, alcohol, or other mind-altering substances, are evincing behavior that might result in physical injury to himself or others.
>
> Emergency Service Unit personnel will obtain the permission of the Emergency Service Unit Supervisor prior to utilizing a Taser/electronic stun device, except in emergencies. (NYPD, 2000)

As a result, deployment of the Taser is allowed only in situations involving an EDP or person under the influence of drugs or alcohol who is posing a threat of physical injury where either ESU officers are dispatched or a supervisor is present and has a Taser in his or her possession.[5]

The data analyzed for the current study are derived from a "Taser/stun device report," which is completed every time an officer deploys the weapon.[6] The report contains a series of questions that use check boxes to elicit a range of information about demographic characteristics of the suspect, his or her emotional and physical state, behavior and level of resistance,

weapons present, the rank and assignment of the officer, and characteristics of Taser deployment (e.g., distance, effect, etc.). Most items on the report are formatted as multiple-choice questions, with an additional narrative section where the officer is required to describe the incident in detail. From these reports, the authors created a data set in SPSS that captures 40 variables relating to each Taser incident. These independent variables serve as predictors of Taser effectiveness for the multivariate analysis. Though the research was admittedly limited by the information collected on the Taser/stun device report, the authors note the earlier work conducted by Kaminski et al. (1999), which employed a similar design and analysis, with similar variables, for an evaluation of the effectiveness of OC spray.

The Dependent Variable: Measuring Effectiveness

The dependent variables used in the study include three separate but related measures of effectiveness. The first two measures of effectiveness are based on the extent of suspect resistance. Specifically, the field report contains several items that measure whether suspect resistance ended after the Taser was deployed and notes how much time transpired (in seconds) before the suspect was incapacitated. A follow-up item requires the responding officer to indicate whether the suspect was incapacitated at all. The average time to incapacitation was 8.10 seconds, but this measure should be viewed with caution. It is likely that officers at the scene were far more concerned about bringing the suspect under physical control than counting the number of seconds needed to terminate the struggle and apply handcuffs. For this reason, we will focus on the dichotomous measures of resistance for the analysis.

In one third of the cases (33.0%), the suspect continued resisting against the officer after the Taser was deployed. The cases involving continued resistance can be divided into two categories based on the nature and duration of the resistance. In 32 cases, the resistance continued immediately following the Taser deployment because the suspect was not restrained by the weapon; that is, at no point was the subject subdued, and he or she continued to resist (*continual resistance*). The Taser was clearly ineffective during these incidents, perhaps because of loose or heavy clothing blocking the darts from making full contact, mechanical failure, or resilience on the part of the suspect. In the other 65 cases involving continued resistance, the subject was initially incapacitated by the Taser and the officer(s) gained control temporarily; however, the suspect began resisting again at a subsequent

point in time (*any resistance*). The distinction between these two different outcomes draws attention to the temporary impact of the Taser (i.e., the involuntary loss of muscle control is not long term) and shows the importance of carefully observing the suspect's actions immediately after the Taser is deployed. Because of the practical importance of this distinction in resistance, both measures are used as dependent variables in the analysis. The base rates for any subsequent resistance and continual resistance are 33.0% and 10.9%, respectively.[7]

At the end of the Taser/stun device report, the officer is instructed to indicate whether the device performed satisfactorily (yes or no). Police officers' responses to this question serve as the third measure of Taser effectiveness. Officers reported that the Taser performed satisfactorily during 78.7% of the cases. Officer satisfaction is likely related to a host of factors, including the physiological effect on the suspect and the outcome of the deployment taken as a whole. Did the Taser discharge as intended? Did both prongs strike the target, and if so, did they penetrate the suspects' clothing? Did the suspect stop resisting the officer and was he or she subsequently taken into custody? Finally, was anyone seriously injured during the altercation?

Data Analysis

The authors employed two analytic approaches, logistic regression and CHAID (a form of segmentation modeling), to identify predictors of Taser effectiveness. Descriptive analyses were conducted to identify significant relationships at the bivariate level. The bivariate findings, theory, and practical expectations directed the identification of predictors for the multivariate analysis, though all variables were included in the multivariate analysis. Logistic regression is employed because all three measures of effectiveness are dichotomous outcomes with yes-or-no responses. Similar to logistic regression, CHAID predicts the probability of an event's occurring, but the method relies on different assumptions and properties and uses segmentation modeling to accomplish the task. CHAID divides a population into "increasingly homogenous" segments that differ on the basis of the dependent variable; in this case, suspect resistance and officer satisfaction (Jones, Harris, Fader, & Grubstein, 2001, p. 490). The resulting segments are mutually exclusive and exhaustive, and as the analysis proceeds, the best predictor is selected among a particular subgroup of cases based on chi-square analysis.

CHAID analysis is employed in this study because it offers a number of advantages. First, "one significant advantage of this approach is that the model can find different combinations of predictors for different subsets of the population" (Jones et al., 2001, p. 490). This is especially useful if there is reason to suspect that predictors may differ in their impact among subgroups. For example, predictors of suspect resistance may be different for intoxicated and sober suspects, and CHAID facilitates the identification and exploration of these interactions. Second, Jones et al. (2001) point out that numerous studies have examined statistical issues in risk prediction (Gottfredson, 1987; Simon, 1971; Tarling & Perry, 1985), including the use of CHAID and more traditional methods such as logistic regression, and the general consensus is that "no method is consistently better than any other" (Tarling & Perry, 1985, p. 212). With this conclusion in mind, multiple methods allow researchers to either "triangulate" their findings or identify inconsistencies across techniques. Last, an additional benefit of CHAID is the user-friendly visual representation of variables that interact to produce an outcome; in this case, the technique highlights the important situational dynamics of Taser incidents—and how those dynamics relate to outcomes—in a more interpretable manner for practitioners and policy makers.

Limitations and Considerations

Several limitations of this study should be considered. First, the article examines official reports from one police department that has deployed the Taser in a controlled, limited manner. This impairs the generalizability of the findings to other police departments, particularly, those agencies that have issued the Taser to all patrol officers.[8] Second, this study examines only Taser incidents that generated an official police report. There is no indication that officers are not completing the Taser field report on a systematic basis, especially considering that the device tracks each deployment electronically; however, it is possible that some incidents did not result in a report. Third, anecdotal evidence provides some support for a deterrent effect when the Taser is exposed to a potential subject but not used; that is, much like the firearm, suspects may become compliant when confronted with the imminent possibility of being stunned with the Taser. Researchers and police practitioners would consider this type of incident as a successful de-escalation, but these situations are not captured in the data because the NYPD requires a field report after discharge only.

Results

Descriptive Analysis of Taser Incidents

Suspect characteristics. Suspects targeted in the Taser incidents were primarily male (88.8%) with a mean age of 34.9; more than half were African American (52.1%), 18.7% were White, and 27.3% were Hispanic (see Table 1). Most of the suspects did not appear under the influence of drugs or alcohol (87.2%), but the majority exhibited signs of mental illness (92.5%) and were therefore identified by the responding officers as EDPs.[9] About 40% of the subjects were armed with a weapon (39.6%), most commonly, a kitchen knife or cutting instrument (84% of armed suspects, 32% of all cases).[10] The vast majority of suspects (95%) engaged in physical violence. The violent behavior was directed at an officer during more than half of the incidents (53.3%), one fifth involved a threat of suicide or self-harm (18.6%), and the remaining violent individuals (18.9%) directed their aggression toward multiple individuals at the scene.

Officer characteristics. The Taser/stun device report captures limited information regarding the officer who deploys the weapon. More than half of the officers who used the device were detectives (55.5%), and 41.2% were patrol officers. Just 3.2% were supervisors. More than 90% of the officers were assigned to the ESU. In the majority of cases, the officer deploying the Taser was not alone. One or more back-up officers were present during nearly all of the incidents (93.5%), and a supervisor was present in 88.1% of the cases.[11]

At the bivariate level, there are notable differences in officer rank with regard to the outcomes of interest: satisfaction and suspect resistance. During the study period, 12 cases involved supervisors who were not assigned to the ESU (i.e., patrol sergeants). The effectiveness ratings from these supervisors are significantly lower than the ratings from the ESU officers: Any suspect resistance was reported by 54.5% of the supervisors, compared to 26.7% of police officers and 36.3% of detectives; 20.0% of the supervisors reported resistance immediately after the Taser was used, compared to 7.6% of police officers and 12.0% of detectives; and 41.7% of the supervisors reported being satisfied with the Taser, compared to 81.7% of police officers and 79.4% of detectives.[12] These findings may have implications for the NYPD, because supervisors outside of the ESU receive less training in use of the Taser and may also be using an older model of the device.

Table 1
Characteristics of Suspects and Officers Involved in Taser Deployments

	Percentage	n
Suspect characteristics		
Gender		
Male	88.8	332
Female	11.2	42
Total	100.0	374
Racial background		
African American	52.1	189
White	18.7	68
Hispanic	27.3	99
Asian or Other	1.9	7
Total	100.0	363
Mean age = 34.9 years		332
Emotionally disturbed		
No	7.5	28
Yes	92.5	347
Total	100.0	375
Intoxicated		
No	87.2	321
Drugs	7.1	26
Alcohol	4.3	16
Both drugs and alcohol	1.4	5
Total	100.0	368
Armed with a weapon		
No	60.4	217
Yes	39.6	142
Total	100.0	359
Violent behavior		
No	5.2	19
Toward self	18.6	68
Toward officer	53.3	195
Toward other citizens	4.1	15
Toward multiple	18.9	69
Total	100.0	366
Officer characteristics		
Rank		
Patrol officer	41.2	153
Detective	55.5	206
Supervisor	3.2	12
Total	100.0	371
Command		
Emergency Service Unit	91.2	321
Other	8.8	31
Total	100.0	352
Back-up present		
No	6.5	22
Yes	93.5	318
Total	100.0	340
Supervisor Present		
No	11.9	42
Yes	88.1	310
Total	100.0	352

Note: Total numbers are different because of missing data. In some of the study cases, information for one or more variables was missing, and the tables reflect known information only.

Incident characteristics. More than three quarters of the incidents occurred indoors (see Table 2). Per department policy, the majority of suspects (95.6%) were transported to a hospital for a physical examination following the incident. Interestingly, three quarters of the subjects (75.9%) were not arrested after the incident, although many of them were held at the hospital for psychological examination and/or civil commitment. The average distance between the officer and the suspect at the time of deployment is approximately 5.5 feet. In 80.7% of the incidents, the Taser was deployed only once by the officer, and in nearly 80% of the cases, both darts made contact with the suspect as intended. Officers used the device in stun mode in 48 incidents (direct contact to skin, no darts).[13] In 22% of the cases, officers also used another nonlethal device, most typically another type of stun device (14%) or pepper spray (5%). In 86% of the cases, a supervisor indicated that use of the Taser was consistent with departmental policy.[14] Findings with regard to officer satisfaction and suspect resistance—the dependent variables for the multivariate analysis—have been summarized above.

Multivariate Analysis

Logistic regression analysis. Table 3 displays the results of the logistic regression models predicting the three measures of Taser effectiveness. The table provides the logistic regression coefficients, standard errors, and odds ratios for the independent variables in each of the models. The likelihood ratio test for each of the models was statistically significant, and Nagelkerke R^2 estimates suggest that the models predicting any subsequent suspect resistance, resistance immediately after use of the Taser, and officer satisfaction accounted for 23%, 13%, and 21% of the explained variation, respectively.[15] In the first model, statistically significant predictors of any suspect resistance include the following:

- The suspect's body weight is greater than 200 pounds.
- Distance between the officer and the suspect is 3 feet or less.
- The suspect is under the influence of drugs or alcohol.
- The suspect directs violence toward an officer or citizen (as opposed to oneself).
- One or both Taser darts missed the intended target.
- The officer used another nonlethal device before or after using the Taser.[16]

Specifically, when one or both Taser darts miss the suspect, the likelihood of any suspect resistance increases by about 300%. Three predictors—violence directed at an officer or citizen, drug or alcohol intoxication, and

Table 2
Characteristics of Incidents Resulting in Taser Deployments

Incident Characteristic	Percentage	n
Location		
Indoors	77.5	286
Outdoors	22.5	83
Total	100.0	369
Suspect arrested		
No	75.9	274
Yes	24.1	87
Total	100.0	361
Suspect transported to hospital		
No	4.4	16
Yes	95.6	346
Total	100.0	362
Number of Taser deployments		
One	80.7	284
More than one	19.3	68
Total	100.0	352
Mean distance between officer and suspect = 5.41 feet		
Darts on target		
Both darts on target	77.7	240
One dart missed	4.5	14
Both darts missed	1.6	5
Darts made contact but fell from clothing	0.6	2
Device used in stun mode	15.5	48
Total	100.0	309
Was suspect incapacitated?		
No	13.2	42
Yes	86.8	277
Total	100.0	319
Mean time to incapacitation = 8.10 seconds		
Did suspect continue to resist?		
No	67.0	235
Yes	33.0	116
Total	100.0	351
Officer satisfied with Taser?		
No	21.3	74
Yes	78.7	273
Total	100.0	347

Note: Total numbers are different because of missing data. In some of the study cases, information for one or more variables was missing, and the tables reflect known information only.

police use of another less lethal weapon—more than double the odds of the occurrence of any suspect resistance during Taser incidents. In addition, suspects who weigh more than 200 pounds are about 84% more likely to resist the officer after the Taser is deployed.

Significant predictors of resistance occurring immediately after deployment of the Taser include the following:

- The suspect's body weight is greater than 200 pounds.
- The suspect is under the influence of drugs or alcohol.
- One or both Taser darts missed the intended target.

Findings for the second model are similar to the model predicting any suspect resistance. Continual resistance immediately after the Taser is deployed is most likely to occur in circumstances where the Taser darts miss a large suspect who is intoxicated.

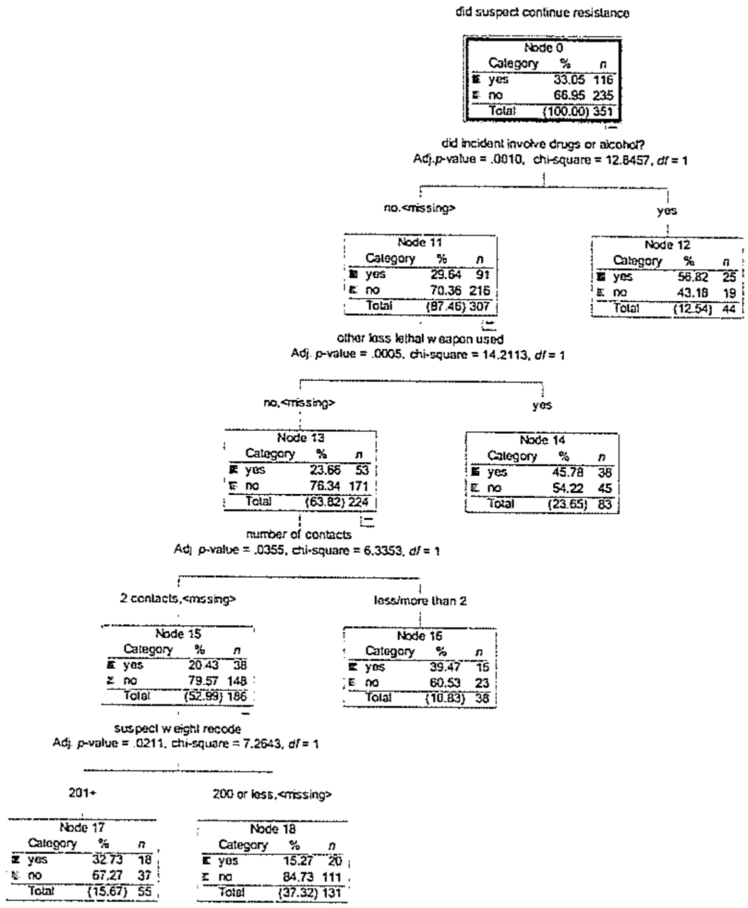
Results from the model predicting officer satisfaction indicate that the following independent variables are statistically significant:

- The suspect's body weight is 200 pounds or less.
- Distance between the officer and the suspect is greater than 3 feet.
- The suspect is armed with a knife or gun.
- Both Taser darts struck the intended target.[17]

Interestingly, the strongest predictor of officer satisfaction with the Taser is the suspect's being armed with a knife or gun. When the suspect is armed with a weapon, the likelihood of police's reporting that they are satisfied with the Taser is about 200% greater. A possible explanation may be that the likelihood that harmful consequences will occur when the Taser does not work properly is greater when the suspect is armed with a knife or gun; therefore, the sense of relief experienced when the device does perform properly in these volatile situations affects the officer's reporting of satisfaction. The distance between the officer and the suspect during the Taser deployment is also positively associated with officer satisfaction with the device.

CHAID analysis. Figures 1 to 3 show the results of the CHAID analysis, which uses the same set of variables to predict Taser effectiveness. In Figure 1, the top cell (or root node) in the CHAID tree reflects 33.05% of the cases where any suspect resistance occurred. The initial split was made on the basis of whether the suspect was under the influence of drugs or alcohol, thus separating the 375 Taser cases into two cells: those where the

Figure 1
CHAID Analysis Predicting Any Suspect Resistance



Note: CHAID = chi-square automatic interaction detection.

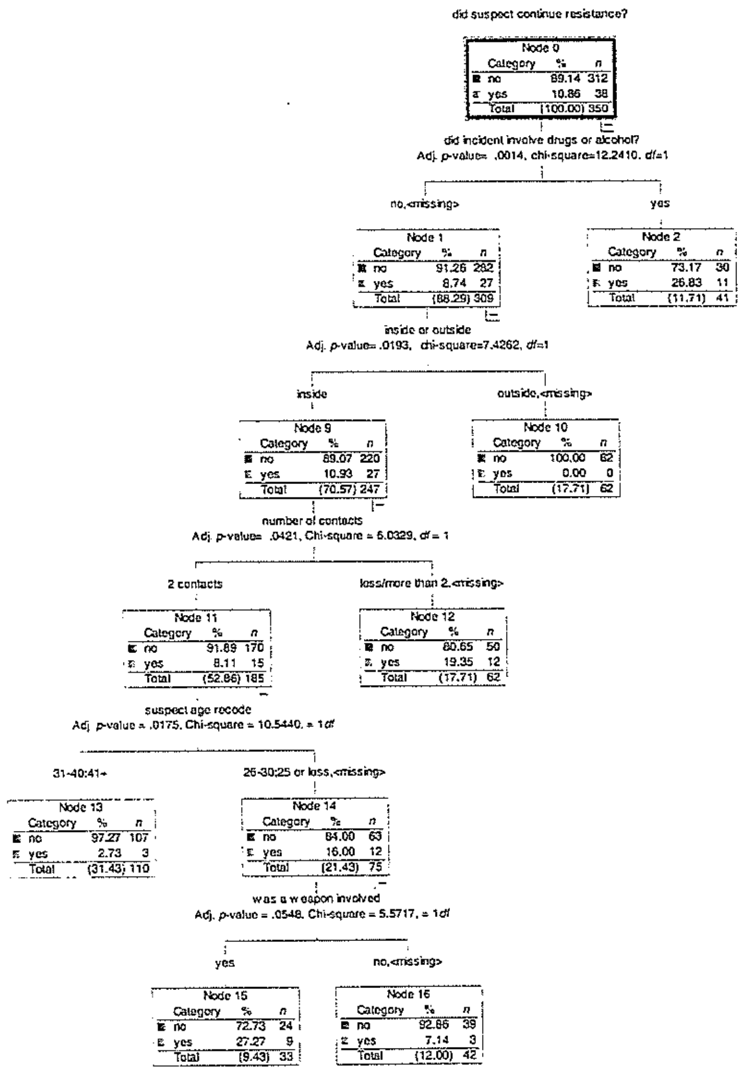
whether police used another less lethal weapon: Suspect resistance occurred in 45.8% of cases where another less lethal weapon was used in addition to the Taser, compared to 23.7% of cases where only the Taser was used. The next split was made from the cell indicating that no other less lethal weapon

was used except the Taser. This split is based on the number of darts that made contact with the suspect: Subjects who were not intoxicated during the encounter, where no other less lethal weapon was used except the Taser, continued to resist during 20.4% of the cases where two darts made contact, compared to 39.5% of the cases where fewer or more than two contacts were made.[18] The final split is made from the cell indicating that two darts made contact and is based on suspect body weight: Suspects in cases where both darts made contact, where no other less lethal weapon was used except the Taser, and where the suspect was not intoxicated were more likely to continue to resist if they weighed more than 200 pounds (32.7% compared to 15.3% for those who weighed 200 pounds or less). Table 4 summarizes the termination cells for the CHAID tree predicting any suspect resistance, which includes the predictors, cell size, percentage of the total cases, and percentage of the dependent variable: any suspect resistance.

Figure 2 displays the CHAID tree predicting continual resistance, and the top cell represents 10.9% of the cases where suspect resistance occurred immediately after the deployment. The initial split is based on the use of drugs or alcohol, as it was for the first CHAID tree: Intoxicated suspects continued to resist immediately after the Taser was deployed in 26.8% of the cases, compared to 8.7% of the cases in which the suspect was not intoxicated. Several additional splits flow from the cell indicating that the suspect was not intoxicated. The next split is based on whether the Taser incident occurred indoors or outside (10.9% suspect resistance inside compared to 0.0% resistance outside). From the cell indicating that the incident occurred indoors, the next split is based on whether the two darts made contact or not (8.1% resistance compared to 19.4%). From the "two contacts" cell, the split is based on whether the suspect was 30 years old or younger (16.0% resistance) as opposed to 31 years old or older (2.7% resistance). The final split flows from the *30 years old or younger* cell and is based on whether the suspect was armed with a weapon (27.3% resistance) or not (7.1% resistance). Termination cell summaries are again shown in Table 4.

Figure 3 shows the CHAID tree for the last measure of effectiveness: officer satisfaction. An initial split is based on the number of darts that made contact—two darts, or fewer or more—with greater officer satisfaction when two darts made contact (83.7% vs. 66.3%). The next split, made from the *two contacts* cell, is based on the distance between the police officer and the suspect. Officer satisfaction is greater when the officers are 4 feet or more away from the target: In this category, 86.7% of the officers reported being satisfied, compared to 72.0% for the officers who were 3 feet away or closer (see Table 4 for summary).

Figure 2
CHAID Analysis Predicting Resistance Immediately After Deployment



Note: CHAID = chi-square automatic interaction detection.

Table 4
Summary of CHAID End Groups

	n	% of Total	% of Suspect Resistance
Any suspect resistance			
Suspect intoxicated	44	12.54	56.82
Suspect not intoxicated (or missing); other less lethal weapon used	83	23.65	45.78
Suspect not intoxicated (or missing); no other less lethal weapon used (or missing); not two contacts	38	10.83	39.47
Suspect not intoxicated (or missing); no other less lethal weapon used (or missing); two contacts (or missing); suspect weighs 201+ pounds	55	15.67	32.73
Suspect not intoxicated (or missing); no other less lethal weapon used (or missing); two contacts (or missing); suspect weighs 200 pounds or less (or missing)	131	37.32	15.27
Total	351	100.00	
Resistance immediately after deployment			
Suspect not intoxicated (or missing); occurred inside; two contacts; suspect 30 or younger (or missing); suspect has weapon	33	9.43	27.27
Suspect intoxicated	41	11.71	26.83
Suspect not intoxicated (or missing); occurred inside; not two contacts (or missing)	62	17.71	19.35
Suspect not intoxicated (or missing); occurred inside; two contacts; suspect 30 or younger (or missing); suspect has no weapon (or missing)	42	12.00	7.14
Suspect not intoxicated (or missing); occurred inside; two contacts; suspect 31 or older	110	31.43	2.73
Suspect not intoxicated (or missing); occurred outside (or missing)	62	17.71	0.00
Total	350	100.00	
Officer satisfaction			
Two contacts; distance 4 feet or more (or missing)	196	56.48	86.73
Two contacts; distance 3 feet or less	50	14.41	72.00
Not two contacts (or missing)	101	29.11	66.34
Total	347	100.00	

Note: CHAID = chi-square automatic interaction detection analysis.

profound implications for police administrators who are responsible for upholding use-of-force standards. This article seeks to contribute to the dialogue on CEDs by identifying predictors of Taser effectiveness.

Findings from the descriptive analysis suggest consistency across the types of incidents (and suspects) in which officers in the NYPD deploy the Taser.

- Most suspects were male, African American or Hispanic, and in their 30s.
- Few suspects were under the influence of alcohol or drugs, but nearly all were identified as exhibiting signs of mental illness.[19]
- Nearly all suspects engaged in violent behavior.
- Just fewer than half of suspects were armed, and among armed suspects, the majority possessed a knife or cutting instrument.
- Nearly all the officers using the Taser in the NYPD were assigned to the ESU.
- Back-up officers and supervisors were present in almost all cases.
- A large majority of suspects were incapacitated by the Taser after the first deployment, and most were incapacitated within 5 seconds.
- Most of the subjects were not arrested on criminal charges, although nearly all were transported to a hospital for physical and/or psychological evaluation.

Findings from the multivariate analyses, both logistic regression and CHAID, are remarkably consistent in predicting the three effectiveness measures:

Any suspect resistance (a measure of ineffectiveness)

- Suspect body weight was over 200 pounds (logistic and CHAID).
- Suspect was intoxicated (logistic and CHAID).
- One or both Taser darts missed the intended target (logistic and CHAID).
- Officer used another less lethal weapon (logistic and CHAID).
- Distance between the officer and the suspect was 3 feet or less (logistic).
- Suspect directed violence toward an officer or citizen (logistic).

Resistance occurring immediately after Taser use (a measure of ineffectiveness)

- Suspect was intoxicated (logistic and CHAID).
- One or both Taser darts missed the intended target (logistic and CHAID).
- Suspect body weight was more than 200 pounds (logistic).
- For a subset of cases, incident occurred indoors, suspect was 30 years old or younger, and suspect was armed (CHAID).

Officer satisfaction (a measure of effectiveness)

- Suspect and officer were more than 3 feet apart (logistic and CHAID).
- Both Taser darts struck the intended target (logistic and CHAID).
- Suspect body weight was 200 pounds or less (logistic).
- Suspect was armed with a gun or knife (logistic).

Three important findings emerge from the analysis. First, the analysis suggests that Taser effectiveness can be modeled using multivariate techniques, as several suspect- and incident-related variables are associated with a greater or lesser likelihood of effectiveness. Considering the paucity of research examining use and effectiveness of the Taser, this finding alone is important. Second, a number of variables were noticeably absent from the statistically significant predictors of Taser effectiveness identified in the multivariate analysis. For example, the race and gender of the suspects were unrelated to any of the three measures of effectiveness. Importantly, whether the suspect was classified as "emotionally disturbed" was also unrelated to Taser effectiveness. Note that only 28 cases did not involve a suspect classified as an EDP, so caution should be used in generalizing to this subgroup. The findings relating to EDPs are particularly important, however, because anecdotal evidence made available by the news media and interest groups suggests that the mentally ill may be more likely to continue to resist the police and to experience serious injury or death when stunned by the Taser. The results of this study indicate that the suspects' mental health at the time of the incident did not affect the effectiveness of the Taser. Additionally, the authors reviewed all news reports (N = 192) of Taser incidents printed in *The New York Times* during the study period to become more familiar with the qualitative aspects of the incidents and found evidence of only one case where NYPD deployment of the Taser resulted in the death of an emotionally disturbed suspect.[20]

The third important research finding relates to the variables that were identified as significant predictors in the multivariate analyses, including suspect intoxication, body weight, violence directed at an officer or citizen, and distance between the officer and the suspect. A relatively small proportion of the Taser cases involved an intoxicated suspect—13%, or 46 incidents—but effectiveness dropped significantly for those cases: Intoxicated suspects were twice as likely to exhibit any resistance during the encounter (57% compared to 30%, respectively), they were about 3 times as likely to resist immediately after police deployed the Taser (27% compared to 9%, respectively), and intoxication was associated with lower officer-reported satisfaction with the Taser (67% compared to 80%, respectively).[21] Although the reason for this finding is not clear, one possible explanation relates to

the effect of drugs and alcohol on the suspect's ability to reason and process information. The intoxicated suspects may be less capable of thinking rationally during the police–citizen encounter and therefore less inclined to comply with the officer's instructions after the effects of the Taser wear off. This finding clearly warrants attention from police researchers and practitioners. If it is replicated in other police jurisdictions, with other suspect samples, there are clear policy and training implications. Police field training can highlight the increased likelihood of continued resistance among intoxicated suspects and provide officers with a clear set of guidelines to anticipate and curtail resistance to prevent violence escalation and serious injuries.

The emergence of suspect body weight as a predictor of Taser effectiveness is both interesting and puzzling. Evidence that the weapon is less effective against heavier individuals is not apparent from the CED industry reports or the growing clinical research. This study finds suspect weight—with a cutoff at 200 pounds—a significant predictor of both resistance measures and officer satisfaction. Depending on the degree to which body weight moderates the effects of the Taser, there are implications for Taser use and for police policy and training. Police officers may need to prepare for the greater likelihood of resistance immediately after using the weapon on particularly tall or heavy suspects. Policy should offer guidance on subsequent responses, which may include additional Taser deployments or alternative less lethal weapons. Given the potential relationship between multiple Taser deployments and elevated risk of serious injury or death, police departments may need to craft their policies carefully. Moreover, researchers should consider investigating the potential for an interaction effect between body weight and intoxication. For example, 18 cases in the study data involve an intoxicated suspect who weighs more than 200 pounds, of whom 13 (72%) continued to resist the officer after being stunned with a Taser. This is clearly an important issue that requires further investigation.

Two other suspect-related variables were significant in the multivariate analysis: violent behavior directed at an officer or another person and whether the subject was armed with a weapon. Suspects who were suicidal, engaged in self-harm, or threatened self-harm were less likely to continue resisting after being stunned with the Taser, compared to those who were acting violently toward an officer or citizen. The implications for police are straightforward: Suspects who direct their violence toward others—most notably, the police officer—represent the greatest risk of a physical struggle after being stunned with the Taser, and therefore, officers should remain especially vigilant when using the Taser on subjects that fit this description.

The association between armed suspects and measures of effectiveness indicates that police use of the Taser is most effective in those situations where the potential for serious injury or death is highest. Further research is needed to substantiate this finding, but there are a number of potential explanations:

- High-risk situations could be fundamentally different in ways that affect officer satisfaction.
- The actual physiological effects of the Taser may be different (e.g., more effective) in these types of encounters.
- Police officer performance during and after Taser use may be different in high-risk encounters (e.g., quicker reaction times, better handcuffing, etc.).

Several incident-related characteristics are also associated with the effectiveness measures, notably, distance from the intended target, police use of another less lethal device in addition to the Taser, and the number of darts that make contact with the suspect. The importance of the number of darts that strike the subject and police use of other less lethal weapons is clear. For the Taser to deliver the current, both darts must strike the suspect, penetrate the clothing, and attach to the skin. If this does not occur, the device will not work as intended, and consequently, resistance will be more likely to continue. Although the field report does not specify the order in which multiple weapons are used, the fact that more than one weapon is used implies that one or more instruments were ineffective in curtailing resistance.

The significance of the distance from the suspect as a predictor of effectiveness has both training and policy implications. Taser International offers cartridges with maximum ranges of 15 feet, 21 feet, 25 feet, and even 35 feet. The study findings suggest that the Taser is less effective when used at close range—within 3 feet or less of the target. (Note that distance remained significant when controlling for use of the device in stun mode, i.e., direct contact to the suspect's skin.) The reasons for this are unclear, although use at close range may increase the likelihood that suspect movement could affect the accuracy of the weapon, the suspect could grasp or bump into the weapon at time of discharge, or the darts may not spread out sufficiently to deliver the optimal current. Police agencies may want to consult with each other or the CED manufacturer to determine if this short-range problem has emerged elsewhere. Regardless, maintaining a safe distance whenever possible is of central importance; in fact, the NYPD (2000) patrol guide states that officers should maintain a "zone of safety" of 20 feet and call ESU when

responding to EDPs. Findings from this study suggest that the "safe-distance" principle should be reinforced for ESU as well, particularly when there is reasonable suspicion that a Taser may be deployed.

Conclusion

This article sought to address questions about the use and effectiveness of CEDs by examining all Taser deployments by the NYPD from 2002 to 2005 (N = 375). The authors employ both logistic regression and CHAID analysis to identify predictors of Taser effectiveness, measured as the extent of suspect resistance and officer satisfaction. A number of statistically significant predictors surfaced with policy and training implications, including suspect body weight, drug and alcohol use, violent behavior, and the distance between the responding officer and the suspect. Considering the lack of empirical research predicting Taser effectiveness, this article takes an important step in thinking about the circumstances in which favorable deployment outcomes are likely to occur.

As we suggested earlier, there is an ongoing discourse between civil rights organizations and the CED industry regarding the widespread adoption of these devices. Although this research offers an objective, empirical analysis of Taser deployments, for a number of reasons, it is difficult for the authors to weigh in on this debate. First, much of the debate has focused on the physiological effects of CEDs, which is not a focus of this research. Second, we have examined one police department with a restrictive and closely monitored deployment pattern, which limits the conclusions we can draw. Alternatively, this research shows that the study police department experienced positive outcomes while avoiding the current controversies associated with use and effectiveness. Both PERF and IACP offer detailed guidance on model policy and procedures for the Taser, most of which mirror the NYPD approach. Thus, we can conclude that with regard to the use and effectiveness questions only, this research suggests that departments can successfully deploy the Taser—avoiding problems with misuse and abuse—by implementing and closely monitoring the guidelines developed by PERF and IACP.

Nonetheless, additional research on this topic is necessary not only because the technology is relatively new but also because different agencies are adopting the weapon to varying degrees and developing different standards and expectations concerning its proper use. A multisite analysis of police agencies that have incorporated the Taser into routine practice based on

different approaches would yield valuable comparative data. This type of cross-site approach—coupled with the release of research supported by the National Institute of Justice, particularly, the national-level study being conducted by Alpert and colleagues—will enable researchers to begin asking more complex questions about police use of the Taser, such as to what extent it is used by officers as an alternative to other less lethal weapons (and physical force) and what types of information would be required for a rigorous cost-benefit analysis of the Taser.

Notes

1. There are competitors to Taser, including Stinger Systems and Law Enforcement Associates, but Taser dominates the market with approximately 95% of conducted energy device (CED) sales in the United States. Stinger Systems has sold just 12,000 weapons since 2000. Law Enforcement Associates introduced their CED only recently, in March 2005.

2. Important considerations and limitations associated with these reports include small sampling frames and potentially competing interests among those who carried out the studies. The National Institute of Justice is currently funding several national-level research projects on the Taser, but these studies have just begun.

3. This estimate becomes much greater if handcuffing and verbal commands are included as use of force.

4. For example, the effects of mace and pepper spray are often felt for several hours, and their range of effectiveness is much shorter (which increases the likelihood of other officers' being hit). Beanbag guns and similar impact munitions are often fired from a specialized shotgun that is larger and bulkier than CED.

5. The New York Police Department's (NYPD; 2000) patrol guide also offers a definition of an emotionally disturbed person (EDP):

> A person who appears to be mentally ill or temporarily deranged and is conducting himself in a manner which a police officer reasonably believes is likely to result in serious injury to himself or others. (p. 1)

In situations involving an EDP, officers are instructed to create and maintain a "zone of safety" of approximately 20 feet and to call for the Emergency Service Unit (ESU) and a patrol supervisor as well as an ambulance (NYPD, 2000). Officers are not to attempt to take an EDP into custody unless

- The EDP is unarmed, not violent and is willing to leave voluntarily; OR
- The EDP's actions constitute an immediate threat of serious physical injury or death to himself or others. (NYPD, 2000, p. 1)

6. These reports were provided to the authors by the supervisor of the department's training division. Although the form is used primarily for the Taser, there were 33 forms involving use of another type of nonlethal weapon: either a stun device or other similar alternative. Because the focus of this article is the Taser, these cases were excluded from the analysis.

7. Given that the intent of the Taser is temporary incapacitation only, the latter suspect resistance measure—10.9%—is probably a fairer measure of the Taser's effectiveness. Also, the *any suspect resistance* measure includes both types of resistance (i.e., continual resistance is a subset of the more general resistance measure). Both measures are examined in the multivariate analysis.

8. At the same time, it is worth noting that the limited manner in which the NYPD has implemented the Taser is a practical advantage to police administrators in New York, who have avoided being criticized in the news media for excessive reliance on the Taser.

9. This variable is based on the police officer's assessment of the suspect at the time of the incident. It is not based on more definitive tests, such as a urinalysis or blood or hair analysis. Although this would appear to suggest that police officers in the study department use the Taser disproportionately against the mentally ill in crisis, this finding must be interpreted in the context of how the department has deployed the Taser. Per department policy, the ESU is called when the patrol officers or supervisors on scene determine that the situation involves an EDP who is behaving in a manner that could result in physical injury or death to the EDP or others (NYPD, 2000). Thus, these data are a reflection of the types of suspects typically handled by the ESU—a highly specialized group of officers—not the suspects typically handled by line officers.

10. There were also two cases where the suspect was armed with a gun: In one case, the suspect was threatening to commit suicide, and in the other case, the suspect had taken a hostage and was threatening multiple people (including the hostage and himself). Of the remaining cases involving an armed suspect, the most common weapon was a blunt object, such as a metal pipe, baseball bat, chair, or large stick.

11. The nearly universal presence of back-up officers and supervisors is again dictated by the fact that most of these cases involve the ESU. This unit is typically called to the scene by the first responding officer, and often a supervisor will also respond.

12. Both police officers and detectives are assigned ranks in the ESU. Chi-square values indicate that the satisfaction and any-resistance differences are statistically significant (p = .005 and p = .050, respectively). It may be useful in future research to examine length of time on the job and officer training as factors related to effectiveness. These variables may more accurately capture the relationship between officer's use of the Taser—especially among non-ESU personnel—and effectiveness measures.

13. Information on the number of dart contacts was not reported in 66 cases. Rather than make assumptions about the number of contacts, the authors have proceeded conservatively and coded these cases as missing. This decision, however, reduces the number of cases available for multivariate analysis.

14. In the remaining 14% of the cases (n = 53), the form was not signed and there was no information about whether the use met departmental policy. However, a review of the narrative of those 53 cases suggests that they too conformed with department policy on use of the Taser.

15. Nagelkerke R^2 provides an approximation of the explained variation in a logistic regression model. This measure of model strength is considered slightly more conservative than the R^2 statistic in ordinary least squares regression but less conservative than the Cox and Snell R^2 estimate, which does not have a maximum value of 1.0.

16. Although the "Taser/stun device report" indicates whether another nonlethal device was also used, it does not specify which is used first, the Taser or the alternative.

17. Suspect resistance was also a predictor of officer satisfaction, but it has been excluded from the analyses because it serves as the other effectiveness measure. The authors question the value of a model that uses one outcome measure to predict another.

Oleoresin Capsicum Spray and Tasers:

A Comparison of Factors Predicting Use and Effectiveness

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Oleoresin Capsicum Spray and Tasers:

A Comparison of Factors Predicting Use and Effectiveness

ABSTRACT

In the last few decades, several less-lethal forms of force have been introduced, adopted, and deployed by police agencies. Oleoresin capsicum spray is now used in nearly every department across the United States; the Taser is used in the majority of police departments. Despite their widespread use, we still know relatively little about the factors associated with the use of OC spray and Tasers and the effectiveness of these weapons in incapacitating subjects. This paper contributes to that discussion by analyzing 504 use-of-force incidents where the police used OC spray or Tasers during the event. Data were obtained from a large municipal police department on incidents that occurred in 2010 and 2011. Policy implications and directions for further research are discussed.

INTRODUCTION

A fundamental but controversial function of the police is their ability to use coercive force (Bittner, 1970; Klockars, 1985). Force is most likely to be used by the police in situations where they are confronted with non-compliant subjects (Reiss, 1971; Terrill & Mastrofski, 2002). In such situations, police officers have several options. At one end of the spectrum, beyond verbal commands and threats, officers may use bodily force (e.g., decentralizations, focused strikes). Bodily force alone is the most common form of physical force used by police officers (Adams, 1999). At the other end of the spectrum, officers may use their firearms. The use of firearms is considered a last resort; it is only to be used to defend human life. In between bodily force and deadly force, there are several "less-than-lethal" or "less-lethal" options.

In the last few decades, several less-lethal forms of force have been introduced, adopted, and deployed by police agencies. Today, nearly all local departments authorize the use of one or more less-lethal weapons (Reaves, 2010). The most common less-lethal weapon is pepper spray, authorized by 97% of all local departments (Reaves, 2010). Conducted Energy Devices (CEDs)[1], including Tasers[2] and stun guns, are authorized by 60% of all local police agencies (Reaves, 2010). While the number of departments authorizing pepper spray is not much higher than in the year 2000 (91%; Hickman & Reaves, 2003), the number of local police departments that authorize the use of CEDs has dramatically increased since 2000, when just 7% authorized them (Reaves, 2010).

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[1] CEDs are sometimes also known as Electronic Control Devices (ECDs), Conducted Electrical Weapons (CEWs), or Conducted Energy Weapons (CEWs).

[2] The Taser (short for the Thomas A. Swift Electric Rifle) is currently the most popular CED on the market. It is also the CED used by the department in this study. As such, we use the term "Taser" rather than the more general "CED" throughout this paper.

In response to the greater prevalence and use of less-lethal weapons, particularly OC spray and Tasers, a substantial amount of research has been conducted on issues related to them. For instance, researchers have analyzed the frequency with which different types of force are used before, during, and after OC spray or Tasers are introduced in departments (e.g., Lin & Jones, 2010; Lumb & Friday, 1997). Studies have examined the factors associated with the use of OC spray (Morabito & Doerner, 1997) and Tasers (Crow & Adrion, 2011; Gau, Mosher, & Pratt, 2010) as well as officer and citizen injuries associated with their use (e.g., Terrill & Paoline, 2011; Kaminski et al., 2013; Paoline, Terrill, & Ingram, 2012; Kaminski et al., 1999; Smith et al., 2007). Finally, researchers have examined the effectiveness of OC spray (Morabito & Doerner, 1997; Kaminski, Edwards, & Johnson, 1999; Adang et al., 2006) and Tasers (White & Ready, 2010; White & Ready, 2007), defining effectiveness in terms of their ability to induce subject compliance.

While this research has advanced our understanding of the benefits and limitations of OC spray and Tasers, we still know relatively little about the factors associated with the use of OC spray and Tasers and the effectiveness of these weapons in incapacitating subjects. In particular, there are no studies to date that directly compare the use and relative effectiveness of OC spray and the Taser within the same jurisdiction during the same time frame.[3] Some studies examine OC spray, while others examine Tasers. It is difficult, if not impossible, to draw definitive conclusions about the use and relative effectiveness of OC spray and Tasers on the basis of studies that do not include both OC spray and Taser incidents, do not compare OC spray with Tasers, that use different sampling procedures and measurements schemes for critical variables,

[3] An exception is a study performed by TASER International (as cited in White and Ready, 2007). In this study, the effectiveness of the OC spray and the Taser were compared, but only when both were used in the same incident. In these encounters, OC spray was effective 33% of the time while the TASER was effective in 83% of cases (Taser International, 2002).

and that were conducted in different police departments with different use-of-force policies and continuums. As such, we do not know whether Tasers are significantly more (or less) effective than OC spray in similar situations, or whether different factors predict their use and effectiveness. This study examines the factors that predict the use and effectiveness of OC spray (N= 259) and Tasers (N=245) in a single large municipal police department. Data were obtained from official use-of-force reports of the police department on incidents that occurred in 2010 and 2011.

LITERATURE REVIEW

Police use of force, defined as "acts that threaten or inflict physical harm on suspects" (Terrill, 2003, p. 56), has been an important and constant topic of research since the 1970s. This attention is warranted for theoretical and practical reasons. Theoretically, research on police use of force is important because it involves the defining characteristic of policing. In large part, an understanding of the complexities and dilemmas of police work depends on an understanding of police use of force. Practically speaking, research on the control of police use of force is important in that use of force can have devastating—and deadly—consequences. As such, it can dramatically affect police-community relations, public cooperation with the police, and the legitimacy of the police more generally.

Due to the potentially serious consequences of police use of force, police officers are constrained in their ability to use it. Along with legal (*Graham v. Connor*, 490 U.S. 386 1989) and accreditation standards (Commission on Accreditation for Law Enforcement Agencies, 1999), the majority of police departments guide officer behavior with a "continuum of force" or "force continuum" (Terrill & Paoline, 2012). Most often, officers are to base force decisions on

the level of suspect resistance or aggression; force is only escalated to the next level when less forceful actions fail to induce suspect compliance. While OC spray and Tasers are usually placed at the same level on force continuums (Alpert et al., 2011; IACP, 2005), there is little agreement between and among departments where they should be placed. In some departments, OC spray and the Tasers are placed at the lower end of the continuum, authorizing their use against passive resisters; other departments place them closer to lethal force on the continuum, authorizing their use only against active resisters. Where OC spray and Tasers are located on the continuum of force matters when understanding the circumstances in which the weapons are used (Crow & Adrion, 2011; Morabito & Doerner, 1997). In turn, the circumstances in which OC spray and Tasers are used may have implications for their effectiveness in inducing compliance among subjects.

OC SPRAY AND TASERS

Oleoresin capsicum (OC) spray, otherwise known as pepper spray, was introduced to law enforcement in the 1980s. OC is an inflammatory agent naturally found in cayenne peppers. When a person is sprayed with OC spray, the effects are immediate: the respiratory tract becomes inflamed, the individual experiences an intense burning sensation and swelling around the eyes, and the subject's eyes close involuntarily (Lumb & Friday, 1997). Although the subject may be in extreme discomfort, he or she may still be able to resist. Ideally though, the effects of OC spray render a resistive suspect passive and compliant, and the officer is able to take the suspect into custody without further incident.

Once introduced, OC spray immediately demonstrated advantages over other forms of force. The effects of OC spray, while immediate and dramatic, were more temporary than other

forms of chemical gasses used previously (Lumb & Friday, 1997). OC spray proved more effective on intoxicated individuals than mace, and was less prone to secondary contamination (White & Ready, 2007). Finally, OC spray was less likely to cause injury than bodily force, batons, and flashlights (Lumb & Friday, 1997). As summarized by Lumb & Friday (1997):

> ...OC spray is an effective alternative to the more harmful types of weapons available to police. OC causes almost instantaneous incapacitation and leaves no long term residual effects. It allows the officer to stay away from the suspect when affecting a custodial arrest that is being resisted, and there are few problems associated with transporting the person, as OC spray residue dissipates fairly quickly (p. 138).

Today, while OC spray is standard issue in police departments, CEDs, such as the Taser and other stun devices, are still gaining popularity. First introduced in the 1990s, the Taser is a 50,000 volt, 26-watt weapon that uses nitrogen cartridges to fire its probes. Once the probes attach to the suspect, the Taser delivers an electrical current which overrides the central nervous system, causing involuntary muscle contractions and incapacitation (Alpert et al., 2011; Means & Edwards, 2005).

The Taser has advantages over other less-lethal alternatives including their greater reliability at longer distances, the relatively quick recovery time involved, and their perceived effectiveness in inducing suspect compliance (White & Ready 2010). In addition, because Tasers do not rely on pain to induce compliance, ideally they should be more effective on persons who have a higher tolerance of pain, such as people under the influence of drugs or alcohol or who have a mental illness (Means & Edwards, 2005).

Despite their popularity and advantages, OC spray and Tasers are not without controversy. One concern relates to their safety. In the late 1980s and early 1990s, OC spray was claimed to have caused several in-custody deaths (ACLU of Southern California, 1993; Alpert et al., 2011). Twenty years later, the Taser was also alleged to be a proximate cause of in-

custody deaths (Alpert et al., 2011; White & Ready, 2007). Research has shown that most deaths involving OC spray were instead the result of positional asphyxia, pre-existing health conditions, or were drug-related (Granfield, Onnen, & Petty, 1994; Petty, 2004). With regard to Tasers, it has been demonstrated that the risk of death when a Taser is used is less than 0.25 percent (NIJ, 2011), and in those situations the death is likely to be a result of drug intoxication, preexisting heart conditions, and exposure to other forms of nonlethal police force (White & Ready, 2007).

Another concern relates to police overuse of OC spray and Tasers (Alpert et al., 2011). For instance, members of the ACLU and Amnesty International have voiced concern that OC spray and Tasers are used in a disparate fashion against members of minority groups (ACLU of Southern California, 1993; Amnesty International, 2006). A related concern is that police have authorized their use too low on continuums of force and consequently are using them against passive (versus active) resisters (Terrill & Mastrofski, 2002). Finally, there are concerns about the use of OC spray and Tasers with the elderly, children, pregnant women, and persons with medical conditions that put them at greater risk of experiencing dangerous medical side effects (Amnesty International, 2006; Sloane & Vilke, 2006).

A final concern has to do with manufacturer exaggeration of the capabilities and effectiveness of OC spray and Tasers in incapacitating subjects, which, in part, may have contributed to their widespread adoption in police departments. Some early studies reported "effectiveness rates" as high as 100% for OC spray (as cited in Adang et al., 2006) and 94% for the Taser (as cited in White & Ready, 2010). Objective empirical research on the effectiveness of these devices remains rather sparse. Of the independent studies that do exist, effectiveness rates have not been found to be as high as those originally reported by the manufacturers. For

instance, and as discussed below, Kaminski et al. (1999) found an effectiveness rate of 71% for OC spray. White and Ready (2010) found an effectiveness rate of 85% for the Taser.

RESEARCH ON THE USE AND EFFECTIVENESS OF OC SPRAY AND TASERS

While research appears to have ameliorated concerns about OC spray and Tasers causing serious injury and death, there remain concerns about their use and effectiveness. In response, there has been a growing body of literature that examines the use and effectiveness of these weapons. Given the objectives of the current study, we review here the studies that examine the factors associated with the *use* of OC spray and Tasers and the *effectiveness* of OC spray and Tasers (with effectiveness defined in terms their ability to facilitate the arrests of resisting subjects).

The Use of OC Spray

Morabito and Doerner (1997) analyzed OC spray use-of-force reports from the Tallahassee Police Department. They examined characteristics of officers and suspects that were associated with the use of OC spray at two points in time: prior to and after a change in the circumstances in which OC spray was authorized in the department. At Time 1, OC spray was only authorized in cases when the suspect was actively physically resisting police. At Time 2, the threshold for the use of OC spray was reduced from active physical resistance to verbal/passive physical resistance. At Time 1, OC spray use was compared to impact weapons such as batons, flashlights, and stun guns. At Time 2, OC spray use was compared to the use of soft hand techniques (punches, kicks, and pain compliance techniques). The officer characteristics of interest included race, gender, education and experience. Suspect variables

included race, gender, height and weight (relative to the officer's height and weight), suspect intoxication, and whether the suspect was armed or attacked the officer. While none of the predictor variables were significant at Time 1, several factors were associated with OC spray use at Time 2. At Time 2, male, educated, and veteran officers were more likely to use OC spray than soft hand techniques. OC spray was also more likely to be used than soft hand techniques when the suspect was heavier and taller than the officer and when the suspect was armed.

The Use of Tasers

Gau, Mosher, and Pratt (2010) analyzed case file data on Tasers and other types of force used by officers in a state patrol agency from 2005 to 2007. The authors were primarily interested in examining possible racial disparities in the use of a Tasers on subjects. Tasers were used in nearly one-half of all use-of-force incidents. They found that compared to other forms of force, Tasers were equally likely to be used on white, Hispanic, and Black subjects; although when a Taser was used, Hispanic subjects were more likely than White subjects to have a Taser be the first type of force used. The authors also found that females were less likely to be "tased" than males, and that subjects who actively resisted and who were assaultive were *less* likely to be tased than subjects who passively resisted. Finally, white officers were significantly less likely to use a Taser than officers of other races.

Crow and Adrion (2011) analyzed 461 use-of-force incidents (reports) that occurred between 2004 and 2010 in a medium-sized municipal police department. The authors compared incidents where a Taser was used and incidents where "other" types of force were used (takedowns, physical force, pepper foam, impact weapons, police dog, use of a vehicle as a weapon, and firearms). The authors found that a Taser was *less* likely to be used than other forms

of force when subjects physically resisted and when resistance involved a weapon. A Taser was equally likely to be used when resistance was in the form of "presence," "flight," and "verbal" (meanings unspecified). A Taser was more likely to be used than other forms of force on non-white and male subjects. Older officers were significantly more likely to use Tasers. A policy change to restrict the use of Tasers also had its intended affect; after the policy change, Tasers were less likely to be deployed. Call type, time of day of the incident, officer sex, race, age, and rank did not affect the likelihood of Taser use.

The Effectiveness of OC Spray

Three studies have examined the effectiveness of OC spray (Morabito & Doerner, 1997; Adang et al., 2006; Kaminski, Edwards, & Johnson, 1999), generally defined in terms of the extent to which it facilitates the arrests of suspects who resist. As previously noted, Morabito and Doerner (1997) analyzed use of force reports from the Tallahassee Police Department. Although these authors were most concerned with the factors associated with the use of OC spray, they also briefly considered the effectiveness of it. As the authors explained, OC spray "was considered effective if it induced the expected physiological effects and enabled the officer to take the subject into custody without further incident" (p. 690). They calculated a "success rate" of 73% for OC spray and found that OC spray worked "equally well on mentally disturbed subjects, intoxicated subjects, and physically stressed subjects who were involved in either a foot chase or a physical struggle" (p. 690).

Kaminski et al. (1999) analyzed data on incidents where OC spray was used by officers in the Baltimore County Police Department. Based on assessments provided by officers who were involved in the incidents, three measures of OC spray effectiveness were constructed. In

their most conservative measure, they defined effectiveness in terms of whether the use of OC spray incapacitated (fully and immediately immobilized) the suspect (yes/no). According to this measure, OC spray was effective in 71% of cases. Their second measure of effectiveness was also dichotomous, measured as the officer's assessment of whether the use of OC spray eased arrest (yes/no). In this case, the use of OC spray was deemed effective 85% of the time. Their third measure of effectiveness consisted of a 5-point scale ranging from totally effective (i.e., incapacitated suspect) to totally ineffective (i.e., OC spray had no effect). Here, OC spray was considered effective 84% of the time.

Kaminski et al. (1999) examined the effects of suspect characteristics on OC spray effectiveness. In particular, they examined the variables of suspect race, gender, age, weight, height, and condition (i.e., suspect was drinking, mentally disturbed, on drugs, or other). The authors also examined the distance from which OC was sprayed. They found that OC spray was more effective (yes/no) with younger and older suspects (but less effective among middle-aged suspects) and intoxicated suspects. It was less effective when it was used on suspects who were under the influence of drugs and when sprayed from longer distances.

Adang et al. (2006) analyzed data on incidents where OC spray was used by police officers in the Netherlands. They used surveys of officers, supervisors, and prosecutors to measure the effectiveness of OC in several ways: the degree to which the subject was incapacitated (with options ranging from "completely" to "not at all"), the degree to which OC made the arrest easier ("much easier" to "much more difficult"), whether suspects became more or less aggressive after exposure to OC spray ("much more" to "much less"), and how satisfied officers were with the performance of OC spray ("dissatisfied" to "highly satisfied"). Estimates of effectiveness ranged from 69% (suspects who became less aggressive after being sprayed with

OC) to 92% (officers who were satisfied with the performance of OC spray). In the model predicting the extent of suspect incapacitation, four of thirteen independent variables were statistically significant. Specifically, OC spray was less effective when used by less experienced officers, against minority suspects, when suspects were warned beforehand they were going to be sprayed, and when suspects were under the influence of drugs.

The Effectiveness of Tasers

Two studies have examined the effectiveness of Tasers with specific regard to the incapacitation of subjects in arrest situations (White & Ready, 2007; White & Ready, 2010). White and Ready (2007) examined the effects of Tasers based on self-report surveys completed by (primarily SWAT) officers who worked in a large metropolitan police department. They considered the Taser effective if it led to the "successful incapacitation" of the subject. They found that after deploying a Taser, "85% of subjects were subdued by the Taser and taken into custody" (p. 183). The authors developed a multivariate "violence escalation scale" that they used to score each Taser incident. The scale included whether the subject was violent, armed with a weapon (and what type of weapon), under the influence of drugs or alcohol, mentally ill, the weight of the subject, and whether the officer was alone. Although individual analyses were not provided on each variable, the analyses performed on the scale revealed that the Taser was the most effective in the "highest risk" situations.

White and Ready (2010) analyzed Taser deployments from the New York City Police Department; the data were derived from the reports that officers completed subsequent to the deployment of the weapon. Three measures of Taser effectiveness were used in the study. The first measure was the officer's assessment of whether the Taser performed satisfactorily (yes/no).

Officers rated the performance of the Taser as satisfactory in 79% of cases. While this indicator of effectiveness was also used in prior studies (see Adang et al., 2006), the other two are unique in that they measure suspect resistance or, in other words, the *in*effectiveness of the Taser. The authors classified suspect resistance two ways: First, "continual resistance" included those situations where the suspect was not affected at any point by the weapon; the suspect continued to resist after the Taser was deployed. This occurred in 33% of all Taser deployments. In these instances the Taser was clearly ineffective. Second, "any resistance" included those situations where the Taser temporarily resulted in the incapacitation of the suspect, but the suspect resisted again prior to the conclusion of the incident. This occurred in about 11% of Taser deployments.

In their models predicting Taser (in)effectiveness, White and Ready (2010) explored the impact of multiple officer, suspect, and incident characteristics. They found the Taser to be less effective on heavier subjects (i.e., over 200 lbs), subjects who were under the influence of drugs or alcohol, subjects who were violent, when another less lethal weapon was used, when one or both prongs missed the subject, and when the Taser was fired from farther away (i.e., greater than three feet). When effectiveness was based on officer satisfaction, the Taser was also perceived to be more effective when the suspect was armed with a knife or gun.

Conclusions

There are too few studies available to draw confident conclusions about the factors that affect the use and effectiveness of OC spray and Tasers. Other than that males are more likely than females to be subject to a Taser than other forms of force (Gau, Mosher, & Pratt 2010; Crow and Adrion 2011), that OC spray is less likely to be effective on subjects who are under the influence of drugs compared to subjects who are not (Kaminski et al. 1999; Adang et al. 2006),

and that departmental policy affects the use of OC spray and Tasers (Crow & Adrion 2011; Morabito & Doerner, 1997), there is little consistency in findings. There is also little consistency in variables included in previous studies and the measurement of those variables.

It is safe to conclude, however, that estimates regarding the effectiveness of OC and Tasers depend at least in part on the measures used; different definitions of effectiveness produce different rates of effectiveness. In the studies reviewed here, rates of OC effectiveness ranged from 69% to 92% (Adang et al., 2006), while the effectiveness of the Taser ranged from 66% to 89% (White & Ready, 2010). The variation in effectiveness estimates notwithstanding, it appears that most studies show the Taser to be more effective than OC spray.

Our study adds to the discourse on the use and effectiveness of OC spray and the Taser in several ways. First and most importantly, this study is the first that directly compares OC spray with Tasers in terms of their use and their effectiveness, and we do so in the context of the same study site. Second, we include all intentional OC spray and Taser deployments to provide a potentially more inclusive assessment of effectiveness.[4] Lastly, we provide a logical measure of weapon effectiveness that incorporates the dynamic nature of use of force incidents and we use this same measure to evaluate OC spray and Tasers.

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[4] Interestingly, Kaminski et al. (1999) excluded from their analyses incidents where OC was used but where it missed its intended target and incidents where it was used in a crowd situation. The authors also explain that if multiple officers or multiple subjects were involved in the incident, a single officer and/or a single subject was selected for analysis. In addition, it is unknown what, if any, other types of force were used before or after the deployment of OC spray. Adang et al. (2006), like Kaminski et al. (1999), excluded several categories of incidents from their analysis: incidents where officers deployed OC spray but it missed its intended target, where OC was intended to be used but the canister malfunctioned, incidents that involved a crowd situation, and when it was deployed against female subjects. In addition, the authors did not specify what, if any, other types of force were used before or after the deployment of OC spray. It is unknown how these factors may have affected their conclusions about OC spray effectiveness.

custody deaths (Alpert et al., 2011; White & Ready, 2007). Research has shown that most deaths involving OC spray were instead the result of positional asphyxia, pre-existing health conditions, or were drug-related (Granfield, Onnen, & Petty, 1994; Petty, 2004). With regard to Tasers, it has been demonstrated that the risk of death when a Taser is used is less than 0.25 percent (NIJ, 2011), and in those situations the death is likely to be a result of drug intoxication, preexisting heart conditions, and exposure to other forms of nonlethal police force (White & Ready, 2007).

Another concern relates to police overuse of OC spray and Tasers (Alpert et al., 2011). For instance, members of the ACLU and Amnesty International have voiced concern that OC spray and Tasers are used in a disparate fashion against members of minority groups (ACLU of Southern California, 1993; Amnesty International, 2006). A related concern is that police have authorized their use too low on continuums of force and consequently are using them against passive (versus active) resisters (Terrill & Mastrofski, 2002). Finally, there are concerns about the use of OC spray and Tasers with the elderly, children, pregnant women, and persons with medical conditions that put them at greater risk of experiencing dangerous medical side effects (Amnesty International, 2006; Sloane & Vilke, 2006).

A final concern has to do with manufacturer exaggeration of the capabilities and effectiveness of OC spray and Tasers in incapacitating subjects, which, in part, may have contributed to their widespread adoption in police departments. Some early studies reported "effectiveness rates" as high as 100% for OC spray (as cited in Adang et al., 2006) and 94% for the Taser (as cited in White & Ready, 2010). Objective empirical research on the effectiveness of these devices remains rather sparse. Of the independent studies that do exist, effectiveness rates have not been found to be as high as those originally reported by the manufacturers. For

instance, and as discussed below, Kaminski et al. (1999) found an effectiveness rate of 71% for OC spray. White and Ready (2010) found an effectiveness rate of 85% for the Taser.

RESEARCH ON THE USE AND EFFECTIVENESS OF OC SPRAY AND TASERS

While research appears to have ameliorated concerns about OC spray and Tasers causing serious injury and death, there remain concerns about their use and effectiveness. In response, there has been a growing body of literature that examines the use and effectiveness of these weapons. Given the objectives of the current study, we review here the studies that examine the factors associated with the *use* of OC spray and Tasers and the *effectiveness* of OC spray and Tasers (with effectiveness defined in terms their ability to facilitate the arrests of resisting subjects).

The Use of OC Spray

Morabito and Doerner (1997) analyzed OC spray use-of-force reports from the Tallahassee Police Department. They examined characteristics of officers and suspects that were associated with the use of OC spray at two points in time: prior to and after a change in the circumstances in which OC spray was authorized in the department. At Time 1, OC spray was only authorized in cases when the suspect was actively physically resisting police. At Time 2, the threshold for the use of OC spray was reduced from active physical resistance to verbal/passive physical resistance. At Time 1, OC spray use was compared to impact weapons such as batons, flashlights, and stun guns. At Time 2, OC spray use was compared to the use of soft hand techniques (punches, kicks, and pain compliance techniques). The officer characteristics of interest included race, gender, education and experience. Suspect variables

included race, gender, height and weight (relative to the officer's height and weight), suspect intoxication, and whether the suspect was armed or attacked the officer. While none of the predictor variables were significant at Time 1, several factors were associated with OC spray use at Time 2. At Time 2, male, educated, and veteran officers were more likely to use OC spray than soft hand techniques. OC spray was also more likely to be used than soft hand techniques when the suspect was heavier and taller than the officer and when the suspect was armed.

The Use of Tasers

Gau, Mosher, and Pratt (2010) analyzed case file data on Tasers and other types of force used by officers in a state patrol agency from 2005 to 2007. The authors were primarily interested in examining possible racial disparities in the use of a Tasers on subjects. Tasers were used in nearly one-half of all use-of-force incidents. They found that compared to other forms of force, Tasers were equally likely to be used on white, Hispanic, and Black subjects; although when a Taser was used, Hispanic subjects were more likely than White subjects to have a Taser be the first type of force used. The authors also found that females were less likely to be "tased" than males, and that subjects who actively resisted and who were assaultive were *less* likely to be tased than subjects who passively resisted. Finally, white officers were significantly less likely to use a Taser than officers of other races.

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of force when subjects physically resisted and when resistance involved a weapon. A Taser was equally likely to be used when resistance was in the form of "presence," "flight," and "verbal" (meanings unspecified). A Taser was more likely to be used than other forms of force on non-white and male subjects. Older officers were significantly more likely to use Tasers. A policy change to restrict the use of Tasers also had its intended affect; after the policy change, Tasers were less likely to be deployed. Call type, time of day of the incident, officer sex, race, age, and rank did not affect the likelihood of Taser use.

The Effectiveness of OC Spray

Three studies have examined the effectiveness of OC spray (Morabito & Doerner, 1997; Adang et al., 2006; Kaminski, Edwards, & Johnson, 1999), generally defined in terms of the extent to which it facilitates the arrests of suspects who resist. As previously noted, Morabito and Doerner (1997) analyzed use of force reports from the Tallahassee Police Department. Although these authors were most concerned with the factors associated with the use of OC spray, they also briefly considered the effectiveness of it. As the authors explained, OC spray "was considered effective if it induced the expected physiological effects and enabled the officer to take the subject into custody without further incident" (p. 690). They calculated a "success rate" of 73% for OC spray and found that OC spray worked "equally well on mentally disturbed subjects, intoxicated subjects, and physically stressed subjects who were involved in either a foot chase or a physical struggle" (p. 690).

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OC) to 92% (officers who were satisfied with the performance of OC spray). In the model predicting the extent of suspect incapacitation, four of thirteen independent variables were statistically significant. Specifically, OC spray was less effective when used by less experienced officers, against minority suspects, when suspects were warned beforehand they were going to be sprayed, and when suspects were under the influence of drugs.

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Two studies have examined the effectiveness of Tasers with specific regard to the incapacitation of subjects in arrest situations (White & Ready, 2007; White & Ready, 2010). White and Ready (2007) examined the effects of Tasers based on self-report surveys completed by (primarily SWAT) officers who worked in a large metropolitan police department. They considered the Taser effective if it led to the "successful incapacitation" of the subject. They found that after deploying a Taser, "85% of subjects were subdued by the Taser and taken into custody" (p. 183). The authors developed a multivariate "violence escalation scale" that they used to score each Taser incident. The scale included whether the subject was violent, armed with a weapon (and what type of weapon), under the influence of drugs or alcohol, mentally ill, the weight of the subject, and whether the officer was alone. Although individual analyses were not provided on each variable, the analyses performed on the scale revealed that the Taser was the most effective in the "highest risk" situations.

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In their models predicting Taser (in)effectiveness, White and Ready (2010) explored the impact of multiple officer, suspect, and incident characteristics. They found the Taser to be less effective on heavier subjects (i.e., over 200 lbs), subjects who were under the influence of drugs or alcohol, subjects who were violent, when another less lethal weapon was used, when one or both prongs missed the subject, and when the Taser was fired from farther away (i.e., greater than three feet). When effectiveness was based on officer satisfaction, the Taser was also perceived to be more effective when the suspect was armed with a knife or gun.

Conclusions

There are too few studies available to draw confident conclusions about the factors that affect the use and effectiveness of OC spray and Tasers. Other than that males are more likely than females to be subject to a Taser than other forms of force (Gau, Mosher, & Pratt 2010; Crow and Adrion 2011), that OC spray is less likely to be effective on subjects who are under the influence of drugs compared to subjects who are not (Kaminski et al. 1999; Adang et al. 2006),

and that departmental policy affects the use of OC spray and Tasers (Crow & Adrion 2011; Morabito & Doerner, 1997), there is little consistency in findings. There is also little consistency in variables included in previous studies and the measurement of those variables.

It is safe to conclude, however, that estimates regarding the effectiveness of OC and Tasers depend at least in part on the measures used; different definitions of effectiveness produce different rates of effectiveness. In the studies reviewed here, rates of OC effectiveness ranged from 69% to 92% (Adang et al., 2006), while the effectiveness of the Taser ranged from 66% to 89% (White & Ready, 2010). The variation in effectiveness estimates notwithstanding, it appears that most studies show the Taser to be more effective than OC spray.

Our study adds to the discourse on the use and effectiveness of OC spray and the Taser in several ways. First and most importantly, this study is the first that directly compares OC spray with Tasers in terms of their use and their effectiveness, and we do so in the context of the same study site. Second, we include all intentional OC spray and Taser deployments to provide a potentially more inclusive assessment of effectiveness.[4] Lastly, we provide a logical measure of weapon effectiveness that incorporates the dynamic nature of use of force incidents and we use this same measure to evaluate OC spray and Tasers.

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[4] Interestingly, Kaminski et al. (1999) excluded from their analyses incidents where OC was used but where it missed its intended target and incidents where it was used in a crowd situation. The authors also explain that if multiple officers or multiple subjects were involved in the incident, a single officer and/or a single subject was selected for analysis. In addition, it is unknown what, if any, other types of force were used before or after the deployment of OC spray. Adang et al. (2006), like Kaminski et al. (1999), excluded several categories of incidents from their analysis: incidents where officers deployed OC spray but it missed its intended target, where OC was intended to be used but the canister malfunctioned, incidents that involved a crowd situation, and when it was deployed against female subjects. In addition, the authors did not specify what, if any, other types of force were used before or after the deployment of OC spray. It is unknown how these factors may have affected their conclusions about OC spray effectiveness.

METHOD

Data

The data for this study were obtained from a large municipal police department. At the time of the study, the department employed approximately 2,000 sworn officers, about 1,200 of whom were patrol officers. The police department served a population of approximately 600,000; 40% of the population was African American and 10% was Latino.

Analyses were performed on all use of force incidents in 2010 and 2011 where an officer from the department intentionally discharged OC spray (n=259) or deployed a Taser (n=245) against a person. While an additional 24 incidents involved the use of OC and a Taser, and another 45 incidents involved the use of another type of weapon, the analyses conducted here focus on the 504 incidents where OC *or* a Taser was used.

All officers in the department were trained and authorized to carry and use OC spray. During the academy, officers received 4 to 8 hours of instruction on the use of OC spray. Only about 300 officers (approximately 25% of patrol officers) were trained and certified to use a Taser. Further, on each of the three shifts at each of the eight districts, approximately six to eight Tasers were available to be signed out and carried by the certified Taser officers. Therefore, at any given time during the time of this study, there were no more than 68 Tasers actually being carried by officers. With regard to Taser training, officers who volunteered for training first had to be approved by Internal Affairs. Officers who were selected to be Taser trained participated in 16 hours of "new user" training and an additional 8 hours of "refresher" training every 2 years.[5]

At the time of the study, the use of force policy of the department specified OC spray and Tasers as "control devices." According to the policy, "the goal of control devices is to overcome

[5] The only training required by TASER International is the 8 hours of "new user" training.

active resistance or its threat [italics added]." Control devices, escort holds, compliance holds and passive counter measures were more broadly considered "control alternatives." Although a continuum of force was not specified per se, "intervention options" were provided; these options ranged from presence, dialogue, control alternatives, protective alternatives (e.g., focused strikes, vertical stuns), to deadly force (see Figure 1).

Most of the data for the study were obtained from a case management system used by the police department and were converted into a Statistical Package for the Social Sciences (SPSS) data file for analyses. The database was organized with use of force incidents as the unit of analysis. The use of force data were based on reports that were completed by supervisory officers when a use of force incident occurred. According to the official policy of the department at the time of the study, a use of force report was to be completed by a supervisor when an officer: (a) discharged a firearm, (b) used a baton, (c) discharged Oleoresin Capsicum (OC), (d) deployed an Electronic Control Device (Taser), (e) used any other type of force, which resulted in an injury, or a complaint of an injury, to a person, or (f) when a department canine bit a subject in the performance of their duty. Clearly, this is a relatively narrow definition of force as it does not include incidents where only bodily force was used when that force did not result in an injury (or a complaint of an injury) to a subject (or verbal force, see Terrill & Mastrofski, 2002). Nevertheless, that the department policy did not require all bodily force incidents to be reported is of little concern in this study. This study focuses specifically on incidents that involved the use OC spray or a Taser. Departmental policy specified that all such incidents be recorded and all types of force used in those incidents be recorded.

Along with the departmental use of force report, a narrative of the incidents was also written by the supervisory officer and was included in the case management system. For this

study, all of the narratives for incidents that involved the use of OC and/or a Taser were reviewed (787 pages) and additional data were coded from them (e.g., level of subject resistance, the order in which force was used by officers).

Variables

The two primary dependent variables in this study are: 1) the *use of* OC spray and the Taser and 2) the *effectiveness of* OC spray and the Taser. Determining whether or not a particular type of force was used in an incident was relatively straight-forward. If OC was sprayed or a Taser was deployed, OC or the Taser was considered to have been used. If the target was missed, if the weapon malfunctioned, if it was used in a crowd situation, or if it was used against females, the incident was still included. If the incident involved multiple officers and/or multiple subjects, the incident was included. In the few incidents that involved multiple subjects, the characteristics of the person identified as the primary subject in the officer's report was coded.

Determining the effectiveness of OC spray and the Taser was more complicated. As discussed earlier, previous studies have used different measures of effectiveness although each study, in one way or another, examined how well, or to what degree, OC spray or the Taser incapacitated the subject who resisted the police. Of course, the variation in measurement is important to consider when interpreting findings across studies. Ultimately, in a use of force incident, the legitimate objective is to neutralize the threat posed by the subject and gain control over that subject. Most often, practically speaking, "gaining control" means using as much force as necessary in order to place handcuffs on the subject. Many use-of-force situations are

complicated; they unfold, one action leads to another, but ultimately force is used to gain control over the physical actions of the subject.

In this study, we provide a relatively straight-forward, bottom-line, measure of OC and Taser effectiveness. OC spray and/or Tasers were considered effective in two circumstances: First, if OC or a Taser was the *only* type of force that was used in the incident in order to subdue/handcuff the subject, OC or the Taser was considered effective. In these situations, OC spray or the Taser, by itself, led to the legitimate desired outcome; it was effective. Second, if OC or a Taser was the *last* type of force used in the incident prior to the subject being subdued/handcuffed, then OC or the Taser was considered effective. For example, if OC spray was deployed but then some other type of force was necessary in order to gain control over the subject to the point of placing him in handcuffs, then the OC was considered ineffective. OC may, or may not, have had some effect, but ultimately it was not effective in achieving the legitimate objective of the use of force incident—additional force needed to be used.

Of course, one must not lose sight of the possible cumulative effects that various types of force that were used in an incident may have in bringing an incident to an end. Indeed, several of the studies reviewed above simply did not take into account any other types of force that may have been used in the incident. Given the nature of the data analyzed in this study, measuring the precise effect that various forms of force may have had in a use of force incident is difficult, if not impossible. Nevertheless, to the extent possible, and when possible, we consider not only the last type of force used, but all types of force used in the incident. It is also important to highlight that the same criteria are used in measuring the effectiveness of OC and Tasers, providing for an equal ("apples-to-apples") comparison of the effectiveness of the two forms of

force. It is in these ways that an understanding of the relative effectiveness of OC and Tasers can be achieved.

Independent Variables

The independent variables in this study consist of subject characteristics and actions (see Tables 1 and 2 for coding and descriptive statistics). In particular, we focus on: 1) who was the subject? and 2) what did the subject do? Officer characteristics are not included primarily because of the analytic difficulties in doing so.[6] The number of officers who used force in an incident and the number of officers present when force was used were coded and included in the analyses as controls. The number of subjects who had force used upon them was also coded and included as a control.[7]

Data on "who the subject was" (i.e., the characteristics of the subject) were coded according to the supervisor's report. These variables consisted of subject race (white/minority[8]), age, sex, height, and weight.

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[6] Of course, this is a less than optimal solution to the issue; however, previous studies have struggled with the same issue and also resolved it in less than optimal ways. For instance, studies that have included officer characteristics either included only one officer when multiple officers were involved in the incident (Adang et al., 2006; Kaminski et al., 1999), or counted single incidents multiple times if multiple officers used force (White and Ready, 2007). Some studies are unclear about how multiple officer and multiple subject incidents were handled in the analyses (Morabito and Doerner, 1997). Each of these options essentially reduces the complexity of the incidents that are analyzed. None of these options are good, nor is the exclusion of officer characteristics; however, by not including officer characteristics we do not systematically exclude cases. Clearly, there is a trade-off between model error and sample bias.

[7] As noted, in multiple subject incidents, the characteristics of the primary subject, as identified in the police narrative report, were coded and included in the analyses.

[8] Ideally, sub-racial and ethnic groups would be analyzed instead of the "minority" category (Gau et al., 2010). However, too few Hispanics and/or other ethnic/racial group members were included among the incidents. The "minority" group classification consisted of 90% African American subjects (377 out of 419).

Most of the data on "what the subject did" (i.e., how the subject acted) were coded from the narrative reports prepared by supervisory officers and the statements included in the reports. These variables consisted of: whether the subject was mentally disturbed (yes/no), whether the subject was under the influence of drugs or alcohol (yes/no), whether a subject was believed to be armed with a weapon (yes/no), whether a subject was actually armed with a weapon (yes/no),whether a subject fled the police on foot (yes/no), whether a subject assaulted an officer ("yes" if it was stated in the narrative that the subject intentionally hit, kicked, bit, shot, stabbed, or spat upon an officer, "no" otherwise), and the level of resistance offered by the subject (coded on the basis of information provided in the narrative).[9]

RESULTS

Given the purposes of this study, results are organized into two sections: 1) those that relate to the *use* of OC spray and the Taser and 2) those that relate to the *effectiveness* of OC spray and the Taser. We begin with bivariate analyses and multivariate analyses of OC/Taser use and then turn attention to bivariate and multivariate analyses of OC/Taser effectiveness.

The Use of OC Spray and Tasers

How do the 259 incidents where OC spray was used differ from the 245 incidents where a Taser was used? This question was first addressed by calculating statistical differences

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[9] Examples of *passive* resistance included when a subject refused to exit a car, subject went limp, subject refused to move after being ordered to do so, subject refused to show hands after being ordered to do so; examples of *verbal* resistance included when a subject told the officer(s) to leave him/her alone, subject stated he or she will not comply; examples of *defensive* resistance included when subject attempted to or actually fled the police, the subject attempted to hide from the police, subject pulled away from the officer, subject got up after being directed to the ground; examples of *active* resistance included subject fighting with the police, subject lunging at officer, subject attempting to disarm the officer (Terrill and Mastrofski, 2002).

between the variables of interest and OC spray and Taser incidents on the basis of chi-square and *t* tests (for the sake of space, results are not tabled here). Next, a logistic regression equation was estimated to identify factors that predicted OC spray versus Taser use; these results are shown in Table 3.

In the bivariate analyses, OC spray was significantly more likely than a Taser to be used on minority subjects ($X^2 = 6.82; p < .01$); OC spray and a Taser were equally likely to be used regardless of subject age, sex, weight, or height. A Taser was significantly more likely to be used than OC when the subject appeared to be mentally disturbed ($X^2 = 18.61; p < .01$), was believed to be armed with a weapon ($X^2 = 19.23; p < .01$), when the subject was actually armed with a weapon ($X^2 = 6.52; p < .05$), and when the subject fled the police on foot ($X^2 = 16.14; p < .01$). OC spray and Tasers were equally likely to be used when the subject was believed to be under the influence of alcohol or drugs, when the subject assaulted a police officer, and regardless of the amount of resistance provided to the police. OC was more likely to be used than a Taser when more than one subject had force used upon them in the incident ($t = -2.03; p < .05$); a Taser was more likely to be used than OC when more officers used force in the incident ($t = 2.30; p < .05$) and when more officers were present at the incident ($t = 6.39; p < .01$).

Table 3 shows the results of the logistic regression analyses performed for OC spray and Taser use. Due to substantial missing data, subject height and weight were not included in the equation. Two models were estimated: one compares those incidents where OC was used to those incidents where a Taser was used ("OC Used"), the other compares Taser use to OC use ("Taser Used"). The independent variables identified as significant in the earlier analyses are similar to those identified as significant here. First, all other variables held constant, when the subject was believed to be mentally disturbed, a Taser was more than two times more likely to be

used than OC spray (odds ratio = 3.296; p = .000). Second, when the subject was believed to be armed, a Taser was significantly more likely to be used than OC spray (odds ratio = 1.858; p = .023). Third, when the subject fled the police on foot, a Taser was significantly more likely to be used on the subject than OC spray (odds ratio = 2.452; p = .000). Fourth, when there were more subjects involved, OC spray was nearly 80% more likely to be used than a Taser (odds ratio = 1.794; p = .04). Finally, when there were more officers present at the incident, a Taser was significantly more likely to be used (odds ratio = 1.668; p = .000).

The Effectiveness of OC Spray and Tasers

Before examining the factors associated with the effectiveness of OC and Tasers spray, it is necessary to calculate an effectiveness rate for OC spray and Tasers (see Table 4). Of the 259 incidents where OC spray was used, 63 involved only the use of OC spray. That no other force was needed to subdue the subject can be considered reasonable evidence that OC spray was effective. In the other 196 incidents, OC spray and some other force were used. In these 196 incidents, the order in which force was applied is meaningful. In 128 of these 196 incidents, OC ended the encounter; presumably OC was used to subdue the subject because the force that was applied prior to the OC did not work, or did not appear to be working, at least in the judgment of the officer who deployed the OC spray.[10] There were 68 incidents where OC was deployed during the incident but some other force ended the encounter.[11] To calculate an effectiveness rate of OC spray, the 63 incidents that only involved OC spray and the 128 incidents where OC

[10] Of the 128 incidents, in 125 of them bodily force was used prior to OC spray; in 3 incidents, bodily force and a baton were used prior to OC.

[11] Of the 68 incidents, 63 ended as a result of bodily force, 5 ended with the use of a baton.

was used last are combined (63 + 128) and divided by the total number of incidents in which a OC spray was used (259). This calculation results in a 73.8% effectiveness rate.

Of the 245 incidents where a Taser was used, in 85 of them, only a Taser was used. In the other 160 incidents, a Taser and some other force were used. In 136 of the 160 incidents, a Taser was the last type of force used.[12] In the other 24 incidents, a Taser was deployed first but some other force ended the encounter.[13] To calculate an effectiveness rate of Tasers, the 85 incidents that only involved a Taser and the 136 incidents where a Taser was used last are combined (85 + 136) and divided by the total number of incidents in which a Taser was used (245). This calculation results in a 90.2% effectiveness rate. Using the same parameters for calculating the effectiveness of OC spray and Tasers, it is clear that Tasers demonstrate a substantially higher effectiveness rate than OC.

As demonstrated in prior studies, OC spray and Tasers may be more effective with some subjects than with others. Again, we calculated statistical differences between the variables of interest and OC spray and Taser incidents on the basis of chi-square and *t* tests (results not tabled). Overall, the results showed that the effectiveness of OC and Tasers did not vary significantly by any of the subject demographic variables included: subject race, age, sex, height, or weight. OC spray was significantly less effective when the subject was believed to be armed ($X^2 = 4.67$; $p < .05$), when the subject assaulted the police ($X^2 = 5.88$; $p < .05$), and when the subject provided higher levels of resistance ($X^2 = 16.91$; $p < .01$). As with OC spray, Tasers

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[12] Of the 136 incidents, in 135 of them bodily force was used prior to the Taser; in 1 incident, bodily force and a baton was used prior to a Taser.

[13] Of the 24 incidents, 21 ended as a result of bodily force, 1 ended with the use of a baton, and 2 ended with the use of a firearm.

were less effective with greater subject resistance ($X^2 = 10.78$; $p < .05$). The results also showed that OC spray and Tasers were less likely to be the last type of force used (less likely to be "effective") when more officers used force in the incident ($t = 3.73$; $p < .01$ and $t = 3.29$; $p < .01$, respectively). OC spray and Tasers were also less likely to be the last type of force used when more officers were present during the incident ($t = 3.00$; $p < .01$ and $t = 2.04$; $p < .05$, respectively).

To identify more directly the factors that predict the effectiveness of OC spray and Tasers, two logistic regression equations were estimated: one for OC effectiveness the other for Taser effectiveness (see Table 5). For each model, the comparison was between effective versus not effective. There are two primary findings worthy of discussion based on the logistic regression results. First, while the OC model is significant, the Taser model is not. It appears that the Taser is uniformly effective, regardless of the variables included here. Second, of all the variables examined, the only significant predictor of OC spray effectiveness is subject resistance. With more resistance offered, OC spray was 48% less likely to be effective (odds ratio = .515; p = .027).[14] Apparently, OC spray alone is not enough to subdue a subject who is more resistive.

DISCUSSION

Previous research on the use and effectiveness of OC spray and Tasers is characterized by incomplete and conflicting findings. There are simply too few studies from which to draw conclusions. Varying study sites, comparisons, data sources, and measurement schemes certainly contribute to these conflicting findings. Nevertheless, a basic conclusion of previous research is that OC spray and Tasers are used in different circumstances. This study used

[14] Congruent with Kaminski et al. (1999), in each of the logistic regression models, younger and older subjects (under 22 and over 38) were compared to "middle" aged subjects (22-37). The results of the analyses did not change in any meaningful way.

OC Spray/Taser Effectiveness

The only significant predictor of OC spray (in)effectiveness was subject resistance. The more a subject resisted the police, the less likely OC spray was to be effective. In particular, when OC spray was used in situations where the subject resisted, it was likely that OC was not the last type of force used. Either the OC spray led to additional resistance that had to be overcome with other force, or OC was not effective in subduing a subject who was already resisting. The model predicting Taser effectiveness was not significant; this suggests that the Taser was effective to the degree that our predictors did not contribute to our understanding of its effectiveness. As noted, the observed level of Taser effectiveness may be a function of the circumstances in which Tasers are used, the amount and quality of training officers received with the Taser, as well as their limited deployment in the study department.

With regard to the effectiveness rates of OC spray and the Taser, and congruent with previous studies, we found that the Taser was substantially more effective than OC spray. Given the research that has been conducted, it is safe to say that Tasers have inherent advantages over OC spray in their ability to incapacitate subjects. However, with this conclusion, it is important not to lose sight of the fact that OC spray and Tasers are simply tools and, like hammers, can be more effectively used by some people than others.

In summary, OC spray and Taser use and effectiveness are clearly different outcomes with different predictors. Overall, suspect behaviors are of value in predicting the *use* of OC and Tasers but not when predicting their *effectiveness*. While suspect behaviors may drive the decision to choose OC spray or the Taser over other forms of force, other factors determine whether OC spray or the Taser actually work to induce suspect compliance. For example, whether OC spray actually works may have less to do with the subject's characteristics and

actions, and more to do with the capabilities of the weapon itself (e.g., amount of OC sprayed, distance between officer and suspect when OC is sprayed). Further research that directly compares OC spray with Tasers may highlight other critical variables that would help explain the use and effectiveness of them.

IMPLICATIONS FOR POLICY AND RESEARCH

Given the relative paucity of research on the use and effectiveness of OC spray and Tasers, specific policy implications are premature. However, when considering the current findings along with the results of prior studies, several policy- and especially research-related questions come to light.

In particular, how Tasers are distributed among officers may have implications for their use and effectiveness in particular police departments. Specifically, are Tasers used at a higher rate if more officers are equipped with them? Is OC spray used at a lower rate if more officers are equipped with Tasers? If more officers are equipped with Tasers, and Tasers are used more frequently, is Taser effectiveness impacted? In addition, does the amount, type, and quality of training received by officers on OC spray and Tasers impact their use and effectiveness? To what extent does organizational policy regarding the use of OC spray and Tasers affect their use and effectiveness? As such, it would be worthwhile and interesting to consider the use and effectiveness of OC and Tasers across similar departments with different deployment arrangements, training standards, and policies regarding the OC and Tasers. Clearly, there is variance between departments in this regard.

It will not be until research accumulates that it will be possible to draw conclusions about the use and effectiveness of OC and Tasers with confidence. Along with factors already mentioned, the effectiveness of OC spray and Tasers are likely to depend on factors not included

in this study or in most others, including the distance from which the weapon was used, the type of clothing worn by the subject (heavy clothing being worn by the subject may inhibit the use of a Taser and/or the effectiveness of it), whether the target was moving at the time of weapon deployment, and the height/weight the subject in relation to the officer.

Another interesting topic for research on the issue is the impact of the *threat* of Taser use on resisting subjects. Adang et al. (2006) examined the impact of threats with respect to OC spray (in their study, OC spray was less effective when suspects were warned beforehand they were going to be sprayed), but no studies have looked at this issue with respect to Tasers; we currently lack information about how often Tasers are threatened to be used (or how often they are even displayed) by officers and the effects of those actions. Such studies could enhance our understanding of the overall effectiveness of the weapons and inform associated policy.

While there is a clear need for additional research on the use of effectiveness of OC spray and Tasers, there is also a need for additional research on the use and effectiveness of bodily force in use of force situations, especially given its frequency. Most use of force incidents begin with bodily force and most injuries to officers and subjects are as a result of bodily force (Adams, 1999). As such, it would be worthwhile for researchers to consider the effectiveness and other issues related to the use of bodily force. What factors predict the effectiveness or ineffectiveness of bodily force? There are many forms of bodily force, what types are most often used and most effective? Answers to these questions may provide insight into situations where bodily force (or certain types of bodily force) should be avoided and OC spray or Tasers used instead.

LIMITATIONS

This study contributes to the discussion about the factors associated with the use and effectiveness of OC spray and Tasers, but it has limitations. First, the data used in the study were collected from police reports which provide the official account of what happened during the use of force incident. Even the order in which force was used, which was critical for the measurement of OC spray and Taser effectiveness in this study, could be misrepresented in the reports. Although there is no evidence of systematic distortion or under-reporting in the reports, the accuracy of the reports could be questioned in this regard. Although many other use-of-force studies, and studies on other topics for that matter, also use official police reports, the veracity of the reports needs to be considered when drawing conclusions on the basis of them.

Second, the generalizability of the findings presented here can be questioned. This department had a unique arrangement for the deployment of Tasers among officers and had a specific policy which guided officer decision making in use of force incidents that involved OC spray and Tasers. Establishing external validity is always an empirical issue; as noted, there is a need for additional research to be conducted on the topic in other police departments.

Finally, this study included a relatively limited range of variables in trying to predict the use and effectiveness of OC spray and Tasers. We would benefit from additional studies that were able to include a wider range of independent variables in the prediction models. By addressing these limitations, a more complete understanding of the factors that predict the use and effectiveness of OC spray and Tasers may be developed.

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Figure 1

Description of "Intervention Options" Used in Study Department

MODE	Definition	Authorized Police Response(s)
Presence	To present a visible display of authority	Open stance, ready stance, defensive stance
Dialog	To verbally persuade	Search talk, persuasion, light control talk, heavy control talk
Control Alternatives	To overcome passive resistance, active resistance, or their threats	Escort holds, compliance holds, control devices **(i.e., OC, ECDs)**, passive countermeasures
Protective Alternatives	To overcome continued resistance, assaultive behavior, or their threats	Active countermeasures, incapacitating techniques, intermediate weapons
Deadly Force	To stop the threat	Deadly force

Table 1

OC or Taser Used: Coding and Descriptive Statistics

Variable	Scale	OC Used M	OC Used SD	OC Used N	Taser Used M	Taser Used SD	Taser Used N
Subject Characteristics							
Race	0=minority 1=white	.11	.31	253	.20	.40	241
Age	in years	30.70	11.17	252	30.06	10.65	239
Sex	0=female 1=male	.88	.33	251	.92	.27	240
Height	in inches	69.42	3.28	192	69.81	3.46	186
Weight	in pounds	187.49	40.76	192	188.35	46.91	186
Subject Actions							
Mental Disturbed	0=no 1=yes	.09	.29	259	.23	.42	245
Under Influence	0=no 1=yes	.43	.50	258	.46	.50	244
Believed Armed	0=no 1=yes	.22	.41	259	.40	.49	245
Actually Armed	0=no 1=yes	.08	.28	259	.16	.37	245
Fled Police	0=no 1=yes	.22	.41	259	.38	.49	245
Resistance	0=none 1=passive/verbal 2=defensive 3=active	2.40	.76	258	2.44	.73	245
Assaulted Police	0=no 1=yes	.17	.38	259	.13	.34	245
Controls							
# of Subjects		1.12	.47	259	1.04	.35	245
# of Officers Used Force		1.72	.86	259	1.92	1.12	245
# of Officers Present		2.44	1.16	259	3.37	2.03	245

Table 2

OC or Taser Effective: Coding and Descriptive Statistics

Variable	Scale	OC Effective M	OC Effective SD	OC Effective N	Taser Effective M	Taser Effective SD	Taser Effective N
Subject Characteristics							
Race	0=minority 1=white	.12	.32	187	.19	.40	217
Age	in years	30.86	11.47	185	30.02	10.62	215
Sex	0=female 1=male	.86	.35	184	.92	.28	216
Height	in inches	69.29	3.37	140	69.67	3.38	170
Weight	in pounds	184.40	39.78	140	188.05	44.00	170
Subject Actions							
Mental Disturbed	0=no 1=yes	.09	.29	191	.23	.42	221
Under Influence	0=no 1=yes	.42	.50	190	.46	.50	220
Believed Armed	0=no 1=yes	.18	.39	191	.38	.49	221
Actually Armed	0=no 1=yes	.07	.26	191	.15	.36	221
Fled Police	0=no 1=yes	.19	.39	191	.37	.48	221
Resistance	0=none 1=passive/verbal 2=defensive 3=active	2.28	.80	190	2.44	.71	221
Assaulted Police	0=no 1=yes	.14	.34	191	.12	.33	221
Controls							
# of Subjects Force Used Upon		1.14	.49	191	1.04	.37	221
# of Officers Used Force		1.60	.75	191	1.85	1.06	221
# of Officers Present		2.31	1.02	191	3.29	1.92	221

Table 3

Logistic Regression Models of OC or Taser Use

Variable	OC Used 0=no 1=yes B	p	Exp(B)	Taser Used 0=no 1=yes B	p	Exp(B)
Subject Race	-.579	.056	.560	.579	.056	1.785
Subject Age	.017	.093	1.017	-.017	.093	.983
Subject Sex	-.076	.836	.927	.076	.836	1.079
Subject Mental Disturbed	-1.193	.000	.303	1.193	.000	3.296
Subject Under Influence	-.316	.150	.729	.316	.150	1.372
Subject Believed Armed	-.619	.023	.538	.619	.023	1.858
Subject Actually Armed	.149	.704	1.160	-.149	.704	.862
Subject Fled Police	-.897	.000	.408	.897	.000	2.452
Subject Resistance	-.199	.207	.819	.199	.207	1.221
Subject Assaulted Police	.527	.079	1.694	-.527	.079	.590
No. of Subjects	.584	.041	1.794	-.584	.041	.558
No. of Officers Used Force	.202	.140	1.224	-.202	.140	.817
No. of Officers Present	-.512	.000	.599	.512	.000	1.668
Constant	1.301	.054	3.673	-1.301	.054	.272
Log likelihood	565.613			565.613		
Model Chi Square	103.617			103.617		
df	13			13		
Significance	.000			.000		
R Squared (Nagelkerke)	.258			.258		
N	483			483		

Notes: B=log odds, p=significance, Exp (B)=odds ratios

Table 4

OC and Taser Effectiveness

OC was Used in 259 incidents (no Taser used)

In 63 incidents only OC used
In 196 incidents OC and other form(s) of force were used

In 128 of the 196 incidents, OC ended the encounter
In 68 of the 196 incidents, another type of force ended encounter
(i.e., bodily force = 63; baton = 5)

63 + 128 = 191 / 259 = OC 73.8% effective rate

Taser was Used in 245 incidents (no OC used)

In 85 incidents only a Taser used
In 160 incidents a Taser and other form(s) of force were used

In 136 of the 160 incidents, a Taser ended the encounter
In 24 of the 160 incidents, another type of force ended encounter
(bodily force = 21; baton = 1; firearm = 2)

85 + 136 = 221 / 245 = Taser 90.2% effective rate

OC and Taser were Used in 24 incidents

In 22 of the 24 incidents, the Taser ended the encounter
In 2 of the 24 incidents, OC ended the encounter

Another Weapon was Used in 45 incidents (no OC or Taser)

In 22 of the 45 incidents, only a firearm was used
In 14 of the 45 incidents, bodily force and a baton were used
In 4 of the 45 incidents, only a baton was used
In 3 of the 45 incidents, bodily force and a firearm were used
In 1 of the 45 incidents, gas and a firearm was used
In 1 of the 45 incidents, bodily force and a flashlight were used

Table 5

Logistic Regression of OC and Taser Effectiveness

	OC Effective 0=no 1=yes			Taser Effective 0=no 1=yes		
Variable	B	p	Exp(B)	B	p	Exp(B)
Subject Race	.424	.434	1.528	-.317	.617	.728
Subject Age	.012	.451	1.012	-.014	.557	.986
Subject Sex	-1.433	.076	.239	-.419	.714	.658
Subject Mental Disturbed	-.423	.455	.655	-.001	.999	.999
Subject Under Influence	-.340	.323	.712	.071	.890	1.073
Subject Believed Armed	-.351	.411	.704	-.416	.456	.660
Subject Actually Armed	-.726	.251	.484	-.397	.556	.672
Subject Fled Police	-.265	.483	.767	-.768	.144	.464
Subject Resistance	-.664	.027	.515	.232	.516	1.261
Subject Assaulted Police	-.529	.189	.589	-.754	.255	.470
No. of Subjects	.661	.222	1.037	.657	.697	1.929
No. of Officers Used Force	-.414	.062	.661	-.531	.017	.588
No. of Officers Present	-.174	.286	.840	.000	.998	1.000
Constant	4.651	.001	104.660	3.647	.122	38.343
Log likelihood	244.171			139.531		
Model Chi Square	41.147			15.443		
df	13			13		
Significance	.000			.281		
R Squared (Nagelkerke)	.224			.134		
N	248			235		

Notes: B=log odds, p=significance, Exp(B)=odds ratios

The Impact of the Taser on Suspect Resistance: Identifying Predictors of Effectiveness

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The Impact of the Taser on Suspect Resistance

Identifying Predictors of Effectiveness

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Despite the Taser's increasing popularity among police agencies, questions have been raised concerning the weapon's use and effectiveness as well as its potential to cause serious injury or death. This article examines all Taser deployments by the New York City Police Department from 2002 to 2005 (N = 375) and uses two multivariate approaches—logistic regression and chi-square automatic interaction detection—to identify predictors of Taser effectiveness, measured as continued suspect resistance and officer satisfaction. Findings indicate that several factors are associated with reduced effectiveness, including suspect body weight (more than 200 pounds), drug and alcohol use, physical violence, and close distance (3 feet or less) between the officer and the suspect. Although this study represents a preliminary effort at identifying predictors of Taser effectiveness, there are clear training and policy implications for police departments.

Keywords: *police use of force; Taser; less-than-lethal weapons; conducted energy device (CED)*

Conducted energy devices (CEDs)—most notably, the Taser—are being adopted and deployed by police agencies on a broad scale across the United States. Taser International, the leading developer of stun device technology, has sold more than 200,000 weapons to more than 9,000 police agencies in the United States (Davis, 2007). The economic trends are perhaps a better indicator of the enormous growth of the Taser; Taser International's revenue grew from approximately \$2.5 million for fiscal year 1999 to an estimated \$67 million in 2004 (McBride & Tedder, 2005).[1] Despite its increasing popularity among police departments and private consumers, questions have been raised concerning the weapon's use and

effectiveness as well as its potential to cause serious injury or death. The following examples illustrate why this topic has become contentious:

- Use: In fall 2005, police officers in Miami used a Taser on a 6-year-old boy who was cutting himself with a piece of glass and on a 12-year-old truant fleeing police.
- Effectiveness: In December 2005, Nashville, Tennessee, police officers used the Taser 19 times on a combative suspect before they were able to take him into custody (Bottoroff, 2005).
- Physiological impact: Amnesty International issued a report in 2004 describing 74 cases in the United States and Canada where a suspect died after being stunned by a Taser. The organization cites these deaths, recent biomedical research, and news reports of incidents involving the questionable use of Tasers to support a moratorium on their use.

Although a growing body of research has examined the physiological effects of the Taser (Ho, Miner, Lakireddy, Bultman, & Heegaard, 2006; Joint Non-Lethal Weapons Human Effects Center of Excellence, 2005; McDonald, Stratbucker, Nerheim, & Brewer, 2005), sparse empirical research has been conducted on the use and effectiveness of the instrument in a field setting. Consequently, our knowledge is largely limited to reports from the CED industry (e.g., Taser International) and police agencies on one side and documents from human rights groups (e.g., Amnesty International and the American Civil Liberties Union) on the other.[2]

This article seeks to add to the scientific knowledge base in this area through an examination of all Taser incidents involving officers in the New York Police Department (NYPD) from 2002 to 2005 ($N = 375$), with an emphasis on identifying predictors of weapon effectiveness. Specifically, the authors use both logistic regression and chi-square automatic interaction detection (CHAID), a form of segmentation modeling, to identify predictors of Taser effectiveness, measured as both the termination of suspect resistance and officer satisfaction with the weapon. The article concludes with a discussion of implications for the ongoing public discourse regarding the Taser as well as for police policy and practice.

Prior Research

Police and the Use of Force

Police officers have legal authority to use force in a wide range of situations, and the nature of this force can entail using empty-hand force and

less lethal weapons (e.g., baton, pepper spray, or CED), depriving an individual of liberty through arrest, and as a last resort, using a firearm to take an individual's life (Walker & Katz, 2002). Bittner (1970) asserts that the capacity to threaten or use physical force is the core function of the police that defines their role and shapes each contact with a citizen or suspect:

> There can be no doubt that this feature of police work is uppermost in the minds of people who solicit police aid or direct the attention of the police to problems, that persons against whom the police proceed have this feature in mind and conduct themselves accordingly. and that every conceivable police intervention projects the message that force may be, and may have to be, used to achieve a desired objective. (p. 40)

Despite its central role in police work, research indicates that police use of force is statistically rare, occurring in only about 1% of all police–citizen encounters (U.S. Bureau of Justice Statistics, 1999).[3] However, because of the sheer volume of police–citizen encounters in a given year (approximately 43 million), an estimated 421,000 use-of-force incidents occur annually, which translates into about 1,100 incidents per day. Rubinstein (1973) clearly illustrates the intrusive, dehumanizing effect that force can have on a citizen:

> [The patrol officer] may not only circumscribe a person's liberty by stopping him on the street, he may also completely violate the suspect's privacy and autonomy by running his hands over the man's entire body. The policeman knows that a frisk is a humiliation people usually accept from him because he can sustain his authority by almost any action he feels necessary. While he does not frisk people often to just humble them, he can do so; when he feels obliged to check someone for a concealed weapon, he is not usually in a position to request their permission, even if this were desirable. (p. 271; see also Skolnick & Fyfe, 1993, p. 94)

The consequences of police use of force can be severe and long lasting, far exceeding the immediate impact on the individual officer and citizen involved. Fyfe (1988) notes that use-of-force incidents have led to civil disorder and riots, the firing of police executives, millions of dollars in litigation, criminal prosecutions, and strained police–community relations. Recent examples include outbreaks of civil disorder in Cincinnati, Ohio, and St. Petersburg, Florida, in the late 1990s as well as the riots after the acquittal of the Los Angeles Police Department officers involved in the Rodney King incident.

Because of the magnitude of this responsibility delegated to the police and its potential consequences, police officers are mandated to use the minimum force necessary to accomplish their objective; force exceeding this minimum standard is considered excessive (Commission on Accreditation for Law Enforcement Agencies, 1999). Police departments closely monitor use of force and provide policy guidelines to officers typically through a "force continuum," which describes verbal and physical actions an officer can take in response to different levels of suspect resistance and behavior. The use-of-force continuum will usually highlight the minimum and maximum recommended force options available to the individual officer. As the subject's resistance or aggression increases, the officer may use greater degrees of force and is allowed to remain one level above the suspect as the interaction progresses (i.e., an officer may be permitted to use a less lethal weapon, such as pepper spray or a CED, in response to physical resistance by a suspect).

The Development of Less Lethal Alternatives

The role of the police in igniting the riots that marked the 1960s led scholars and police practitioners to reevaluate the force options available to patrol officers in responding to varying levels of suspect resistance. Although discussions regarding less lethal alternatives to the firearm date back to the 1920s, the President's Commission on Law Enforcement and the Administration of Justice (1967) brought the issue to the forefront of the policing agenda when it recommended the development and adoption of less lethal alternatives. During the past several decades, advances in technology have led to the development of a range of new alternatives, such as oleoresin capsicum (OC) spray, impact weapons, foams, ballistic rounds, nets, and most recently, CEDs (Wrobeleski & Hess, 2003). These weapons are intended to provide officers with more alternatives when a situation requires the application of force but has not escalated to the point where lethal force is necessary—thereby adding response options to the use-of-force continuum.

During the 1990s, the adoption of OC or pepper spray became commonplace among police agencies, and this trend was accompanied by a sizeable literature on its use, impact, and effectiveness (Smith & Alpert, 2000). The research on OC spray serves as an important backdrop for the current work on CEDs, because many of the same issues and concerns have been raised. Specifically, controversies surrounding the use of OC spray included its use

against passive resisters, disproportionate use against minorities, and potential health risks (Kaminski, Edwards, & Johnson, 1999). A number of studies have examined the effectiveness of OC spray, indicating relatively high rates of suspect incapacitation, reduced officer injuries, and less reliance on other types of force (Gauvin, 1994; Lumb & Friday, 1997; Nowicki, 1993). Using interrupted time-series analysis, Kaminksi, Edwards, and Johnson (1998) concluded that the adoption of OC spray in Baltimore County reduced the number of assaults on police by 15%. Furthermore, Kaminski et al. (1999) found that the effectiveness of OC spray was mitigated by suspect age, weight, distance, and drug use (but not alcohol).

New Technology Emerges: CEDs

For many police agencies, CEDs are more than just the latest novelty in less lethal alternatives; rather, they are becoming what mace was for police departments in the 1960s—an integral tool used in daily police practice. Advantages of CEDs over other less lethal alternatives—such as pepper spray, bean bag guns, and other soft-impact rounds—include the relatively short duration of their recovery time, their reliability at greater distances, their size and utility, and their perceived effectiveness.[4]

Nonetheless, some police departments have been cautious in adopting this technology on a broad scale, and anecdotal evidence suggests that line officers may be reluctant to use the device routinely because of its dubious public image. The Taser, an acronym for Thomas A. Swift Electric Rifle, "is a conducted energy weapon that fires a cartridge with two small probes that stay connected to the weapon by high-voltage, insulated wire" (Wrobeleski & Hess, 2003, p. 87). The M26 and X26 advanced Taser models introduced by Taser International in 1999 and 2003, respectively, are the two common "new generation" CEDs used by police agencies. These weapons discharge two darts to a distance of 21 feet, delivering a 50,000-volt shock in a 5-second cycle. The electrical charge overrides the central nervous system, resulting in the loss of neuromuscular control, which gives the officer time to gain control of the suspect and apply handcuffs, if necessary.

Questions Surrounding the Taser

The controversy regarding the Taser has occurred in the public domain and has been widely publicized. News reports describing incidents in which police officers used the weapon against the elderly, children, and the mentally ill have made national headlines. Favorable and unfavorable

media images of police practices have been competing for public attention and serve as the backdrop against which the Taser is being assessed by the public and government officials (Lovell, 2003). Currently, empirical research is not driving the debate. This is unsettling, considering that mainstream media depictions of the police are often inaccurate or unrealistic (Ian Ross, 2000; Manning, 1977, 1997). The controversy regarding the Taser came to a head in 2004 when Amnesty International issued its report:

> In its recommendations . . . *Amnesty International* is reiterating its call on federal, state and local authorities and law enforcement agencies to suspend all transfers and use of electro-shock weapons, pending an urgent rigorous, independent and impartial inquiry into their use and effects. (Amnesty International, 2004, p. 3).

The conclusions of the Amnesty International report underscored the controversy and ongoing debate between CED manufacturers and human rights organizations about the expanded use of CEDs among police agencies in the United States. The organizations' concerns focused on fatalities occurring after Taser deployment as well as the potential for abuse by police and its use as a routine force option. CED manufacturers argue, however, that the device is a safe alternative to other less lethal weapons that reduces injuries to officers and suspects. More generally, concerns about CEDs have emerged in three critical areas. Each is discussed below.

When is it appropriate to use the device? No consensus exists among police agencies regarding where the Taser should be placed on the force continuum (U.S. Government Accountability Office, 2005). Should CEDs be placed at the same level as pepper spray, or are they more appropriate farther down the use-of-force continuum as a last alternative to the firearm? Should they be used against suspects who are passively resisting an officer (e.g., ignoring verbal commands) or only against individuals who are actively resisting arrest? Is there any justification for using the Taser against a minor, a senior citizen, or a pregnant woman? Police departments have varied considerably in their responses to these questions, and both the International Association of Chiefs of Police (IACP; 2005) and the Police Executive Research Forum (PERF; 2005) have taken action recently by developing training guidelines and model policies to offer guidance to agencies in their deployment of CEDs. For example, both the IACP and PERF suggest that CEDs only be used against those who are actively resisting, that they not be used against children or the elderly except

in emergency situations, and that each deployment is closely supervised and documented.

Does it work effectively? Since January 2000, *The New York Times* has printed nearly 200 news stories describing incidents in which officers across the United States have used the Taser to control or subdue a suspect. A review of these articles reveals an abundance of cases in which the Taser appears not to have the intended physiological effect on a suspect. In some cases, one or both of the prongs missed the target, or the prongs hit the target but failed to penetrate the suspect's clothing. To date, much of the academic research on the effectiveness of CEDs has relied on field reports completed by officers after deploying the weapon, which measure whether the CED functioned properly, enabling the officer to incapacitate or arrest the subject. Field data analyzed by Taser International (2006) and internal evaluations conducted by police agencies (see, e.g., Seattle Police Department, 2004) place the effectiveness rate of the Taser somewhere between 80% and 94%, but there is sparse independent empirical research studying the effectiveness of the device. White and Ready (2007) calculated an effectiveness rating by examining the impact of the Taser on suspect resistance. They found that use of the weapon caused suspects to stop resisting in 86% of all Taser deployments by the study department.

Several police agencies that have implemented CEDs on a broad scale have later reported reductions in injuries sustained during police–citizen contacts. Police departments in Austin, Texas; Putnam County, Florida; and Cincinnati, Ohio, experienced reductions in injuries to both suspects and officers after adopting the Taser (see Putnam County Sheriff's Office, 2005; Taser International, 2006). Although these trends are noteworthy, questions remain concerning the extent to which the Taser contributed to these reductions. Retrospective analysis of injury trends may not account for other variables (e.g., more training, crime trends, new leadership, etc.) that influence yearly injuries sustained during police–citizen encounters. At present, there are no national-level baseline data concerning the number of police agencies that have reported reductions in injuries after adopting the Taser as compared to the number of agencies that have not reported reductions. The degree to which the device is used effectively depends less on the physiological effects of the technology than on the policy guidelines and field training that departments apply to reinforce accepted standards of use.

Proponents in the law enforcement community claim that the Taser can serve as a substitute for lethal force and other forms of less lethal force (e.g., baton) that may result in serious injury or death (Heck, 2003;

McBride & Tedder, 2005; U.S. Bureau of Justice Statistics, 1999). This is an empirical question that has not been tested, and any practical benefits must be balanced against the potentially harmful physiological effects of the device.

What is its impact on the likelihood of serious injury or death to a suspect? As noted earlier, Amnesty International called for a moratorium on police use of the Taser in late 2004, citing 74 deaths that occurred in North America following deployment of the weapon. Although there is no evidence of a direct causal link between use of the Taser and elevated risk of serious injury or death, a review of the Amnesty International report suggests that the risk of death may be greater for those with preexisting medical conditions (particularly heart conditions) as well as those under the influence of drugs or alcohol. Recent studies supported by the federal government have tested the physiological effects of CEDs on healthy adult volunteers (a sample that may be very different than suspects targeted by police officers) and have concluded that no decisive evidence of ventricular fibrillation or other serious medical side effects exists (Ho et al., 2006; Joint Non-Lethal Weapons Human Effects Center of Excellence, 2005; McDonald et al., 2005). The Canadian Police Research Centre (2005) conducted an exhaustive review of existing research and concluded that "definitive research or evidence does not exist that implicates a causal relationship between the use of CEDs and death" (p. ii).

In sum, despite the growing popularity of CEDs in American policing, researchers have failed to keep pace with the diffusion of this rapidly spreading technology. A developing body of scientific research has begun to address the research question relating to the potential for the Taser to cause serious injury or death, but the questions concerning when it is appropriate to deploy the weapon (and against whom) and its degree of effectiveness remain largely unanswered. Guidelines outlined by PERF and IACP have played a critical role in clarifying some of the important issues for police administrators. This article seeks to inform the use and effectiveness dialogue by shifting the emphasis toward prediction; that is, under what circumstances and against what types of suspect behavior is the Taser most likely to be effective? In other words, what are the characteristics of police officers and suspects and incident-related circumstances that increase or reduce the odds that police use of the CED will result in a successful resolution?

Method

NYPD and the Taser

This article examines all Taser incidents involving police officers from the NYPD from January 2002 through December 2005 ($N = 375$). The NYPD is cautious in its approach to the deployment of Tasers, and its use is closely monitored. The Taser is issued only to officers in the Emergency Service Unit (ESU). The ESU is responsible for situations that require advanced equipment and expertise, such as crisis situations involving the mentally ill, hostages, and suicidal suspects. The unit consists of several hundred officers, which is a relatively small proportion of the 35,000 sworn NYPD officers. Also, supervisors at the rank of sergeant and above are trained to use the Taser, and each precinct is equipped with one or more devices that can be signed out, though they are not required to carry it. The patrol guide details fairly specific circumstances in which it is appropriate to use the device:

> Patrol supervisors or uniformed members of the service assigned to the Emergency Services Unit may utilize a Taser/electronic stun device to assist in restraining emotionally disturbed persons if necessary. The Taser/electronic stun device may be used:
>
> a. To restrain an EDP [emotionally disturbed person] who is evincing behavior that might result in physical injury to himself or others, OR
> b. To restrain person(s) who, through the use of drugs, alcohol, or other mind-altering substances, are evincing behavior that might result in physical injury to himself or others.
>
> Emergency Service Unit personnel will obtain the permission of the Emergency Service Unit Supervisor prior to utilizing a Taser/electronic stun device, except in emergencies. (NYPD, 2000)

As a result, deployment of the Taser is allowed only in situations involving an EDP or person under the influence of drugs or alcohol who is posing a threat of physical injury where either ESU officers are dispatched or a supervisor is present and has a Taser in his or her possession.[5]

The data analyzed for the current study are derived from a "Taser/stun device report," which is completed every time an officer deploys the weapon.[6] The report contains a series of questions that use check boxes to elicit a range of information about demographic characteristics of the suspect, his or her emotional and physical state, behavior and level of resistance,

weapons present, the rank and assignment of the officer, and characteristics of Taser deployment (e.g., distance, effect, etc.). Most items on the report are formatted as multiple-choice questions, with an additional narrative section where the officer is required to describe the incident in detail. From these reports, the authors created a data set in SPSS that captures 40 variables relating to each Taser incident. These independent variables serve as predictors of Taser effectiveness for the multivariate analysis. Though the research was admittedly limited by the information collected on the Taser/stun device report, the authors note the earlier work conducted by Kaminski et al. (1999), which employed a similar design and analysis, with similar variables, for an evaluation of the effectiveness of OC spray.

The Dependent Variable: Measuring Effectiveness

The dependent variables used in the study include three separate but related measures of effectiveness. The first two measures of effectiveness are based on the extent of suspect resistance. Specifically, the field report contains several items that measure whether suspect resistance ended after the Taser was deployed and notes how much time transpired (in seconds) before the suspect was incapacitated. A follow-up item requires the responding officer to indicate whether the suspect was incapacitated at all. The average time to incapacitation was 8.10 seconds, but this measure should be viewed with caution. It is likely that officers at the scene were far more concerned about bringing the suspect under physical control than counting the number of seconds needed to terminate the struggle and apply handcuffs. For this reason, we will focus on the dichotomous measures of resistance for the analysis.

In one third of the cases (33.0%), the suspect continued resisting against the officer after the Taser was deployed. The cases involving continued resistance can be divided into two categories based on the nature and duration of the resistance. In 32 cases, the resistance continued immediately following the Taser deployment because the suspect was not restrained by the weapon; that is, at no point was the subject subdued, and he or she continued to resist (*continual resistance*). The Taser was clearly ineffective during these incidents, perhaps because of loose or heavy clothing blocking the darts from making full contact, mechanical failure, or resilience on the part of the suspect. In the other 65 cases involving continued resistance, the subject was initially incapacitated by the Taser and the officer(s) gained control temporarily; however, the suspect began resisting again at a subsequent

point in time (*any resistance*). The distinction between these two different outcomes draws attention to the temporary impact of the Taser (i.e., the involuntary loss of muscle control is not long term) and shows the importance of carefully observing the suspect's actions immediately after the Taser is deployed. Because of the practical importance of this distinction in resistance, both measures are used as dependent variables in the analysis. The base rates for any subsequent resistance and continual resistance are 33.0% and 10.9%, respectively.[7]

At the end of the Taser/stun device report, the officer is instructed to indicate whether the device performed satisfactorily (yes or no). Police officers' responses to this question serve as the third measure of Taser effectiveness. Officers reported that the Taser performed satisfactorily during 78.7% of the cases. Officer satisfaction is likely related to a host of factors, including the physiological effect on the suspect and the outcome of the deployment taken as a whole. Did the Taser discharge as intended? Did both prongs strike the target, and if so, did they penetrate the suspects' clothing? Did the suspect stop resisting the officer and was he or she subsequently taken into custody? Finally, was anyone seriously injured during the altercation?

Data Analysis

The authors employed two analytic approaches, logistic regression and CHAID (a form of segmentation modeling), to identify predictors of Taser effectiveness. Descriptive analyses were conducted to identify significant relationships at the bivariate level. The bivariate findings, theory, and practical expectations directed the identification of predictors for the multivariate analysis, though all variables were included in the multivariate analysis. Logistic regression is employed because all three measures of effectiveness are dichotomous outcomes with yes-or-no responses. Similar to logistic regression, CHAID predicts the probability of an event's occurring, but the method relies on different assumptions and properties and uses segmentation modeling to accomplish the task. CHAID divides a population into "increasingly homogenous" segments that differ on the basis of the dependent variable; in this case, suspect resistance and officer satisfaction (Jones, Harris, Fader, & Grubstein, 2001, p. 490). The resulting segments are mutually exclusive and exhaustive, and as the analysis proceeds, the best predictor is selected among a particular subgroup of cases based on chi-square analysis.

CHAID analysis is employed in this study because it offers a number of advantages. First, "one significant advantage of this approach is that the model can find different combinations of predictors for different subsets of the population" (Jones et al., 2001, p. 490). This is especially useful if there is reason to suspect that predictors may differ in their impact among subgroups. For example, predictors of suspect resistance may be different for intoxicated and sober suspects, and CHAID facilitates the identification and exploration of these interactions. Second, Jones et al. (2001) point out that numerous studies have examined statistical issues in risk prediction (Gottfredson, 1987; Simon, 1971; Tarling & Perry, 1985), including the use of CHAID and more traditional methods such as logistic regression, and the general consensus is that "no method is consistently better than any other" (Tarling & Perry, 1985, p. 212). With this conclusion in mind, multiple methods allow researchers to either "triangulate" their findings or identify inconsistencies across techniques. Last, an additional benefit of CHAID is the user-friendly visual representation of variables that interact to produce an outcome; in this case, the technique highlights the important situational dynamics of Taser incidents—and how those dynamics relate to outcomes—in a more interpretable manner for practitioners and policy makers.

Limitations and Considerations

Several limitations of this study should be considered. First, the article examines official reports from one police department that has deployed the Taser in a controlled, limited manner. This impairs the generalizability of the findings to other police departments, particularly, those agencies that have issued the Taser to all patrol officers.[8] Second, this study examines only Taser incidents that generated an official police report. There is no indication that officers are not completing the Taser field report on a systematic basis, especially considering that the device tracks each deployment electronically; however, it is possible that some incidents did not result in a report. Third, anecdotal evidence provides some support for a deterrent effect when the Taser is exposed to a potential subject but not used; that is, much like the firearm, suspects may become compliant when confronted with the imminent possibility of being stunned with the Taser. Researchers and police practitioners would consider this type of incident as a successful de-escalation, but these situations are not captured in the data because the NYPD requires a field report after discharge only.

Results

Descriptive Analysis of Taser Incidents

Suspect characteristics. Suspects targeted in the Taser incidents were primarily male (88.8%) with a mean age of 34.9; more than half were African American (52.1%), 18.7% were White, and 27.3% were Hispanic (see Table 1). Most of the suspects did not appear under the influence of drugs or alcohol (87.2%), but the majority exhibited signs of mental illness (92.5%) and were therefore identified by the responding officers as EDPs.[9] About 40% of the subjects were armed with a weapon (39.6%), most commonly, a kitchen knife or cutting instrument (84% of armed suspects, 32% of all cases).[10] The vast majority of suspects (95%) engaged in physical violence. The violent behavior was directed at an officer during more than half of the incidents (53.3%), one fifth involved a threat of suicide or self-harm (18.6%), and the remaining violent individuals (18.9%) directed their aggression toward multiple individuals at the scene.

Officer characteristics. The Taser/stun device report captures limited information regarding the officer who deploys the weapon. More than half of the officers who used the device were detectives (55.5%), and 41.2% were patrol officers. Just 3.2% were supervisors. More than 90% of the officers were assigned to the ESU. In the majority of cases, the officer deploying the Taser was not alone. One or more back-up officers were present during nearly all of the incidents (93.5%), and a supervisor was present in 88.1% of the cases.[11]

At the bivariate level, there are notable differences in officer rank with regard to the outcomes of interest: satisfaction and suspect resistance. During the study period, 12 cases involved supervisors who were not assigned to the ESU (i.e., patrol sergeants). The effectiveness ratings from these supervisors are significantly lower than the ratings from the ESU officers: Any suspect resistance was reported by 54.5% of the supervisors, compared to 26.7% of police officers and 36.3% of detectives; 20.0% of the supervisors reported resistance immediately after the Taser was used, compared to 7.6% of police officers and 12.0% of detectives; and 41.7% of the supervisors reported being satisfied with the Taser, compared to 81.7% of police officers and 79.4% of detectives.[12] These findings may have implications for the NYPD, because supervisors outside of the ESU receive less training in use of the Taser and may also be using an older model of the device.

Table 1
Characteristics of Suspects and Officers Involved in Taser Deployments

	Percentage	*n*
Suspect characteristics		
Gender		
Male	88.8	332
Female	11.2	42
Total	100.0	374
Racial background		
African American	52.1	189
White	18.7	68
Hispanic	27.3	99
Asian or Other	1.9	7
Total	100.0	363
Mean age = 34.9 years		332
Emotionally disturbed		
No	7.5	28
Yes	92.5	347
Total	100.0	375
Intoxicated		
No	87.2	321
Drugs	7.1	26
Alcohol	4.3	16
Both drugs and alcohol	1.4	5
Total	100.0	368
Armed with a weapon		
No	60.4	217
Yes	39.6	142
Total	100.0	359
Violent behavior		
No	5.2	19
Toward self	18.6	68
Toward officer	53.3	195
Toward other citizens	4.1	15
Toward multiple	18.9	69
Total	100.0	366
Officer characteristics		
Rank		
Patrol officer	41.2	153
Detective	55.5	206
Supervisor	3.2	12
Total	100.0	371
Command		
Emergency Service Unit	91.2	321
Other	8.8	31
Total	100.0	352
Back-up present		
No	6.5	22
Yes	93.5	318
Total	100.0	340
Supervisor Present		
No	11.9	42
Yes	88.1	310
Total	100.0	352

Note: Total numbers are different because of missing data. In some of the study cases, information for one or more variables was missing, and the tables reflect known information only.

Incident characteristics. More than three quarters of the incidents occurred indoors (see Table 2). Per department policy, the majority of suspects (95.6%) were transported to a hospital for a physical examination following the incident. Interestingly, three quarters of the subjects (75.9%) were not arrested after the incident, although many of them were held at the hospital for psychological examination and/or civil commitment. The average distance between the officer and the suspect at the time of deployment is approximately 5.5 feet. In 80.7% of the incidents, the Taser was deployed only once by the officer, and in nearly 80% of the cases, both darts made contact with the suspect as intended. Officers used the device in stun mode in 48 incidents (direct contact to skin, no darts).[13] In 22% of the cases, officers also used another nonlethal device, most typically another type of stun device (14%) or pepper spray (5%). In 86% of the cases, a supervisor indicated that use of the Taser was consistent with departmental policy.[14] Findings with regard to officer satisfaction and suspect resistance—the dependent variables for the multivariate analysis—have been summarized above.

Multivariate Analysis

Logistic regression analysis. Table 3 displays the results of the logistic regression models predicting the three measures of Taser effectiveness. The table provides the logistic regression coefficients, standard errors, and odds ratios for the independent variables in each of the models. The likelihood ratio test for each of the models was statistically significant, and Nagelkerke R^2 estimates suggest that the models predicting any subsequent suspect resistance, resistance immediately after use of the Taser, and officer satisfaction accounted for 23%, 13%, and 21% of the explained variation, respectively.[15] In the first model, statistically significant predictors of any suspect resistance include the following:

- The suspect's body weight is greater than 200 pounds.
- Distance between the officer and the suspect is 3 feet or less.
- The suspect is under the influence of drugs or alcohol.
- The suspect directs violence toward an officer or citizen (as opposed to oneself).
- One or both Taser darts missed the intended target.
- The officer used another nonlethal device before or after using the Taser.[16]

Specifically, when one or both Taser darts miss the suspect, the likelihood of any suspect resistance increases by about 300%. Three predictors—violence directed at an officer or citizen, drug or alcohol intoxication, and

Table 2
Characteristics of Incidents Resulting in Taser Deployments

Incident Characteristic	Percentage	*n*
Location		
Indoors	77.5	286
Outdoors	22.5	83
Total	100.0	369
Suspect arrested		
No	75.9	274
Yes	24.1	87
Total	100.0	361
Suspect transported to hospital		
No	4.4	16
Yes	95.6	346
Total	100.0	362
Number of Taser deployments		
One	80.7	284
More than one	19.3	68
Total	100.0	352
Mean distance between officer and suspect = 5.41 feet		
Darts on target		
Both darts on target	77.7	240
One dart missed	4.5	14
Both darts missed	1.6	5
Darts made contact but fell from clothing	0.6	2
Device used in stun mode	15.5	48
Total	100.0	309
Was suspect incapacitated?		
No	13.2	42
Yes	86.8	277
Total	100.0	319
Mean time to incapacitation = 8.10 seconds		
Did suspect continue to resist?		
No	67.0	235
Yes	33.0	116
Total	100.0	351
Officer satisfied with Taser?		
No	21.3	74
Yes	78.7	273
Total	100.0	347

Note: Total numbers are different because of missing data. In some of the study cases, information for one or more variables was missing, and the tables reflect known information only.

police use of another less lethal weapon—more than double the odds of the occurrence of any suspect resistance during Taser incidents. In addition, suspects who weigh more than 200 pounds are about 84% more likely to resist the officer after the Taser is deployed.

Significant predictors of resistance occurring immediately after deployment of the Taser include the following:

- The suspect's body weight is greater than 200 pounds.
- The suspect is under the influence of drugs or alcohol.
- One or both Taser darts missed the intended target.

Findings for the second model are similar to the model predicting any suspect resistance. Continual resistance immediately after the Taser is deployed is most likely to occur in circumstances where the Taser darts miss a large suspect who is intoxicated.

Results from the model predicting officer satisfaction indicate that the following independent variables are statistically significant:

- The suspect's body weight is 200 pounds or less.
- Distance between the officer and the suspect is greater than 3 feet.
- The suspect is armed with a knife or gun.
- Both Taser darts struck the intended target.[17]

Interestingly, the strongest predictor of officer satisfaction with the Taser is the suspect's being armed with a knife or gun. When the suspect is armed with a weapon, the likelihood of police's reporting that they are satisfied with the Taser is about 200% greater. A possible explanation may be that the likelihood that harmful consequences will occur when the Taser does not work properly is greater when the suspect is armed with a knife or gun; therefore, the sense of relief experienced when the device does perform properly in these volatile situations affects the officer's reporting of satisfaction. The distance between the officer and the suspect during the Taser deployment is also positively associated with officer satisfaction with the device.

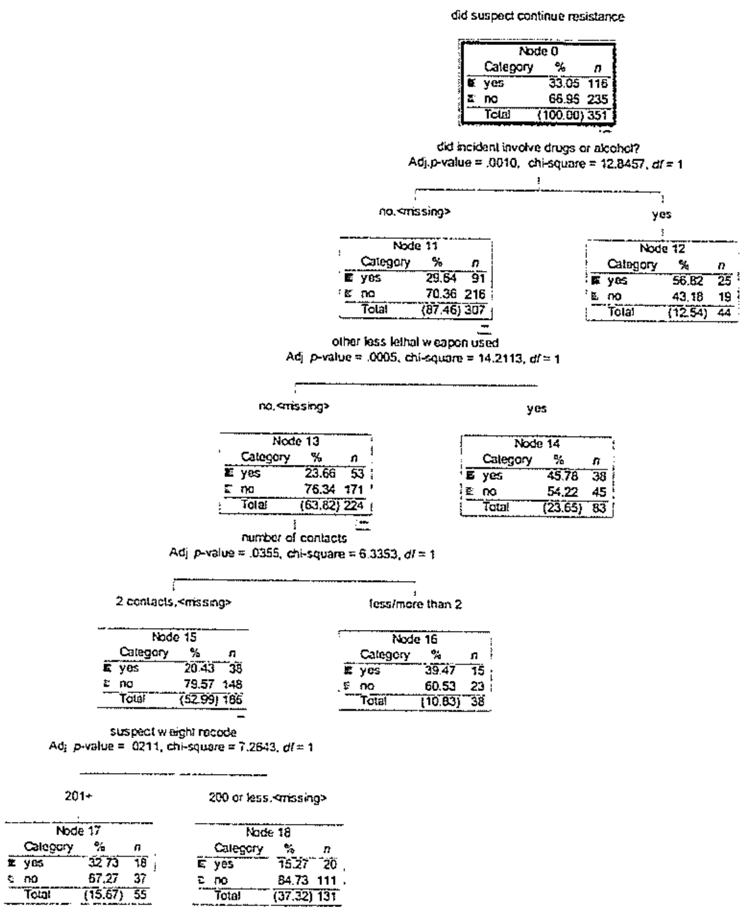
CHAID analysis. Figures 1 to 3 show the results of the CHAID analysis, which uses the same set of variables to predict Taser effectiveness. In Figure 1, the top cell (or root node) in the CHAID tree reflects 33.05% of the cases where any suspect resistance occurred. The initial split was made on the basis of whether the suspect was under the influence of drugs or alcohol, thus separating the 375 Taser cases into two cells: those where the

Table 3
Logistic Regression Predicting Three Measures of Taser Effectiveness

Predictor Variables	*B*	*SE*	Wald	Odds Ratio	*p* Value
Any suspect resistance					
Suspect weight	0.612	.302	4.114	1.844	.043
Distance	−0.667	.306	4.735	0.513	.030
Suspect intoxicated	0.954	.410	5.418	2.596	.020
Suspect violent toward others	0.884	.373	5.617	2.421	.018
One or both prongs miss target	1.393	.531	6.887	4.028	.009
Other less lethal weapon used	1.057	.312	11.445	2.877	.001
Log likelihood	285.065				
R^2 (Nagelkerke)	.227				
Chi-square	46.051				
df	6				
Significance	.000				
n	255				
Resistance immediately after deployment					
Suspect weight	0.882	.416	4.484	2.415	.034
Suspect intoxicated	1.285	.486	6.982	3.614	.008
One or both prongs miss target	1.744	.569	9.379	5.717	.002
Log likelihood	164.691				
R^2 (Nagelkerke)	.130				
Chi-square	17.634				
df	3				
Significance	.001				
n	262				
Officer satisfaction					
Suspect weight	−0.904	.338	7.133	0.405	.008
Distance	0.928	.337	7.586	2.528	.006
Suspect armed with gun or knife	1.111	.422	6.945	3.037	.008
One or both prongs miss target	−2.193	.578	14.408	0.112	.000
Log likelihood	229.067				
R^2 (Nagelkerke)	.213				
Chi-square	37.268				
df	4				
Significance	.000				
n	246				

suspect was not intoxicated (n = 307; 87.46% of the total) and those where the suspect was intoxicated (n = 44; 12.54% of the total). The splits in CHAID are made according to differences in the dependent variable (i.e., any suspect resistance): Of suspects who were intoxicated, 56.8% continued to resist, compared to 29.6% of suspects who were not intoxicated. An additional split was made from the *not intoxicated* cell and is based on

Figure 1
CHAID Analysis Predicting Any Suspect Resistance



Note: CHAID = chi-square automatic interaction detection.

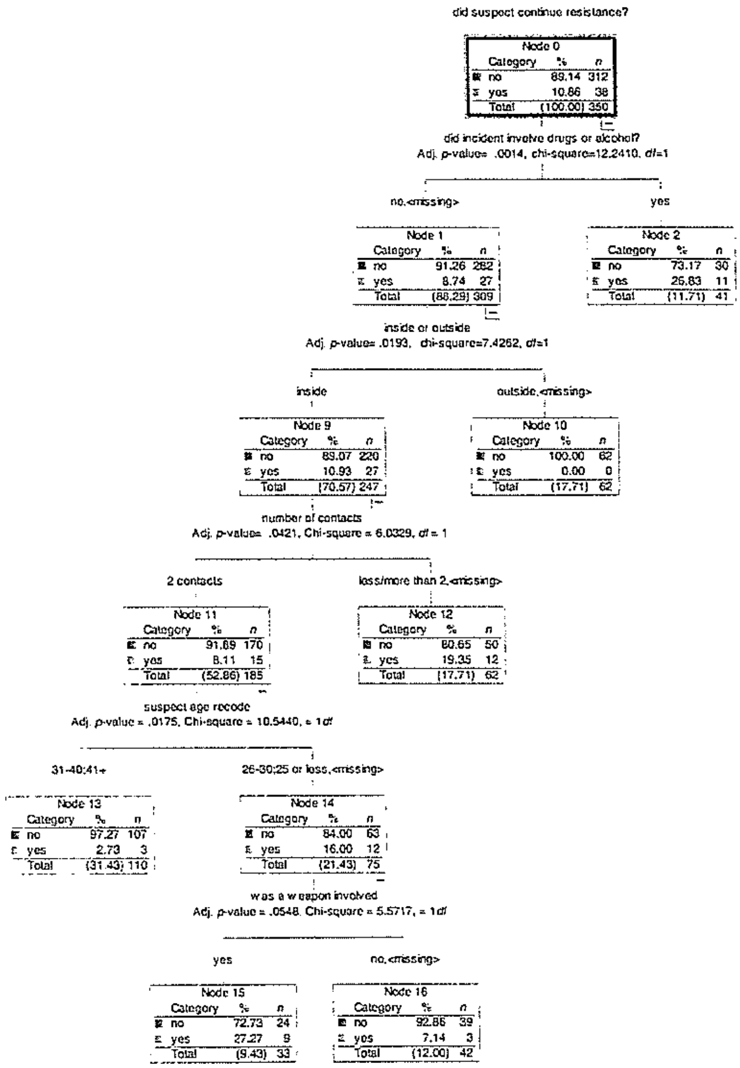
whether police used another less lethal weapon: Suspect resistance occurred in 45.8% of cases where another less lethal weapon was used in addition to the Taser, compared to 23.7% of cases where only the Taser was used. The next split was made from the cell indicating that no other less lethal weapon

was used except the Taser. This split is based on the number of darts that made contact with the suspect: Subjects who were not intoxicated during the encounter, where no other less lethal weapon was used except the Taser, continued to resist during 20.4% of the cases where two darts made contact, compared to 39.5% of the cases where fewer or more than two contacts were made.[18] The final split is made from the cell indicating that two darts made contact and is based on suspect body weight: Suspects in cases where both darts made contact, where no other less lethal weapon was used except the Taser, and where the suspect was not intoxicated were more likely to continue to resist if they weighed more than 200 pounds (32.7% compared to 15.3% for those who weighed 200 pounds or less). Table 4 summarizes the termination cells for the CHAID tree predicting any suspect resistance, which includes the predictors, cell size, percentage of the total cases, and percentage of the dependent variable: any suspect resistance.

Figure 2 displays the CHAID tree predicting continual resistance, and the top cell represents 10.9% of the cases where suspect resistance occurred immediately after the deployment. The initial split is based on the use of drugs or alcohol, as it was for the first CHAID tree: Intoxicated suspects continued to resist immediately after the Taser was deployed in 26.8% of the cases, compared to 8.7% of the cases in which the suspect was not intoxicated. Several additional splits flow from the cell indicating that the suspect was not intoxicated. The next split is based on whether the Taser incident occurred indoors or outside (10.9% suspect resistance inside compared to 0.0% resistance outside). From the cell indicating that the incident occurred indoors, the next split is based on whether the two darts made contact or not (8.1% resistance compared to 19.4%). From the "two contacts" cell, the split is based on whether the suspect was 30 years old or younger (16.0% resistance) as opposed to 31 years old or older (2.7% resistance). The final split flows from the *30 years old or younger* cell and is based on whether the suspect was armed with a weapon (27.3% resistance) or not (7.1% resistance). Termination cell summaries are again shown in Table 4.

Figure 3 shows the CHAID tree for the last measure of effectiveness: officer satisfaction. An initial split is based on the number of darts that made contact—two darts, or fewer or more—with greater officer satisfaction when two darts made contact (83.7% vs. 66.3%). The next split, made from the *two contacts* cell, is based on the distance between the police officer and the suspect. Officer satisfaction is greater when the officers are 4 feet or more away from the target: In this category, 86.7% of the officers reported being satisfied, compared to 72.0% for the officers who were 3 feet away or closer (see Table 4 for summary).

Figure 2
CHAID Analysis Predicting Resistance Immediately After Deployment



Note: CHAID = chi-square automatic interaction detection.

Table 4
Summary of CHAID End Groups

	n	% of Total	% of Suspect Resistance
Any suspect resistance			
Suspect intoxicated	44	12.54	56.82
Suspect not intoxicated (or missing); other less lethal weapon used	83	23.65	45.78
Suspect not intoxicated (or missing); no other less lethal weapon used (or missing); not two contacts	38	10.83	39.47
Suspect not intoxicated (or missing); no other less lethal weapon used (or missing); two contacts (or missing); suspect weighs 201+ pounds	55	15.67	32.73
Suspect not intoxicated (or missing); no other less lethal weapon used (or missing); two contacts (or missing); suspect weighs 200 pounds or less (or missing)	131	37.32	15.27
Total	351	100.00	
Resistance immediately after deployment			
Suspect not intoxicated (or missing); occurred inside; two contacts; suspect 30 or younger (or missing); suspect has weapon	33	9.43	27.27
Suspect intoxicated	41	11.71	26.83
Suspect not intoxicated (or missing); occurred inside; not two contacts (or missing)	62	17.71	19.35
Suspect not intoxicated (or missing); occurred inside; two contacts; suspect 30 or younger (or missing); suspect has no weapon (or missing)	42	12.00	7.14
Suspect not intoxicated (or missing); occurred inside; two contacts; suspect 31 or older	110	31.43	2.73
Suspect not intoxicated (or missing); occurred outside (or missing)	62	17.71	0.00
Total	350	100.00	
Officer satisfaction			
Two contacts; distance 4 feet or more (or missing)	196	56.48	86.73
Two contacts; distance 3 feet or less	50	14.41	72.00
Not two contacts (or missing)	101	29.11	66.34
Total	347	100.00	

Note: CHAID = chi-square automatic interaction detection analysis.

profound implications for police administrators who are responsible for upholding use-of-force standards. This article seeks to contribute to the dialogue on CEDs by identifying predictors of Taser effectiveness.

Findings from the descriptive analysis suggest consistency across the types of incidents (and suspects) in which officers in the NYPD deploy the Taser.

- Most suspects were male, African American or Hispanic, and in their 30s.
- Few suspects were under the influence of alcohol or drugs, but nearly all were identified as exhibiting signs of mental illness.[19]
- Nearly all suspects engaged in violent behavior.
- Just fewer than half of suspects were armed, and among armed suspects, the majority possessed a knife or cutting instrument.
- Nearly all the officers using the Taser in the NYPD were assigned to the ESU.
- Back-up officers and supervisors were present in almost all cases.
- A large majority of suspects were incapacitated by the Taser after the first deployment, and most were incapacitated within 5 seconds.
- Most of the subjects were not arrested on criminal charges, although nearly all were transported to a hospital for physical and/or psychological evaluation.

Findings from the multivariate analyses, both logistic regression and CHAID, are remarkably consistent in predicting the three effectiveness measures:

Any suspect resistance (a measure of ineffectiveness)

- Suspect body weight was over 200 pounds (logistic and CHAID).
- Suspect was intoxicated (logistic and CHAID).
- One or both Taser darts missed the intended target (logistic and CHAID).
- Officer used another less lethal weapon (logistic and CHAID).
- Distance between the officer and the suspect was 3 feet or less (logistic).
- Suspect directed violence toward an officer or citizen (logistic).

Resistance occurring immediately after Taser use (a measure of ineffectiveness)

- Suspect was intoxicated (logistic and CHAID).
- One or both Taser darts missed the intended target (logistic and CHAID).
- Suspect body weight was more than 200 pounds (logistic).
- For a subset of cases, incident occurred indoors, suspect was 30 years old or younger, and suspect was armed (CHAID).

Officer satisfaction (a measure of effectiveness)

- Suspect and officer were more than 3 feet apart (logistic and CHAID).
- Both Taser darts struck the intended target (logistic and CHAID).
- Suspect body weight was 200 pounds or less (logistic).
- Suspect was armed with a gun or knife (logistic).

Three important findings emerge from the analysis. First, the analysis suggests that Taser effectiveness can be modeled using multivariate techniques, as several suspect- and incident-related variables are associated with a greater or lesser likelihood of effectiveness. Considering the paucity of research examining use and effectiveness of the Taser, this finding alone is important. Second, a number of variables were noticeably absent from the statistically significant predictors of Taser effectiveness identified in the multivariate analysis. For example, the race and gender of the suspects were unrelated to any of the three measures of effectiveness. Importantly, whether the suspect was classified as "emotionally disturbed" was also unrelated to Taser effectiveness. Note that only 28 cases did not involve a suspect classified as an EDP, so caution should be used in generalizing to this subgroup. The findings relating to EDPs are particularly important, however, because anecdotal evidence made available by the news media and interest groups suggests that the mentally ill may be more likely to continue to resist the police and to experience serious injury or death when stunned by the Taser. The results of this study indicate that the suspects' mental health at the time of the incident did not affect the effectiveness of the Taser. Additionally, the authors reviewed all news reports ($N = 192$) of Taser incidents printed in *The New York Times* during the study period to become more familiar with the qualitative aspects of the incidents and found evidence of only one case where NYPD deployment of the Taser resulted in the death of an emotionally disturbed suspect.[20]

The third important research finding relates to the variables that were identified as significant predictors in the multivariate analyses, including suspect intoxication, body weight, violence directed at an officer or citizen, and distance between the officer and the suspect. A relatively small proportion of the Taser cases involved an intoxicated suspect—13%, or 46 incidents—but effectiveness dropped significantly for those cases: Intoxicated suspects were twice as likely to exhibit any resistance during the encounter (57% compared to 30%, respectively), they were about 3 times as likely to resist immediately after police deployed the Taser (27% compared to 9%, respectively), and intoxication was associated with lower officer-reported satisfaction with the Taser (67% compared to 80%, respectively).[21] Although the reason for this finding is not clear, one possible explanation relates to

the effect of drugs and alcohol on the suspect's ability to reason and process information. The intoxicated suspects may be less capable of thinking rationally during the police–citizen encounter and therefore less inclined to comply with the officer's instructions after the effects of the Taser wear off. This finding clearly warrants attention from police researchers and practitioners. If it is replicated in other police jurisdictions, with other suspect samples, there are clear policy and training implications. Police field training can highlight the increased likelihood of continued resistance among intoxicated suspects and provide officers with a clear set of guidelines to anticipate and curtail resistance to prevent violence escalation and serious injuries.

The emergence of suspect body weight as a predictor of Taser effectiveness is both interesting and puzzling. Evidence that the weapon is less effective against heavier individuals is not apparent from the CED industry reports or the growing clinical research. This study finds suspect weight—with a cutoff at 200 pounds—a significant predictor of both resistance measures and officer satisfaction. Depending on the degree to which body weight moderates the effects of the Taser, there are implications for Taser use and for police policy and training. Police officers may need to prepare for the greater likelihood of resistance immediately after using the weapon on particularly tall or heavy suspects. Policy should offer guidance on subsequent responses, which may include additional Taser deployments or alternative less lethal weapons. Given the potential relationship between multiple Taser deployments and elevated risk of serious injury or death, police departments may need to craft their policies carefully. Moreover, researchers should consider investigating the potential for an interaction effect between body weight and intoxication. For example, 18 cases in the study data involve an intoxicated suspect who weighs more than 200 pounds, of whom 13 (72%) continued to resist the officer after being stunned with a Taser. This is clearly an important issue that requires further investigation.

Two other suspect-related variables were significant in the multivariate analysis: violent behavior directed at an officer or another person and whether the subject was armed with a weapon. Suspects who were suicidal, engaged in self-harm, or threatened self-harm were less likely to continue resisting after being stunned with the Taser, compared to those who were acting violently toward an officer or citizen. The implications for police are straightforward: Suspects who direct their violence toward others—most notably, the police officer—represent the greatest risk of a physical struggle after being stunned with the Taser, and therefore, officers should remain especially vigilant when using the Taser on subjects that fit this description.

The association between armed suspects and measures of effectiveness indicates that police use of the Taser is most effective in those situations where the potential for serious injury or death is highest. Further research is needed to substantiate this finding, but there are a number of potential explanations:

- High-risk situations could be fundamentally different in ways that affect officer satisfaction.
- The actual physiological effects of the Taser may be different (e.g., more effective) in these types of encounters.
- Police officer performance during and after Taser use may be different in high-risk encounters (e.g., quicker reaction times, better handcuffing, etc.).

Several incident-related characteristics are also associated with the effectiveness measures, notably, distance from the intended target, police use of another less lethal device in addition to the Taser, and the number of darts that make contact with the suspect. The importance of the number of darts that strike the subject and police use of other less lethal weapons is clear. For the Taser to deliver the current, both darts must strike the suspect, penetrate the clothing, and attach to the skin. If this does not occur, the device will not work as intended, and consequently, resistance will be more likely to continue. Although the field report does not specify the order in which multiple weapons are used, the fact that more than one weapon is used implies that one or more instruments were ineffective in curtailing resistance.

The significance of the distance from the suspect as a predictor of effectiveness has both training and policy implications. Taser International offers cartridges with maximum ranges of 15 feet, 21 feet, 25 feet, and even 35 feet. The study findings suggest that the Taser is less effective when used at close range—within 3 feet or less of the target. (Note that distance remained significant when controlling for use of the device in stun mode, i.e., direct contact to the suspect's skin.) The reasons for this are unclear, although use at close range may increase the likelihood that suspect movement could affect the accuracy of the weapon, the suspect could grasp or bump into the weapon at time of discharge, or the darts may not spread out sufficiently to deliver the optimal current. Police agencies may want to consult with each other or the CED manufacturer to determine if this short-range problem has emerged elsewhere. Regardless, maintaining a safe distance whenever possible is of central importance; in fact, the NYPD (2000) patrol guide states that officers should maintain a "zone of safety" of 20 feet and call ESU when

responding to EDPs. Findings from this study suggest that the "safe-distance" principle should be reinforced for ESU as well, particularly when there is reasonable suspicion that a Taser may be deployed.

Conclusion

This article sought to address questions about the use and effectiveness of CEDs by examining all Taser deployments by the NYPD from 2002 to 2005 (N = 375). The authors employ both logistic regression and CHAID analysis to identify predictors of Taser effectiveness, measured as the extent of suspect resistance and officer satisfaction. A number of statistically significant predictors surfaced with policy and training implications, including suspect body weight, drug and alcohol use, violent behavior, and the distance between the responding officer and the suspect. Considering the lack of empirical research predicting Taser effectiveness, this article takes an important step in thinking about the circumstances in which favorable deployment outcomes are likely to occur.

As we suggested earlier, there is an ongoing discourse between civil rights organizations and the CED industry regarding the widespread adoption of these devices. Although this research offers an objective, empirical analysis of Taser deployments, for a number of reasons, it is difficult for the authors to weigh in on this debate. First, much of the debate has focused on the physiological effects of CEDs, which is not a focus of this research. Second, we have examined one police department with a restrictive and closely monitored deployment pattern, which limits the conclusions we can draw. Alternatively, this research shows that the study police department experienced positive outcomes while avoiding the current controversies associated with use and effectiveness. Both PERF and IACP offer detailed guidance on model policy and procedures for the Taser, most of which mirror the NYPD approach. Thus, we can conclude that with regard to the use and effectiveness questions only, this research suggests that departments can successfully deploy the Taser—avoiding problems with misuse and abuse—by implementing and closely monitoring the guidelines developed by PERF and IACP.

Nonetheless, additional research on this topic is necessary not only because the technology is relatively new but also because different agencies are adopting the weapon to varying degrees and developing different standards and expectations concerning its proper use. A multisite analysis of police agencies that have incorporated the Taser into routine practice based on

different approaches would yield valuable comparative data. This type of cross-site approach—coupled with the release of research supported by the National Institute of Justice, particularly, the national-level study being conducted by Alpert and colleagues—will enable researchers to begin asking more complex questions about police use of the Taser, such as to what extent it is used by officers as an alternative to other less lethal weapons (and physical force) and what types of information would be required for a rigorous cost-benefit analysis of the Taser.

Notes

1. There are competitors to Taser, including Stinger Systems and Law Enforcement Associates, but Taser dominates the market with approximately 95% of conducted energy device (CED) sales in the United States. Stinger Systems has sold just 12,000 weapons since 2000. Law Enforcement Associates introduced their CED only recently, in March 2005.

2. Important considerations and limitations associated with these reports include small sampling frames and potentially competing interests among those who carried out the studies. The National Institute of Justice is currently funding several national-level research projects on the Taser, but these studies have just begun.

3. This estimate becomes much greater if handcuffing and verbal commands are included as use of force.

4. For example, the effects of mace and pepper spray are often felt for several hours, and their range of effectiveness is much shorter (which increases the likelihood of other officers' being hit). Beanbag guns and similar impact munitions are often fired from a specialized shotgun that is larger and bulkier than CED.

5. The New York Police Department's (NYPD; 2000) patrol guide also offers a definition of an emotionally disturbed person (EDP):

> A person who appears to be mentally ill or temporarily deranged and is conducting himself in a manner which a police officer reasonably believes is likely to result in serious injury to himself or others. (p. 1)

In situations involving an EDP, officers are instructed to create and maintain a "zone of safety" of approximately 20 feet and to call for the Emergency Service Unit (ESU) and a patrol supervisor as well as an ambulance (NYPD, 2000). Officers are not to attempt to take an EDP into custody unless

- The EDP is unarmed, not violent and is willing to leave voluntarily; OR
- The EDP's actions constitute an immediate threat of serious physical injury or death to himself or others. (NYPD, 2000, p. 1)

6. These reports were provided to the authors by the supervisor of the department's training division. Although the form is used primarily for the Taser, there were 33 forms involving use of another type of nonlethal weapon: either a stun device or other similar alternative. Because the focus of this article is the Taser, these cases were excluded from the analysis.

7. Given that the intent of the Taser is temporary incapacitation only, the latter suspect resistance measure—10.9%—is probably a fairer measure of the Taser's effectiveness. Also, the *any suspect resistance* measure includes both types of resistance (i.e., continual resistance is a subset of the more general resistance measure). Both measures are examined in the multivariate analysis.

8. At the same time, it is worth noting that the limited manner in which the NYPD has implemented the Taser is a practical advantage to police administrators in New York, who have avoided being criticized in the news media for excessive reliance on the Taser.

9. This variable is based on the police officer's assessment of the suspect at the time of the incident. It is not based on more definitive tests, such as a urinalysis or blood or hair analysis. Although this would appear to suggest that police officers in the study department use the Taser disproportionately against the mentally ill in crisis, this finding must be interpreted in the context of how the department has deployed the Taser. Per department policy, the ESU is called when the patrol officers or supervisors on scene determine that the situation involves an EDP who is behaving in a manner that could result in physical injury or death to the EDP or others (NYPD, 2000). Thus, these data are a reflection of the types of suspects typically handled by the ESU—a highly specialized group of officers—not the suspects typically handled by line officers.

10. There were also two cases where the suspect was armed with a gun: In one case, the suspect was threatening to commit suicide, and in the other case, the suspect had taken a hostage and was threatening multiple people (including the hostage and himself). Of the remaining cases involving an armed suspect, the most common weapon was a blunt object, such as a metal pipe, baseball bat, chair, or large stick.

11. The nearly universal presence of back-up officers and supervisors is again dictated by the fact that most of these cases involve the ESU. This unit is typically called to the scene by the first responding officer, and often a supervisor will also respond.

12. Both police officers and detectives are assigned ranks in the ESU. Chi-square values indicate that the satisfaction and any-resistance differences are statistically significant (p = .005 and p = .050, respectively). It may be useful in future research to examine length of time on the job and officer training as factors related to effectiveness. These variables may more accurately capture the relationship between officer's use of the Taser—especially among non-ESU personnel—and effectiveness measures.

13. Information on the number of dart contacts was not reported in 66 cases. Rather than make assumptions about the number of contacts, the authors have proceeded conservatively and coded these cases as missing. This decision, however, reduces the number of cases available for multivariate analysis.

14. In the remaining 14% of the cases (n = 53), the form was not signed and there was no information about whether the use met departmental policy. However, a review of the narrative of those 53 cases suggests that they too conformed with department policy on use of the Taser.

15. Nagelkerke R^2 provides an approximation of the explained variation in a logistic regression model. This measure of model strength is considered slightly more conservative than the R^2 statistic in ordinary least squares regression but less conservative than the Cox and Snell R^2 estimate, which does not have a maximum value of 1.0.

16. Although the "Taser/stun device report" indicates whether another nonlethal device was also used, it does not specify which is used first, the Taser or the alternative.

17. Suspect resistance was also a predictor of officer satisfaction, but it has been excluded from the analyses because it serves as the other effectiveness measure. The authors question the value of a model that uses one outcome measure to predict another.

Oleoresin Capsicum Spray and Tasers:

A Comparison of Factors Predicting Use and Effectiveness

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Oleoresin Capsicum Spray and Tasers:

A Comparison of Factors Predicting Use and Effectiveness

ABSTRACT

In the last few decades, several less-lethal forms of force have been introduced, adopted, and deployed by police agencies. Oleoresin capsicum spray is now used in nearly every department across the United States; the Taser is used in the majority of police departments. Despite their widespread use, we still know relatively little about the factors associated with the use of OC spray and Tasers and the effectiveness of these weapons in incapacitating subjects. This paper contributes to that discussion by analyzing 504 use-of-force incidents where the police used OC spray or Tasers during the event. Data were obtained from a large municipal police department on incidents that occurred in 2010 and 2011. Policy implications and directions for further research are discussed.

INTRODUCTION

A fundamental but controversial function of the police is their ability to use coercive force (Bittner, 1970; Klockars, 1985). Force is most likely to be used by the police in situations where they are confronted with non-compliant subjects (Reiss, 1971; Terrill & Mastrofski, 2002). In such situations, police officers have several options. At one end of the spectrum, beyond verbal commands and threats, officers may use bodily force (e.g., decentralizations, focused strikes). Bodily force alone is the most common form of physical force used by police officers (Adams, 1999). At the other end of the spectrum, officers may use their firearms. The use of firearms is considered a last resort; it is only to be used to defend human life. In between bodily force and deadly force, there are several "less-than-lethal" or "less-lethal" options.

In the last few decades, several less-lethal forms of force have been introduced, adopted, and deployed by police agencies. Today, nearly all local departments authorize the use of one or more less-lethal weapons (Reaves, 2010). The most common less-lethal weapon is pepper spray, authorized by 97% of all local departments (Reaves, 2010). Conducted Energy Devices (CEDs)[1], including Tasers[2] and stun guns, are authorized by 60% of all local police agencies (Reaves, 2010). While the number of departments authorizing pepper spray is not much higher than in the year 2000 (91%; Hickman & Reaves, 2003), the number of local police departments that authorize the use of CEDs has dramatically increased since 2000, when just 7% authorized them (Reaves, 2010).

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[1] CEDs are sometimes also known as Electronic Control Devices (ECDs), Conducted Electrical Weapons (CEWs), or Conducted Energy Weapons (CEWs).

[2] The Taser (short for the Thomas A. Swift Electric Rifle) is currently the most popular CED on the market. It is also the CED used by the department in this study. As such, we use the term "Taser" rather than the more general "CED" throughout this paper.

In response to the greater prevalence and use of less-lethal weapons, particularly OC spray and Tasers, a substantial amount of research has been conducted on issues related to them. For instance, researchers have analyzed the frequency with which different types of force are used before, during, and after OC spray or Tasers are introduced in departments (e.g., Lin & Jones, 2010; Lumb & Friday, 1997). Studies have examined the factors associated with the use of OC spray (Morabito & Doerner, 1997) and Tasers (Crow & Adrion, 2011; Gau, Mosher, & Pratt, 2010) as well as officer and citizen injuries associated with their use (e.g., Terrill & Paoline, 2011; Kaminski et al., 2013; Paoline, Terrill, & Ingram, 2012; Kaminski et al., 1999; Smith et al., 2007). Finally, researchers have examined the effectiveness of OC spray (Morabito & Doerner, 1997; Kaminski, Edwards, & Johnson, 1999; Adang et al., 2006) and Tasers (White & Ready, 2010; White & Ready, 2007), defining effectiveness in terms of their ability to induce subject compliance.

While this research has advanced our understanding of the benefits and limitations of OC spray and Tasers, we still know relatively little about the factors associated with the use of OC spray and Tasers and the effectiveness of these weapons in incapacitating subjects. In particular, there are no studies to date that directly compare the use and relative effectiveness of OC spray and the Taser within the same jurisdiction during the same time frame.[3] Some studies examine OC spray, while others examine Tasers. It is difficult, if not impossible, to draw definitive conclusions about the use and relative effectiveness of OC spray and Tasers on the basis of studies that do not include both OC spray and Taser incidents, do not compare OC spray with Tasers, that use different sampling procedures and measurements schemes for critical variables,

[3] An exception is a study performed by TASER International (as cited in White and Ready, 2007). In this study, the effectiveness of the OC spray and the Taser were compared, but only when both were used in the same incident. In these encounters, OC spray was effective 33% of the time while the TASER was effective in 83% of cases (Taser International, 2002).

and that were conducted in different police departments with different use-of-force policies and continuums. As such, we do not know whether Tasers are significantly more (or less) effective than OC spray in similar situations, or whether different factors predict their use and effectiveness. This study examines the factors that predict the use and effectiveness of OC spray (N= 259) and Tasers (N=245) in a single large municipal police department. Data were obtained from official use-of-force reports of the police department on incidents that occurred in 2010 and 2011.

LITERATURE REVIEW

Police use of force, defined as "acts that threaten or inflict physical harm on suspects" (Terrill, 2003, p. 56), has been an important and constant topic of research since the 1970s. This attention is warranted for theoretical and practical reasons. Theoretically, research on police use of force is important because it involves the defining characteristic of policing. In large part, an understanding of the complexities and dilemmas of police work depends on an understanding of police use of force. Practically speaking, research on the control of police use of force is important in that use of force can have devastating—and deadly—consequences. As such, it can dramatically affect police-community relations, public cooperation with the police, and the legitimacy of the police more generally.

Due to the potentially serious consequences of police use of force, police officers are constrained in their ability to use it. Along with legal (*Graham v. Connor*, 490 U.S. 386 1989) and accreditation standards (Commission on Accreditation for Law Enforcement Agencies, 1999), the majority of police departments guide officer behavior with a "continuum of force" or "force continuum" (Terrill & Paoline, 2012). Most often, officers are to base force decisions on

the level of suspect resistance or aggression; force is only escalated to the next level when less forceful actions fail to induce suspect compliance. While OC spray and Tasers are usually placed at the same level on force continuums (Alpert et al., 2011; IACP, 2005), there is little agreement between and among departments where they should be placed. In some departments, OC spray and the Tasers are placed at the lower end of the continuum, authorizing their use against passive resisters; other departments place them closer to lethal force on the continuum, authorizing their use only against active resisters. Where OC spray and Tasers are located on the continuum of force matters when understanding the circumstances in which the weapons are used (Crow & Adrion, 2011; Morabito & Doerner, 1997). In turn, the circumstances in which OC spray and Tasers are used may have implications for their effectiveness in inducing compliance among subjects.

OC SPRAY AND TASERS

Oleoresin capsicum (OC) spray, otherwise known as pepper spray, was introduced to law enforcement in the 1980s. OC is an inflammatory agent naturally found in cayenne peppers. When a person is sprayed with OC spray, the effects are immediate: the respiratory tract becomes inflamed, the individual experiences an intense burning sensation and swelling around the eyes, and the subject's eyes close involuntarily (Lumb & Friday, 1997). Although the subject may be in extreme discomfort, he or she may still be able to resist. Ideally though, the effects of OC spray render a resistive suspect passive and compliant, and the officer is able to take the suspect into custody without further incident.

Once introduced, OC spray immediately demonstrated advantages over other forms of force. The effects of OC spray, while immediate and dramatic, were more temporary than other

forms of chemical gasses used previously (Lumb & Friday, 1997). OC spray proved more effective on intoxicated individuals than mace, and was less prone to secondary contamination (White & Ready, 2007). Finally, OC spray was less likely to cause injury than bodily force, batons, and flashlights (Lumb & Friday, 1997). As summarized by Lumb & Friday (1997):

> ...OC spray is an effective alternative to the more harmful types of weapons available to police. OC causes almost instantaneous incapacitation and leaves no long term residual effects. It allows the officer to stay away from the suspect when affecting a custodial arrest that is being resisted, and there are few problems associated with transporting the person, as OC spray residue dissipates fairly quickly (p. 138).

Today, while OC spray is standard issue in police departments, CEDs, such as the Taser and other stun devices, are still gaining popularity. First introduced in the 1990s, the Taser is a 50,000 volt, 26-watt weapon that uses nitrogen cartridges to fire its probes. Once the probes attach to the suspect, the Taser delivers an electrical current which overrides the central nervous system, causing involuntary muscle contractions and incapacitation (Alpert et al., 2011; Means & Edwards, 2005).

The Taser has advantages over other less-lethal alternatives including their greater reliability at longer distances, the relatively quick recovery time involved, and their perceived effectiveness in inducing suspect compliance (White & Ready 2010). In addition, because Tasers do not rely on pain to induce compliance, ideally they should be more effective on persons who have a higher tolerance of pain, such as people under the influence of drugs or alcohol or who have a mental illness (Means & Edwards, 2005).

Despite their popularity and advantages, OC spray and Tasers are not without controversy. One concern relates to their safety. In the late 1980s and early 1990s, OC spray was claimed to have caused several in-custody deaths (ACLU of Southern California, 1993; Alpert et al., 2011). Twenty years later, the Taser was also alleged to be a proximate cause of in-

custody deaths (Alpert et al., 2011; White & Ready, 2007). Research has shown that most deaths involving OC spray were instead the result of positional asphyxia, pre-existing health conditions, or were drug-related (Granfield, Onnen, & Petty, 1994; Petty, 2004). With regard to Tasers, it has been demonstrated that the risk of death when a Taser is used is less than 0.25 percent (NIJ, 2011), and in those situations the death is likely to be a result of drug intoxication, preexisting heart conditions, and exposure to other forms of nonlethal police force (White & Ready, 2007).

Another concern relates to police overuse of OC spray and Tasers (Alpert et al., 2011). For instance, members of the ACLU and Amnesty International have voiced concern that OC spray and Tasers are used in a disparate fashion against members of minority groups (ACLU of Southern California, 1993; Amnesty International, 2006). A related concern is that police have authorized their use too low on continuums of force and consequently are using them against passive (versus active) resisters (Terrill & Mastrofski, 2002). Finally, there are concerns about the use of OC spray and Tasers with the elderly, children, pregnant women, and persons with medical conditions that put them at greater risk of experiencing dangerous medical side effects (Amnesty International, 2006; Sloane & Vilke, 2006).

A final concern has to do with manufacturer exaggeration of the capabilities and effectiveness of OC spray and Tasers in incapacitating subjects, which, in part, may have contributed to their widespread adoption in police departments. Some early studies reported "effectiveness rates" as high as 100% for OC spray (as cited in Adang et al., 2006) and 94% for the Taser (as cited in White & Ready, 2010). Objective empirical research on the effectiveness of these devices remains rather sparse. Of the independent studies that do exist, effectiveness rates have not been found to be as high as those originally reported by the manufacturers. For

instance, and as discussed below, Kaminski et al. (1999) found an effectiveness rate of 71% for OC spray. White and Ready (2010) found an effectiveness rate of 85% for the Taser.

RESEARCH ON THE USE AND EFFECTIVENESS OF OC SPRAY AND TASERS

While research appears to have ameliorated concerns about OC spray and Tasers causing serious injury and death, there remain concerns about their use and effectiveness. In response, there has been a growing body of literature that examines the use and effectiveness of these weapons. Given the objectives of the current study, we review here the studies that examine the factors associated with the *use* of OC spray and Tasers and the *effectiveness* of OC spray and Tasers (with effectiveness defined in terms their ability to facilitate the arrests of resisting subjects).

The Use of OC Spray

Morabito and Doerner (1997) analyzed OC spray use-of-force reports from the Tallahassee Police Department. They examined characteristics of officers and suspects that were associated with the use of OC spray at two points in time: prior to and after a change in the circumstances in which OC spray was authorized in the department. At Time 1, OC spray was only authorized in cases when the suspect was actively physically resisting police. At Time 2, the threshold for the use of OC spray was reduced from active physical resistance to verbal/passive physical resistance. At Time 1, OC spray use was compared to impact weapons such as batons, flashlights, and stun guns. At Time 2, OC spray use was compared to the use of soft hand techniques (punches, kicks, and pain compliance techniques). The officer characteristics of interest included race, gender, education and experience. Suspect variables

included race, gender, height and weight (relative to the officer's height and weight), suspect intoxication, and whether the suspect was armed or attacked the officer. While none of the predictor variables were significant at Time 1, several factors were associated with OC spray use at Time 2. At Time 2, male, educated, and veteran officers were more likely to use OC spray than soft hand techniques. OC spray was also more likely to be used than soft hand techniques when the suspect was heavier and taller than the officer and when the suspect was armed.

The Use of Tasers

Gau, Mosher, and Pratt (2010) analyzed case file data on Tasers and other types of force used by officers in a state patrol agency from 2005 to 2007. The authors were primarily interested in examining possible racial disparities in the use of a Tasers on subjects. Tasers were used in nearly one-half of all use-of-force incidents. They found that compared to other forms of force, Tasers were equally likely to be used on white, Hispanic, and Black subjects; although when a Taser was used, Hispanic subjects were more likely than White subjects to have a Taser be the first type of force used. The authors also found that females were less likely to be "tased" than males, and that subjects who actively resisted and who were assaultive were *less* likely to be tased than subjects who passively resisted. Finally, white officers were significantly less likely to use a Taser than officers of other races.

Crow and Adrion (2011) analyzed 461 use-of-force incidents (reports) that occurred between 2004 and 2010 in a medium-sized municipal police department. The authors compared incidents where a Taser was used and incidents where "other" types of force were used (takedowns, physical force, pepper foam, impact weapons, police dog, use of a vehicle as a weapon, and firearms). The authors found that a Taser was *less* likely to be used than other forms

of force when subjects physically resisted and when resistance involved a weapon. A Taser was equally likely to be used when resistance was in the form of "presence," "flight," and "verbal" (meanings unspecified). A Taser was more likely to be used than other forms of force on non-white and male subjects. Older officers were significantly more likely to use Tasers. A policy change to restrict the use of Tasers also had its intended affect; after the policy change, Tasers were less likely to be deployed. Call type, time of day of the incident, officer sex, race, age, and rank did not affect the likelihood of Taser use.

The Effectiveness of OC Spray

Three studies have examined the effectiveness of OC spray (Morabito & Doerner, 1997; Adang et al., 2006; Kaminski, Edwards, & Johnson, 1999), generally defined in terms of the extent to which it facilitates the arrests of suspects who resist. As previously noted, Morabito and Doerner (1997) analyzed use of force reports from the Tallahassee Police Department. Although these authors were most concerned with the factors associated with the use of OC spray, they also briefly considered the effectiveness of it. As the authors explained, OC spray "was considered effective if it induced the expected physiological effects and enabled the officer to take the subject into custody without further incident" (p. 690). They calculated a "success rate" of 73% for OC spray and found that OC spray worked "equally well on mentally disturbed subjects, intoxicated subjects, and physically stressed subjects who were involved in either a foot chase or a physical struggle" (p. 690).

Kaminski et al. (1999) analyzed data on incidents where OC spray was used by officers in the Baltimore County Police Department. Based on assessments provided by officers who were involved in the incidents, three measures of OC spray effectiveness were constructed. In

their most conservative measure, they defined effectiveness in terms of whether the use of OC spray incapacitated (fully and immediately immobilized) the suspect (yes/no). According to this measure, OC spray was effective in 71% of cases. Their second measure of effectiveness was also dichotomous, measured as the officer's assessment of whether the use of OC spray eased arrest (yes/no). In this case, the use of OC spray was deemed effective 85% of the time. Their third measure of effectiveness consisted of a 5-point scale ranging from totally effective (i.e., incapacitated suspect) to totally ineffective (i.e., OC spray had no effect). Here, OC spray was considered effective 84% of the time.

Kaminski et al. (1999) examined the effects of suspect characteristics on OC spray effectiveness. In particular, they examined the variables of suspect race, gender, age, weight, height, and condition (i.e., suspect was drinking, mentally disturbed, on drugs, or other). The authors also examined the distance from which OC was sprayed. They found that OC spray was more effective (yes/no) with younger and older suspects (but less effective among middle-aged suspects) and intoxicated suspects. It was less effective when it was used on suspects who were under the influence of drugs and when sprayed from longer distances.

Adang et al. (2006) analyzed data on incidents where OC spray was used by police officers in the Netherlands. They used surveys of officers, supervisors, and prosecutors to measure the effectiveness of OC in several ways: the degree to which the subject was incapacitated (with options ranging from "completely" to "not at all"), the degree to which OC made the arrest easier ("much easier" to "much more difficult"), whether suspects became more or less aggressive after exposure to OC spray ("much more" to "much less"), and how satisfied officers were with the performance of OC spray ("dissatisfied" to "highly satisfied"). Estimates of effectiveness ranged from 69% (suspects who became less aggressive after being sprayed with

OC) to 92% (officers who were satisfied with the performance of OC spray). In the model predicting the extent of suspect incapacitation, four of thirteen independent variables were statistically significant. Specifically, OC spray was less effective when used by less experienced officers, against minority suspects, when suspects were warned beforehand they were going to be sprayed, and when suspects were under the influence of drugs.

The Effectiveness of Tasers

Two studies have examined the effectiveness of Tasers with specific regard to the incapacitation of subjects in arrest situations (White & Ready, 2007; White & Ready, 2010). White and Ready (2007) examined the effects of Tasers based on self-report surveys completed by (primarily SWAT) officers who worked in a large metropolitan police department. They considered the Taser effective if it led to the "successful incapacitation" of the subject. They found that after deploying a Taser, "85% of subjects were subdued by the Taser and taken into custody" (p. 183). The authors developed a multivariate "violence escalation scale" that they used to score each Taser incident. The scale included whether the subject was violent, armed with a weapon (and what type of weapon), under the influence of drugs or alcohol, mentally ill, the weight of the subject, and whether the officer was alone. Although individual analyses were not provided on each variable, the analyses performed on the scale revealed that the Taser was the most effective in the "highest risk" situations.

White and Ready (2010) analyzed Taser deployments from the New York City Police Department; the data were derived from the reports that officers completed subsequent to the deployment of the weapon. Three measures of Taser effectiveness were used in the study. The first measure was the officer's assessment of whether the Taser performed satisfactorily (yes/no).

Officers rated the performance of the Taser as satisfactory in 79% of cases. While this indicator of effectiveness was also used in prior studies (see Adang et al., 2006), the other two are unique in that they measure suspect resistance or, in other words, the *in*effectiveness of the Taser. The authors classified suspect resistance two ways: First, "continual resistance" included those situations where the suspect was not affected at any point by the weapon; the suspect continued to resist after the Taser was deployed. This occurred in 33% of all Taser deployments. In these instances the Taser was clearly ineffective. Second, "any resistance" included those situations where the Taser temporarily resulted in the incapacitation of the suspect, but the suspect resisted again prior to the conclusion of the incident. This occurred in about 11% of Taser deployments.

In their models predicting Taser (in)effectiveness, White and Ready (2010) explored the impact of multiple officer, suspect, and incident characteristics. They found the Taser to be less effective on heavier subjects (i.e., over 200 lbs), subjects who were under the influence of drugs or alcohol, subjects who were violent, when another less lethal weapon was used, when one or both prongs missed the subject, and when the Taser was fired from farther away (i.e., greater than three feet). When effectiveness was based on officer satisfaction, the Taser was also perceived to be more effective when the suspect was armed with a knife or gun.

Conclusions

There are too few studies available to draw confident conclusions about the factors that affect the use and effectiveness of OC spray and Tasers. Other than that males are more likely than females to be subject to a Taser than other forms of force (Gau, Mosher, & Pratt 2010; Crow and Adrion 2011), that OC spray is less likely to be effective on subjects who are under the influence of drugs compared to subjects who are not (Kaminski et al. 1999; Adang et al. 2006),

and that departmental policy affects the use of OC spray and Tasers (Crow & Adrion 2011; Morabito & Doerner, 1997), there is little consistency in findings. There is also little consistency in variables included in previous studies and the measurement of those variables.

It is safe to conclude, however, that estimates regarding the effectiveness of OC and Tasers depend at least in part on the measures used; different definitions of effectiveness produce different rates of effectiveness. In the studies reviewed here, rates of OC effectiveness ranged from 69% to 92% (Adang et al., 2006), while the effectiveness of the Taser ranged from 66% to 89% (White & Ready, 2010). The variation in effectiveness estimates notwithstanding, it appears that most studies show the Taser to be more effective than OC spray.

Our study adds to the discourse on the use and effectiveness of OC spray and the Taser in several ways. First and most importantly, this study is the first that directly compares OC spray with Tasers in terms of their use and their effectiveness, and we do so in the context of the same study site. Second, we include all intentional OC spray and Taser deployments to provide a potentially more inclusive assessment of effectiveness.[4] Lastly, we provide a logical measure of weapon effectiveness that incorporates the dynamic nature of use of force incidents and we use this same measure to evaluate OC spray and Tasers.

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[4] Interestingly, Kaminski et al. (1999) excluded from their analyses incidents where OC was used but where it missed its intended target and incidents where it was used in a crowd situation. The authors also explain that if multiple officers or multiple subjects were involved in the incident, a single officer and/or a single subject was selected for analysis. In addition, it is unknown what, if any, other types of force were used before or after the deployment of OC spray. Adang et al. (2006), like Kaminski et al. (1999), excluded several categories of incidents from their analysis: incidents where officers deployed OC spray but it missed its intended target, where OC was intended to be used but the canister malfunctioned, incidents that involved a crowd situation, and when it was deployed against female subjects. In addition, the authors did not specify what, if any, other types of force were used before or after the deployment of OC spray. It is unknown how these factors may have affected their conclusions about OC spray effectiveness.

METHOD

Data

The data for this study were obtained from a large municipal police department. At the time of the study, the department employed approximately 2,000 sworn officers, about 1,200 of whom were patrol officers. The police department served a population of approximately 600,000; 40% of the population was African American and 10% was Latino.

Analyses were performed on all use of force incidents in 2010 and 2011 where an officer from the department intentionally discharged OC spray (n=259) or deployed a Taser (n=245) against a person. While an additional 24 incidents involved the use of OC and a Taser, and another 45 incidents involved the use of another type of weapon, the analyses conducted here focus on the 504 incidents where OC *or* a Taser was used.

All officers in the department were trained and authorized to carry and use OC spray. During the academy, officers received 4 to 8 hours of instruction on the use of OC spray. Only about 300 officers (approximately 25% of patrol officers) were trained and certified to use a Taser. Further, on each of the three shifts at each of the eight districts, approximately six to eight Tasers were available to be signed out and carried by the certified Taser officers. Therefore, at any given time during the time of this study, there were no more than 68 Tasers actually being carried by officers. With regard to Taser training, officers who volunteered for training first had to be approved by Internal Affairs. Officers who were selected to be Taser trained participated in 16 hours of "new user" training and an additional 8 hours of "refresher" training every 2 years.[5]

At the time of the study, the use of force policy of the department specified OC spray and Tasers as "control devices." According to the policy, "the goal of control devices is to overcome

[5] The only training required by TASER International is the 8 hours of "new user" training.

active resistance or its threat [italics added]." Control devices, escort holds, compliance holds and passive counter measures were more broadly considered "control alternatives." Although a continuum of force was not specified per se, "intervention options" were provided; these options ranged from presence, dialogue, control alternatives, protective alternatives (e.g., focused strikes, vertical stuns), to deadly force (see Figure 1).

Most of the data for the study were obtained from a case management system used by the police department and were converted into a Statistical Package for the Social Sciences (SPSS) data file for analyses. The database was organized with use of force incidents as the unit of analysis. The use of force data were based on reports that were completed by supervisory officers when a use of force incident occurred. According to the official policy of the department at the time of the study, a use of force report was to be completed by a supervisor when an officer: (a) discharged a firearm, (b) used a baton, (c) discharged Oleoresin Capsicum (OC), (d) deployed an Electronic Control Device (Taser), (e) used any other type of force, which resulted in an injury, or a complaint of an injury, to a person, or (f) when a department canine bit a subject in the performance of their duty. Clearly, this is a relatively narrow definition of force as it does not include incidents where only bodily force was used when that force did not result in an injury (or a complaint of an injury) to a subject (or verbal force, see Terrill & Mastrofski, 2002). Nevertheless, that the department policy did not require all bodily force incidents to be reported is of little concern in this study. This study focuses specifically on incidents that involved the use OC spray or a Taser. Departmental policy specified that all such incidents be recorded and all types of force used in those incidents be recorded.

Along with the departmental use of force report, a narrative of the incidents was also written by the supervisory officer and was included in the case management system. For this

study, all of the narratives for incidents that involved the use of OC and/or a Taser were reviewed (787 pages) and additional data were coded from them (e.g., level of subject resistance, the order in which force was used by officers).

Variables

The two primary dependent variables in this study are: 1) the *use of* OC spray and the Taser and 2) the *effectiveness of* OC spray and the Taser. Determining whether or not a particular type of force was used in an incident was relatively straight-forward. If OC was sprayed or a Taser was deployed, OC or the Taser was considered to have been used. If the target was missed, if the weapon malfunctioned, if it was used in a crowd situation, or if it was used against females, the incident was still included. If the incident involved multiple officers and/or multiple subjects, the incident was included. In the few incidents that involved multiple subjects, the characteristics of the person identified as the primary subject in the officer's report was coded.

Determining the effectiveness of OC spray and the Taser was more complicated. As discussed earlier, previous studies have used different measures of effectiveness although each study, in one way or another, examined how well, or to what degree, OC spray or the Taser incapacitated the subject who resisted the police. Of course, the variation in measurement is important to consider when interpreting findings across studies. Ultimately, in a use of force incident, the legitimate objective is to neutralize the threat posed by the subject and gain control over that subject. Most often, practically speaking, "gaining control" means using as much force as necessary in order to place handcuffs on the subject. Many use-of-force situations are

complicated; they unfold, one action leads to another, but ultimately force is used to gain control over the physical actions of the subject.

In this study, we provide a relatively straight-forward, bottom-line, measure of OC and Taser effectiveness. OC spray and/or Tasers were considered effective in two circumstances: First, if OC or a Taser was the *only* type of force that was used in the incident in order to subdue/handcuff the subject, OC or the Taser was considered effective. In these situations, OC spray or the Taser, by itself, led to the legitimate desired outcome; it was effective. Second, if OC or a Taser was the *last* type of force used in the incident prior to the subject being subdued/handcuffed, then OC or the Taser was considered effective. For example, if OC spray was deployed but then some other type of force was necessary in order to gain control over the subject to the point of placing him in handcuffs, then the OC was considered ineffective. OC may, or may not, have had some effect, but ultimately it was not effective in achieving the legitimate objective of the use of force incident—additional force needed to be used.

Of course, one must not lose sight of the possible cumulative effects that various types of force that were used in an incident may have in bringing an incident to an end. Indeed, several of the studies reviewed above simply did not take into account any other types of force that may have been used in the incident. Given the nature of the data analyzed in this study, measuring the precise effect that various forms of force may have had in a use of force incident is difficult, if not impossible. Nevertheless, to the extent possible, and when possible, we consider not only the last type of force used, but all types of force used in the incident. It is also important to highlight that the same criteria are used in measuring the effectiveness of OC and Tasers, providing for an equal ("apples-to-apples") comparison of the effectiveness of the two forms of

force. It is in these ways that an understanding of the relative effectiveness of OC and Tasers can be achieved.

Independent Variables

The independent variables in this study consist of subject characteristics and actions (see Tables 1 and 2 for coding and descriptive statistics). In particular, we focus on: 1) who was the subject? and 2) what did the subject do? Officer characteristics are not included primarily because of the analytic difficulties in doing so.[6] The number of officers who used force in an incident and the number of officers present when force was used were coded and included in the analyses as controls. The number of subjects who had force used upon them was also coded and included as a control.[7]

Data on "who the subject was" (i.e., the characteristics of the subject) were coded according to the supervisor's report. These variables consisted of subject race (white/minority[8]), age, sex, height, and weight.

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[6] Of course, this is a less than optimal solution to the issue; however, previous studies have struggled with the same issue and also resolved it in less than optimal ways. For instance, studies that have included officer characteristics either included only one officer when multiple officers were involved in the incident (Adang et al., 2006; Kaminski et al., 1999), or counted single incidents multiple times if multiple officers used force (White and Ready, 2007). Some studies are unclear about how multiple officer and multiple subject incidents were handled in the analyses (Morabito and Doerner, 1997). Each of these options essentially reduces the complexity of the incidents that are analyzed. None of these options are good, nor is the exclusion of officer characteristics; however, by not including officer characteristics we do not systematically exclude cases. Clearly, there is a trade-off between model error and sample bias.

[7] As noted, in multiple subject incidents, the characteristics of the primary subject, as identified in the police narrative report, were coded and included in the analyses.

[8] Ideally, sub-racial and ethnic groups would be analyzed instead of the "minority" category (Gau et al., 2010). However, too few Hispanics and/or other ethnic/racial group members were included among the incidents. The "minority" group classification consisted of 90% African American subjects (377 out of 419).

Most of the data on "what the subject did" (i.e., how the subject acted) were coded from the narrative reports prepared by supervisory officers and the statements included in the reports. These variables consisted of: whether the subject was mentally disturbed (yes/no), whether the subject was under the influence of drugs or alcohol (yes/no), whether a subject was believed to be armed with a weapon (yes/no), whether a subject was actually armed with a weapon (yes/no),whether a subject fled the police on foot (yes/no), whether a subject assaulted an officer ("yes" if it was stated in the narrative that the subject intentionally hit, kicked, bit, shot, stabbed, or spat upon an officer, "no" otherwise), and the level of resistance offered by the subject (coded on the basis of information provided in the narrative).[9]

RESULTS

Given the purposes of this study, results are organized into two sections: 1) those that relate to the *use* of OC spray and the Taser and 2) those that relate to the *effectiveness* of OC spray and the Taser. We begin with bivariate analyses and multivariate analyses of OC/Taser use and then turn attention to bivariate and multivariate analyses of OC/Taser effectiveness.

The Use of OC Spray and Tasers

How do the 259 incidents where OC spray was used differ from the 245 incidents where a Taser was used? This question was first addressed by calculating statistical differences

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[9] Examples of *passive* resistance included when a subject refused to exit a car, subject went limp, subject refused to move after being ordered to do so, subject refused to show hands after being ordered to do so; examples of *verbal* resistance included when a subject told the officer(s) to leave him/her alone, subject stated he or she will not comply; examples of *defensive* resistance included when subject attempted to or actually fled the police, the subject attempted to hide from the police, subject pulled away from the officer, subject got up after being directed to the ground; examples of *active* resistance included subject fighting with the police, subject lunging at officer, subject attempting to disarm the officer (Terrill and Mastrofski, 2002).

between the variables of interest and OC spray and Taser incidents on the basis of chi-square and *t* tests (for the sake of space, results are not tabled here). Next, a logistic regression equation was estimated to identify factors that predicted OC spray versus Taser use; these results are shown in Table 3.

In the bivariate analyses, OC spray was significantly more likely than a Taser to be used on minority subjects ($X^2 = 6.82; p < .01$); OC spray and a Taser were equally likely to be used regardless of subject age, sex, weight, or height. A Taser was significantly more likely to be used than OC when the subject appeared to be mentally disturbed ($X^2 = 18.61; p < .01$), was believed to be armed with a weapon ($X^2 = 19.23; p < .01$), when the subject was actually armed with a weapon ($X^2 = 6.52; p < .05$), and when the subject fled the police on foot ($X^2 = 16.14; p < .01$). OC spray and Tasers were equally likely to be used when the subject was believed to be under the influence of alcohol or drugs, when the subject assaulted a police officer, and regardless of the amount of resistance provided to the police. OC was more likely to be used than a Taser when more than one subject had force used upon them in the incident ($t = -2.03; p < .05$); a Taser was more likely to be used than OC when more officers used force in the incident ($t = 2.30; p < .05$) and when more officers were present at the incident ($t = 6.39; p < .01$).

Table 3 shows the results of the logistic regression analyses performed for OC spray and Taser use. Due to substantial missing data, subject height and weight were not included in the equation. Two models were estimated: one compares those incidents where OC was used to those incidents where a Taser was used ("OC Used"), the other compares Taser use to OC use ("Taser Used"). The independent variables identified as significant in the earlier analyses are similar to those identified as significant here. First, all other variables held constant, when the subject was believed to be mentally disturbed, a Taser was more than two times more likely to be

used than OC spray (odds ratio = 3.296; p = .000). Second, when the subject was believed to be armed, a Taser was significantly more likely to be used than OC spray (odds ratio = 1.858; p = .023). Third, when the subject fled the police on foot, a Taser was significantly more likely to be used on the subject than OC spray (odds ratio = 2.452; p = .000). Fourth, when there were more subjects involved, OC spray was nearly 80% more likely to be used than a Taser (odds ratio = 1.794; p = .04). Finally, when there were more officers present at the incident, a Taser was significantly more likely to be used (odds ratio = 1.668; p = .000).

The Effectiveness of OC Spray and Tasers

Before examining the factors associated with the effectiveness of OC and Tasers spray, it is necessary to calculate an effectiveness rate for OC spray and Tasers (see Table 4). Of the 259 incidents where OC spray was used, 63 involved only the use of OC spray. That no other force was needed to subdue the subject can be considered reasonable evidence that OC spray was effective. In the other 196 incidents, OC spray and some other force were used. In these 196 incidents, the order in which force was applied is meaningful. In 128 of these 196 incidents, OC ended the encounter; presumably OC was used to subdue the subject because the force that was applied prior to the OC did not work, or did not appear to be working, at least in the judgment of the officer who deployed the OC spray.[10] There were 68 incidents where OC was deployed during the incident but some other force ended the encounter.[11] To calculate an effectiveness rate of OC spray, the 63 incidents that only involved OC spray and the 128 incidents where OC

[10] Of the 128 incidents, in 125 of them bodily force was used prior to OC spray; in 3 incidents, bodily force and a baton were used prior to OC.

[11] Of the 68 incidents, 63 ended as a result of bodily force, 5 ended with the use of a baton.

custody deaths (Alpert et al., 2011; White & Ready, 2007). Research has shown that most deaths involving OC spray were instead the result of positional asphyxia, pre-existing health conditions, or were drug-related (Granfield, Onnen, & Petty, 1994; Petty, 2004). With regard to Tasers, it has been demonstrated that the risk of death when a Taser is used is less than 0.25 percent (NIJ, 2011), and in those situations the death is likely to be a result of drug intoxication, preexisting heart conditions, and exposure to other forms of nonlethal police force (White & Ready, 2007).

Another concern relates to police overuse of OC spray and Tasers (Alpert et al., 2011). For instance, members of the ACLU and Amnesty International have voiced concern that OC spray and Tasers are used in a disparate fashion against members of minority groups (ACLU of Southern California, 1993; Amnesty International, 2006). A related concern is that police have authorized their use too low on continuums of force and consequently are using them against passive (versus active) resisters (Terrill & Mastrofski, 2002). Finally, there are concerns about the use of OC spray and Tasers with the elderly, children, pregnant women, and persons with medical conditions that put them at greater risk of experiencing dangerous medical side effects (Amnesty International, 2006; Sloane & Vilke, 2006).

A final concern has to do with manufacturer exaggeration of the capabilities and effectiveness of OC spray and Tasers in incapacitating subjects, which, in part, may have contributed to their widespread adoption in police departments. Some early studies reported "effectiveness rates" as high as 100% for OC spray (as cited in Adang et al., 2006) and 94% for the Taser (as cited in White & Ready, 2010). Objective empirical research on the effectiveness of these devices remains rather sparse. Of the independent studies that do exist, effectiveness rates have not been found to be as high as those originally reported by the manufacturers. For

instance, and as discussed below, Kaminski et al. (1999) found an effectiveness rate of 71% for OC spray. White and Ready (2010) found an effectiveness rate of 85% for the Taser.

RESEARCH ON THE USE AND EFFECTIVENESS OF OC SPRAY AND TASERS

While research appears to have ameliorated concerns about OC spray and Tasers causing serious injury and death, there remain concerns about their use and effectiveness. In response, there has been a growing body of literature that examines the use and effectiveness of these weapons. Given the objectives of the current study, we review here the studies that examine the factors associated with the *use* of OC spray and Tasers and the *effectiveness* of OC spray and Tasers (with effectiveness defined in terms their ability to facilitate the arrests of resisting subjects).

The Use of OC Spray

Morabito and Doerner (1997) analyzed OC spray use-of-force reports from the Tallahassee Police Department. They examined characteristics of officers and suspects that were associated with the use of OC spray at two points in time: prior to and after a change in the circumstances in which OC spray was authorized in the department. At Time 1, OC spray was only authorized in cases when the suspect was actively physically resisting police. At Time 2, the threshold for the use of OC spray was reduced from active physical resistance to verbal/passive physical resistance. At Time 1, OC spray use was compared to impact weapons such as batons, flashlights, and stun guns. At Time 2, OC spray use was compared to the use of soft hand techniques (punches, kicks, and pain compliance techniques). The officer characteristics of interest included race, gender, education and experience. Suspect variables

included race, gender, height and weight (relative to the officer's height and weight), suspect intoxication, and whether the suspect was armed or attacked the officer. While none of the predictor variables were significant at Time 1, several factors were associated with OC spray use at Time 2. At Time 2, male, educated, and veteran officers were more likely to use OC spray than soft hand techniques. OC spray was also more likely to be used than soft hand techniques when the suspect was heavier and taller than the officer and when the suspect was armed.

The Use of Tasers

Gau, Mosher, and Pratt (2010) analyzed case file data on Tasers and other types of force used by officers in a state patrol agency from 2005 to 2007. The authors were primarily interested in examining possible racial disparities in the use of a Tasers on subjects. Tasers were used in nearly one-half of all use-of-force incidents. They found that compared to other forms of force, Tasers were equally likely to be used on white, Hispanic, and Black subjects; although when a Taser was used, Hispanic subjects were more likely than White subjects to have a Taser be the first type of force used. The authors also found that females were less likely to be "tased" than males, and that subjects who actively resisted and who were assaultive were *less* likely to be tased than subjects who passively resisted. Finally, white officers were significantly less likely to use a Taser than officers of other races.

Crow and Adrion (2011) analyzed 461 use-of-force incidents (reports) that occurred between 2004 and 2010 in a medium-sized municipal police department. The authors compared incidents where a Taser was used and incidents where "other" types of force were used (takedowns, physical force, pepper foam, impact weapons, police dog, use of a vehicle as a weapon, and firearms). The authors found that a Taser was *less* likely to be used than other forms

of force when subjects physically resisted and when resistance involved a weapon. A Taser was equally likely to be used when resistance was in the form of "presence," "flight," and "verbal" (meanings unspecified). A Taser was more likely to be used than other forms of force on non-white and male subjects. Older officers were significantly more likely to use Tasers. A policy change to restrict the use of Tasers also had its intended affect; after the policy change, Tasers were less likely to be deployed. Call type, time of day of the incident, officer sex, race, age, and rank did not affect the likelihood of Taser use.

The Effectiveness of OC Spray

Three studies have examined the effectiveness of OC spray (Morabito & Doerner, 1997; Adang et al., 2006; Kaminski, Edwards, & Johnson, 1999), generally defined in terms of the extent to which it facilitates the arrests of suspects who resist. As previously noted, Morabito and Doerner (1997) analyzed use of force reports from the Tallahassee Police Department. Although these authors were most concerned with the factors associated with the use of OC spray, they also briefly considered the effectiveness of it. As the authors explained, OC spray "was considered effective if it induced the expected physiological effects and enabled the officer to take the subject into custody without further incident" (p. 690). They calculated a "success rate" of 73% for OC spray and found that OC spray worked "equally well on mentally disturbed subjects, intoxicated subjects, and physically stressed subjects who were involved in either a foot chase or a physical struggle" (p. 690).

Kaminski et al. (1999) analyzed data on incidents where OC spray was used by officers in the Baltimore County Police Department. Based on assessments provided by officers who were involved in the incidents, three measures of OC spray effectiveness were constructed. In

their most conservative measure, they defined effectiveness in terms of whether the use of OC spray incapacitated (fully and immediately immobilized) the suspect (yes/no). According to this measure, OC spray was effective in 71% of cases. Their second measure of effectiveness was also dichotomous, measured as the officer's assessment of whether the use of OC spray eased arrest (yes/no). In this case, the use of OC spray was deemed effective 85% of the time. Their third measure of effectiveness consisted of a 5-point scale ranging from totally effective (i.e., incapacitated suspect) to totally ineffective (i.e., OC spray had no effect). Here, OC spray was considered effective 84% of the time.

Kaminski et al. (1999) examined the effects of suspect characteristics on OC spray effectiveness. In particular, they examined the variables of suspect race, gender, age, weight, height, and condition (i.e., suspect was drinking, mentally disturbed, on drugs, or other). The authors also examined the distance from which OC was sprayed. They found that OC spray was more effective (yes/no) with younger and older suspects (but less effective among middle-aged suspects) and intoxicated suspects. It was less effective when it was used on suspects who were under the influence of drugs and when sprayed from longer distances.

Adang et al. (2006) analyzed data on incidents where OC spray was used by police officers in the Netherlands. They used surveys of officers, supervisors, and prosecutors to measure the effectiveness of OC in several ways: the degree to which the subject was incapacitated (with options ranging from "completely" to "not at all"), the degree to which OC made the arrest easier ("much easier" to "much more difficult"), whether suspects became more or less aggressive after exposure to OC spray ("much more" to "much less"), and how satisfied officers were with the performance of OC spray ("dissatisfied" to "highly satisfied"). Estimates of effectiveness ranged from 69% (suspects who became less aggressive after being sprayed with

OC) to 92% (officers who were satisfied with the performance of OC spray). In the model predicting the extent of suspect incapacitation, four of thirteen independent variables were statistically significant. Specifically, OC spray was less effective when used by less experienced officers, against minority suspects, when suspects were warned beforehand they were going to be sprayed, and when suspects were under the influence of drugs.

The Effectiveness of Tasers

Two studies have examined the effectiveness of Tasers with specific regard to the incapacitation of subjects in arrest situations (White & Ready, 2007; White & Ready, 2010). White and Ready (2007) examined the effects of Tasers based on self-report surveys completed by (primarily SWAT) officers who worked in a large metropolitan police department. They considered the Taser effective if it led to the "successful incapacitation" of the subject. They found that after deploying a Taser, "85% of subjects were subdued by the Taser and taken into custody" (p. 183). The authors developed a multivariate "violence escalation scale" that they used to score each Taser incident. The scale included whether the subject was violent, armed with a weapon (and what type of weapon), under the influence of drugs or alcohol, mentally ill, the weight of the subject, and whether the officer was alone. Although individual analyses were not provided on each variable, the analyses performed on the scale revealed that the Taser was the most effective in the "highest risk" situations.

White and Ready (2010) analyzed Taser deployments from the New York City Police Department; the data were derived from the reports that officers completed subsequent to the deployment of the weapon. Three measures of Taser effectiveness were used in the study. The first measure was the officer's assessment of whether the Taser performed satisfactorily (yes/no).

Officers rated the performance of the Taser as satisfactory in 79% of cases. While this indicator of effectiveness was also used in prior studies (see Adang et al., 2006), the other two are unique in that they measure suspect resistance or, in other words, the *in*effectiveness of the Taser. The authors classified suspect resistance two ways: First, "continual resistance" included those situations where the suspect was not affected at any point by the weapon; the suspect continued to resist after the Taser was deployed. This occurred in 33% of all Taser deployments. In these instances the Taser was clearly ineffective. Second, "any resistance" included those situations where the Taser temporarily resulted in the incapacitation of the suspect, but the suspect resisted again prior to the conclusion of the incident. This occurred in about 11% of Taser deployments.

In their models predicting Taser (in)effectiveness, White and Ready (2010) explored the impact of multiple officer, suspect, and incident characteristics. They found the Taser to be less effective on heavier subjects (i.e., over 200 lbs), subjects who were under the influence of drugs or alcohol, subjects who were violent, when another less lethal weapon was used, when one or both prongs missed the subject, and when the Taser was fired from farther away (i.e., greater than three feet). When effectiveness was based on officer satisfaction, the Taser was also perceived to be more effective when the suspect was armed with a knife or gun.

Conclusions

There are too few studies available to draw confident conclusions about the factors that affect the use and effectiveness of OC spray and Tasers. Other than that males are more likely than females to be subject to a Taser than other forms of force (Gau, Mosher, & Pratt 2010; Crow and Adrion 2011), that OC spray is less likely to be effective on subjects who are under the influence of drugs compared to subjects who are not (Kaminski et al. 1999; Adang et al. 2006),

and that departmental policy affects the use of OC spray and Tasers (Crow & Adrion 2011; Morabito & Doerner, 1997), there is little consistency in findings. There is also little consistency in variables included in previous studies and the measurement of those variables.

It is safe to conclude, however, that estimates regarding the effectiveness of OC and Tasers depend at least in part on the measures used; different definitions of effectiveness produce different rates of effectiveness. In the studies reviewed here, rates of OC effectiveness ranged from 69% to 92% (Adang et al., 2006), while the effectiveness of the Taser ranged from 66% to 89% (White & Ready, 2010). The variation in effectiveness estimates notwithstanding, it appears that most studies show the Taser to be more effective than OC spray.

Our study adds to the discourse on the use and effectiveness of OC spray and the Taser in several ways. First and most importantly, this study is the first that directly compares OC spray with Tasers in terms of their use and their effectiveness, and we do so in the context of the same study site. Second, we include all intentional OC spray and Taser deployments to provide a potentially more inclusive assessment of effectiveness.[4] Lastly, we provide a logical measure of weapon effectiveness that incorporates the dynamic nature of use of force incidents and we use this same measure to evaluate OC spray and Tasers.

[4] Interestingly, Kaminski et al. (1999) excluded from their analyses incidents where OC was used but where it missed its intended target and incidents where it was used in a crowd situation. The authors also explain that if multiple officers or multiple subjects were involved in the incident, a single officer and/or a single subject was selected for analysis. In addition, it is unknown what, if any, other types of force were used before or after the deployment of OC spray. Adang et al. (2006), like Kaminski et al. (1999), excluded several categories of incidents from their analysis: incidents where officers deployed OC spray but it missed its intended target, where OC was intended to be used but the canister malfunctioned, incidents that involved a crowd situation, and when it was deployed against female subjects. In addition, the authors did not specify what, if any, other types of force were used before or after the deployment of OC spray. It is unknown how these factors may have affected their conclusions about OC spray effectiveness.

METHOD

Data

The data for this study were obtained from a large municipal police department. At the time of the study, the department employed approximately 2,000 sworn officers, about 1,200 of whom were patrol officers. The police department served a population of approximately 600,000; 40% of the population was African American and 10% was Latino.

Analyses were performed on all use of force incidents in 2010 and 2011 where an officer from the department intentionally discharged OC spray (n=259) or deployed a Taser (n=245) against a person. While an additional 24 incidents involved the use of OC and a Taser, and another 45 incidents involved the use of another type of weapon, the analyses conducted here focus on the 504 incidents where OC *or* a Taser was used.

All officers in the department were trained and authorized to carry and use OC spray. During the academy, officers received 4 to 8 hours of instruction on the use of OC spray. Only about 300 officers (approximately 25% of patrol officers) were trained and certified to use a Taser. Further, on each of the three shifts at each of the eight districts, approximately six to eight Tasers were available to be signed out and carried by the certified Taser officers. Therefore, at any given time during the time of this study, there were no more than 68 Tasers actually being carried by officers. With regard to Taser training, officers who volunteered for training first had to be approved by Internal Affairs. Officers who were selected to be Taser trained participated in 16 hours of "new user" training and an additional 8 hours of "refresher" training every 2 years.[5]

At the time of the study, the use of force policy of the department specified OC spray and Tasers as "control devices." According to the policy, "the goal of control devices is to overcome

[5] The only training required by TASER International is the 8 hours of "new user" training.

active resistance or its threat [italics added]." Control devices, escort holds, compliance holds and passive counter measures were more broadly considered "control alternatives." Although a continuum of force was not specified per se, "intervention options" were provided; these options ranged from presence, dialogue, control alternatives, protective alternatives (e.g., focused strikes, vertical stuns), to deadly force (see Figure 1).

Most of the data for the study were obtained from a case management system used by the police department and were converted into a Statistical Package for the Social Sciences (SPSS) data file for analyses. The database was organized with use of force incidents as the unit of analysis. The use of force data were based on reports that were completed by supervisory officers when a use of force incident occurred. According to the official policy of the department at the time of the study, a use of force report was to be completed by a supervisor when an officer: (a) discharged a firearm, (b) used a baton, (c) discharged Oleoresin Capsicum (OC), (d) deployed an Electronic Control Device (Taser), (e) used any other type of force, which resulted in an injury, or a complaint of an injury, to a person, or (f) when a department canine bit a subject in the performance of their duty. Clearly, this is a relatively narrow definition of force as it does not include incidents where only bodily force was used when that force did not result in an injury (or a complaint of an injury) to a subject (or verbal force, see Terrill & Mastrofski, 2002). Nevertheless, that the department policy did not require all bodily force incidents to be reported is of little concern in this study. This study focuses specifically on incidents that involved the use OC spray or a Taser. Departmental policy specified that all such incidents be recorded and all types of force used in those incidents be recorded.

Along with the departmental use of force report, a narrative of the incidents was also written by the supervisory officer and was included in the case management system. For this

study, all of the narratives for incidents that involved the use of OC and/or a Taser were reviewed (787 pages) and additional data were coded from them (e.g., level of subject resistance, the order in which force was used by officers).

Variables

The two primary dependent variables in this study are: 1) the *use of* OC spray and the Taser and 2) the *effectiveness of* OC spray and the Taser. Determining whether or not a particular type of force was used in an incident was relatively straight-forward. If OC was sprayed or a Taser was deployed, OC or the Taser was considered to have been used. If the target was missed, if the weapon malfunctioned, if it was used in a crowd situation, or if it was used against females, the incident was still included. If the incident involved multiple officers and/or multiple subjects, the incident was included. In the few incidents that involved multiple subjects, the characteristics of the person identified as the primary subject in the officer's report was coded.

Determining the effectiveness of OC spray and the Taser was more complicated. As discussed earlier, previous studies have used different measures of effectiveness although each study, in one way or another, examined how well, or to what degree, OC spray or the Taser incapacitated the subject who resisted the police. Of course, the variation in measurement is important to consider when interpreting findings across studies. Ultimately, in a use of force incident, the legitimate objective is to neutralize the threat posed by the subject and gain control over that subject. Most often, practically speaking, "gaining control" means using as much force as necessary in order to place handcuffs on the subject. Many use-of-force situations are

complicated; they unfold, one action leads to another, but ultimately force is used to gain control over the physical actions of the subject.

In this study, we provide a relatively straight-forward, bottom-line, measure of OC and Taser effectiveness. OC spray and/or Tasers were considered effective in two circumstances: First, if OC or a Taser was the *only* type of force that was used in the incident in order to subdue/handcuff the subject, OC or the Taser was considered effective. In these situations, OC spray or the Taser, by itself, led to the legitimate desired outcome; it was effective. Second, if OC or a Taser was the *last* type of force used in the incident prior to the subject being subdued/handcuffed, then OC or the Taser was considered effective. For example, if OC spray was deployed but then some other type of force was necessary in order to gain control over the subject to the point of placing him in handcuffs, then the OC was considered ineffective. OC may, or may not, have had some effect, but ultimately it was not effective in achieving the legitimate objective of the use of force incident—additional force needed to be used.

Of course, one must not lose sight of the possible cumulative effects that various types of force that were used in an incident may have in bringing an incident to an end. Indeed, several of the studies reviewed above simply did not take into account any other types of force that may have been used in the incident. Given the nature of the data analyzed in this study, measuring the precise effect that various forms of force may have had in a use of force incident is difficult, if not impossible. Nevertheless, to the extent possible, and when possible, we consider not only the last type of force used, but all types of force used in the incident. It is also important to highlight that the same criteria are used in measuring the effectiveness of OC and Tasers, providing for an equal ("apples-to-apples") comparison of the effectiveness of the two forms of

force. It is in these ways that an understanding of the relative effectiveness of OC and Tasers can be achieved.

Independent Variables

The independent variables in this study consist of subject characteristics and actions (see Tables 1 and 2 for coding and descriptive statistics). In particular, we focus on: 1) who was the subject? and 2) what did the subject do? Officer characteristics are not included primarily because of the analytic difficulties in doing so.[6] The number of officers who used force in an incident and the number of officers present when force was used were coded and included in the analyses as controls. The number of subjects who had force used upon them was also coded and included as a control.[7]

Data on "who the subject was" (i.e., the characteristics of the subject) were coded according to the supervisor's report. These variables consisted of subject race (white/minority[8]), age, sex, height, and weight.

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[6] Of course, this is a less than optimal solution to the issue; however, previous studies have struggled with the same issue and also resolved it in less than optimal ways. For instance, studies that have included officer characteristics either included only one officer when multiple officers were involved in the incident (Adang et al., 2006; Kaminski et al., 1999), or counted single incidents multiple times if multiple officers used force (White and Ready, 2007). Some studies are unclear about how multiple officer and multiple subject incidents were handled in the analyses (Morabito and Doerner, 1997). Each of these options essentially reduces the complexity of the incidents that are analyzed. None of these options are good, nor is the exclusion of officer characteristics; however, by not including officer characteristics we do not systematically exclude cases. Clearly, there is a trade-off between model error and sample bias.

[7] As noted, in multiple subject incidents, the characteristics of the primary subject, as identified in the police narrative report, were coded and included in the analyses.

[8] Ideally, sub-racial and ethnic groups would be analyzed instead of the "minority" category (Gau et al., 2010). However, too few Hispanics and/or other ethnic/racial group members were included among the incidents. The "minority" group classification consisted of 90% African American subjects (377 out of 419).

Most of the data on "what the subject did" (i.e., how the subject acted) were coded from the narrative reports prepared by supervisory officers and the statements included in the reports. These variables consisted of: whether the subject was mentally disturbed (yes/no), whether the subject was under the influence of drugs or alcohol (yes/no), whether a subject was believed to be armed with a weapon (yes/no), whether a subject was actually armed with a weapon (yes/no),whether a subject fled the police on foot (yes/no), whether a subject assaulted an officer ("yes" if it was stated in the narrative that the subject intentionally hit, kicked, bit, shot, stabbed, or spat upon an officer, "no" otherwise), and the level of resistance offered by the subject (coded on the basis of information provided in the narrative).[9]

RESULTS

Given the purposes of this study, results are organized into two sections: 1) those that relate to the *use* of OC spray and the Taser and 2) those that relate to the *effectiveness* of OC spray and the Taser. We begin with bivariate analyses and multivariate analyses of OC/Taser use and then turn attention to bivariate and multivariate analyses of OC/Taser effectiveness.

The Use of OC Spray and Tasers

How do the 259 incidents where OC spray was used differ from the 245 incidents where a Taser was used? This question was first addressed by calculating statistical differences

[9] Examples of *passive* resistance included when a subject refused to exit a car, subject went limp, subject refused to move after being ordered to do so, subject refused to show hands after being ordered to do so; examples of *verbal* resistance included when a subject told the officer(s) to leave him/her alone, subject stated he or she will not comply; examples of *defensive* resistance included when subject attempted to or actually fled the police, the subject attempted to hide from the police, subject pulled away from the officer, subject got up after being directed to the ground; examples of *active* resistance included subject fighting with the police, subject lunging at officer, subject attempting to disarm the officer (Terrill and Mastrofski, 2002).

between the variables of interest and OC spray and Taser incidents on the basis of chi-square and t tests (for the sake of space, results are not tabled here). Next, a logistic regression equation was estimated to identify factors that predicted OC spray versus Taser use; these results are shown in Table 3.

In the bivariate analyses, OC spray was significantly more likely than a Taser to be used on minority subjects ($X^2 = 6.82$; $p < .01$); OC spray and a Taser were equally likely to be used regardless of subject age, sex, weight, or height. A Taser was significantly more likely to be used than OC when the subject appeared to be mentally disturbed ($X^2 = 18.61$; $p < .01$), was believed to be armed with a weapon ($X^2 = 19.23$; $p < .01$), when the subject was actually armed with a weapon ($X^2 = 6.52$; $p < .05$), and when the subject fled the police on foot ($X^2 = 16.14$; $p < .01$). OC spray and Tasers were equally likely to be used when the subject was believed to be under the influence of alcohol or drugs, when the subject assaulted a police officer, and regardless of the amount of resistance provided to the police. OC was more likely to be used than a Taser when more than one subject had force used upon them in the incident ($t = -2.03$; $p < .05$); a Taser was more likely to be used than OC when more officers used force in the incident ($t = 2.30$; $p < .05$) and when more officers were present at the incident ($t = 6.39$; $p < .01$).

Table 3 shows the results of the logistic regression analyses performed for OC spray and Taser use. Due to substantial missing data, subject height and weight were not included in the equation. Two models were estimated: one compares those incidents where OC was used to those incidents where a Taser was used ("OC Used"), the other compares Taser use to OC use ("Taser Used"). The independent variables identified as significant in the earlier analyses are similar to those identified as significant here. First, all other variables held constant, when the subject was believed to be mentally disturbed, a Taser was more than two times more likely to be

used than OC spray (odds ratio = 3.296; p = .000). Second, when the subject was believed to be armed, a Taser was significantly more likely to be used than OC spray (odds ratio = 1.858; p = .023). Third, when the subject fled the police on foot, a Taser was significantly more likely to be used on the subject than OC spray (odds ratio = 2.452; p = .000). Fourth, when there were more subjects involved, OC spray was nearly 80% more likely to be used than a Taser (odds ratio = 1.794; p = .04). Finally, when there were more officers present at the incident, a Taser was significantly more likely to be used (odds ratio = 1.668; p = .000).

The Effectiveness of OC Spray and Tasers

Before examining the factors associated with the effectiveness of OC and Tasers spray, it is necessary to calculate an effectiveness rate for OC spray and Tasers (see Table 4). Of the 259 incidents where OC spray was used, 63 involved only the use of OC spray. That no other force was needed to subdue the subject can be considered reasonable evidence that OC spray was effective. In the other 196 incidents, OC spray and some other force were used. In these 196 incidents, the order in which force was applied is meaningful. In 128 of these 196 incidents, OC ended the encounter; presumably OC was used to subdue the subject because the force that was applied prior to the OC did not work, or did not appear to be working, at least in the judgment of the officer who deployed the OC spray.[10] There were 68 incidents where OC was deployed during the incident but some other force ended the encounter.[11] To calculate an effectiveness rate of OC spray, the 63 incidents that only involved OC spray and the 128 incidents where OC

[10] Of the 128 incidents, in 125 of them bodily force was used prior to OC spray; in 3 incidents, bodily force and a baton were used prior to OC.

[11] Of the 68 incidents, 63 ended as a result of bodily force, 5 ended with the use of a baton.

was used last are combined (63 + 128) and divided by the total number of incidents in which a OC spray was used (259). This calculation results in a 73.8% effectiveness rate.

Of the 245 incidents where a Taser was used, in 85 of them, only a Taser was used. In the other 160 incidents, a Taser and some other force were used. In 136 of the 160 incidents, a Taser was the last type of force used.[12] In the other 24 incidents, a Taser was deployed first but some other force ended the encounter.[13] To calculate an effectiveness rate of Tasers, the 85 incidents that only involved a Taser and the 136 incidents where a Taser was used last are combined (85 + 136) and divided by the total number of incidents in which a Taser was used (245). This calculation results in a 90.2% effectiveness rate. Using the same parameters for calculating the effectiveness of OC spray and Tasers, it is clear that Tasers demonstrate a substantially higher effectiveness rate than OC.

As demonstrated in prior studies, OC spray and Tasers may be more effective with some subjects than with others. Again, we calculated statistical differences between the variables of interest and OC spray and Taser incidents on the basis of chi-square and *t* tests (results not tabled). Overall, the results showed that the effectiveness of OC and Tasers did not vary significantly by any of the subject demographic variables included: subject race, age, sex, height, or weight. OC spray was significantly less effective when the subject was believed to be armed ($X^2 = 4.67; p < .05$), when the subject assaulted the police ($X^2 = 5.88; p < .05$), and when the subject provided higher levels of resistance ($X^2 = 16.91; p < .01$). As with OC spray, Tasers

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[12] Of the 136 incidents, in 135 of them bodily force was used prior to the Taser; in 1 incident, bodily force and a baton was used prior to a Taser.

[13] Of the 24 incidents, 21 ended as a result of bodily force, 1 ended with the use of a baton, and 2 ended with the use of a firearm.

were less effective with greater subject resistance ($X^2 = 10.78$; $p < .05$). The results also showed that OC spray and Tasers were less likely to be the last type of force used (less likely to be "effective") when more officers used force in the incident ($t = 3.73$; $p < .01$ and $t = 3.29$; $p < .01$, respectively). OC spray and Tasers were also less likely to be the last type of force used when more officers were present during the incident ($t = 3.00$; $p < .01$ and $t = 2.04$; $p < .05$, respectively).

To identify more directly the factors that predict the effectiveness of OC spray and Tasers, two logistic regression equations were estimated: one for OC effectiveness the other for Taser effectiveness (see Table 5). For each model, the comparison was between effective versus not effective. There are two primary findings worthy of discussion based on the logistic regression results. First, while the OC model is significant, the Taser model is not. It appears that the Taser is uniformly effective, regardless of the variables included here. Second, of all the variables examined, the only significant predictor of OC spray effectiveness is subject resistance. With more resistance offered, OC spray was 48% less likely to be effective (odds ratio = .515; p = .027).[14] Apparently, OC spray alone is not enough to subdue a subject who is more resistive.

DISCUSSION

Previous research on the use and effectiveness of OC spray and Tasers is characterized by incomplete and conflicting findings. There are simply too few studies from which to draw conclusions. Varying study sites, comparisons, data sources, and measurement schemes certainly contribute to these conflicting findings. Nevertheless, a basic conclusion of previous research is that OC spray and Tasers are used in different circumstances. This study used

[14] Congruent with Kaminski et al. (1999), in each of the logistic regression models, younger and older subjects (under 22 and over 38) were compared to "middle" aged subjects (22-37). The results of the analyses did not change in any meaningful way.

OC Spray/Taser Effectiveness

The only significant predictor of OC spray (in)effectiveness was subject resistance. The more a subject resisted the police, the less likely OC spray was to be effective. In particular, when OC spray was used in situations where the subject resisted, it was likely that OC was not the last type of force used. Either the OC spray led to additional resistance that had to be overcome with other force, or OC was not effective in subduing a subject who was already resisting. The model predicting Taser effectiveness was not significant; this suggests that the Taser was effective to the degree that our predictors did not contribute to our understanding of its effectiveness. As noted, the observed level of Taser effectiveness may be a function of the circumstances in which Tasers are used, the amount and quality of training officers received with the Taser, as well as their limited deployment in the study department.

With regard to the effectiveness rates of OC spray and the Taser, and congruent with previous studies, we found that the Taser was substantially more effective than OC spray. Given the research that has been conducted, it is safe to say that Tasers have inherent advantages over OC spray in their ability to incapacitate subjects. However, with this conclusion, it is important not to lose sight of the fact that OC spray and Tasers are simply tools and, like hammers, can be more effectively used by some people than others.

In summary, OC spray and Taser use and effectiveness are clearly different outcomes with different predictors. Overall, suspect behaviors are of value in predicting the *use* of OC and Tasers but not when predicting their *effectiveness*. While suspect behaviors may drive the decision to choose OC spray or the Taser over other forms of force, other factors determine whether OC spray or the Taser actually work to induce suspect compliance. For example, whether OC spray actually works may have less to do with the subject's characteristics and

actions, and more to do with the capabilities of the weapon itself (e.g., amount of OC sprayed, distance between officer and suspect when OC is sprayed). Further research that directly compares OC spray with Tasers may highlight other critical variables that would help explain the use and effectiveness of them.

IMPLICATIONS FOR POLICY AND RESEARCH

Given the relative paucity of research on the use and effectiveness of OC spray and Tasers, specific policy implications are premature. However, when considering the current findings along with the results of prior studies, several policy- and especially research-related questions come to light.

In particular, how Tasers are distributed among officers may have implications for their use and effectiveness in particular police departments. Specifically, are Tasers used at a higher rate if more officers are equipped with them? Is OC spray used at a lower rate if more officers are equipped with Tasers? If more officers are equipped with Tasers, and Tasers are used more frequently, is Taser effectiveness impacted? In addition, does the amount, type, and quality of training received by officers on OC spray and Tasers impact their use and effectiveness? To what extent does organizational policy regarding the use of OC spray and Tasers affect their use and effectiveness? As such, it would be worthwhile and interesting to consider the use and effectiveness of OC and Tasers across similar departments with different deployment arrangements, training standards, and policies regarding the OC and Tasers. Clearly, there is variance between departments in this regard.

It will not be until research accumulates that it will be possible to draw conclusions about the use and effectiveness of OC and Tasers with confidence. Along with factors already mentioned, the effectiveness of OC spray and Tasers are likely to depend on factors not included

in this study or in most others, including the distance from which the weapon was used, the type of clothing worn by the subject (heavy clothing being worn by the subject may inhibit the use of a Taser and/or the effectiveness of it), whether the target was moving at the time of weapon deployment, and the height/weight the subject in relation to the officer.

Another interesting topic for research on the issue is the impact of the *threat* of Taser use on resisting subjects. Adang et al. (2006) examined the impact of threats with respect to OC spray (in their study, OC spray was less effective when suspects were warned beforehand they were going to be sprayed), but no studies have looked at this issue with respect to Tasers; we currently lack information about how often Tasers are threatened to be used (or how often they are even displayed) by officers and the effects of those actions. Such studies could enhance our understanding of the overall effectiveness of the weapons and inform associated policy.

While there is a clear need for additional research on the use of effectiveness of OC spray and Tasers, there is also a need for additional research on the use and effectiveness of bodily force in use of force situations, especially given its frequency. Most use of force incidents begin with bodily force and most injuries to officers and subjects are as a result of bodily force (Adams, 1999). As such, it would be worthwhile for researchers to consider the effectiveness and other issues related to the use of bodily force. What factors predict the effectiveness or ineffectiveness of bodily force? There are many forms of bodily force, what types are most often used and most effective? Answers to these questions may provide insight into situations where bodily force (or certain types of bodily force) should be avoided and OC spray or Tasers used instead.

LIMITATIONS

This study contributes to the discussion about the factors associated with the use and effectiveness of OC spray and Tasers, but it has limitations. First, the data used in the study were collected from police reports which provide the official account of what happened during the use of force incident. Even the order in which force was used, which was critical for the measurement of OC spray and Taser effectiveness in this study, could be misrepresented in the reports. Although there is no evidence of systematic distortion or under-reporting in the reports, the accuracy of the reports could be questioned in this regard. Although many other use-of-force studies, and studies on other topics for that matter, also use official police reports, the veracity of the reports needs to be considered when drawing conclusions on the basis of them.

Second, the generalizability of the findings presented here can be questioned. This department had a unique arrangement for the deployment of Tasers among officers and had a specific policy which guided officer decision making in use of force incidents that involved OC spray and Tasers. Establishing external validity is always an empirical issue; as noted, there is a need for additional research to be conducted on the topic in other police departments.

Finally, this study included a relatively limited range of variables in trying to predict the use and effectiveness of OC spray and Tasers. We would benefit from additional studies that were able to include a wider range of independent variables in the prediction models. By addressing these limitations, a more complete understanding of the factors that predict the use and effectiveness of OC spray and Tasers may be developed.

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Figure 1

Description of "Intervention Options" Used in Study Department

MODE	Definition	Authorized Police Response(s)
Presence	To present a visible display of authority	Open stance, ready stance, defensive stance
Dialog	To verbally persuade	Search talk, persuasion, light control talk, heavy control talk
Control Alternatives	To overcome passive resistance, active resistance, or their threats	Escort holds, compliance holds, control devices **(i.e., OC, ECDs)**, passive countermeasures
Protective Alternatives	To overcome continued resistance, assaultive behavior, or their threats	Active countermeasures, incapacitating techniques, intermediate weapons
Deadly Force	To stop the threat	Deadly force

Table 1

OC or Taser Used: Coding and Descriptive Statistics

Variable	Scale	OC Used M	OC Used SD	OC Used N	Taser Used M	Taser Used SD	Taser Used N
Subject Characteristics							
Race	0=minority 1=white	.11	.31	253	.20	.40	241
Age	in years	30.70	11.17	252	30.06	10.65	239
Sex	0=female 1=male	.88	.33	251	.92	.27	240
Height	in inches	69.42	3.28	192	69.81	3.46	186
Weight	in pounds	187.49	40.76	192	188.35	46.91	186
Subject Actions							
Mental Disturbed	0=no 1=yes	.09	.29	259	.23	.42	245
Under Influence	0=no 1=yes	.43	.50	258	.46	.50	244
Believed Armed	0=no 1=yes	.22	.41	259	.40	.49	245
Actually Armed	0=no 1=yes	.08	.28	259	.16	.37	245
Fled Police	0=no 1=yes	.22	.41	259	.38	.49	245
Resistance	0=none 1=passive/verbal 2=defensive 3=active	2.40	.76	258	2.44	.73	245
Assaulted Police	0=no 1=yes	.17	.38	259	.13	.34	245
Controls							
# of Subjects		1.12	.47	259	1.04	.35	245
# of Officers Used Force		1.72	.86	259	1.92	1.12	245
# of Officers Present		2.44	1.16	259	3.37	2.03	245

Table 2

OC or Taser Effective: Coding and Descriptive Statistics

Variable	Scale	OC Effective M	SD	N	Taser Effective M	SD	N
Subject Characteristics							
Race	0=minority 1=white	.12	.32	187	.19	.40	217
Age	in years	30.86	11.47	185	30.02	10.62	215
Sex	0=female 1=male	.86	.35	184	.92	.28	216
Height	in inches	69.29	3.37	140	69.67	3.38	170
Weight	in pounds	184.40	39.78	140	188.05	44.00	170
Subject Actions							
Mental Disturbed	0=no 1=yes	.09	.29	191	.23	.42	221
Under Influence	0=no 1=yes	.42	.50	190	.46	.50	220
Believed Armed	0=no 1=yes	.18	.39	191	.38	.49	221
Actually Armed	0=no 1=yes	.07	.26	191	.15	.36	221
Fled Police	0=no 1=yes	.19	.39	191	.37	.48	221
Resistance	0=none 1=passive/verbal 2=defensive 3=active	2.28	.80	190	2.44	.71	221
Assaulted Police	0=no 1=yes	.14	.34	191	.12	.33	221
Controls							
# of Subjects Force Used Upon		1.14	.49	191	1.04	.37	221
# of Officers Used Force		1.60	.75	191	1.85	1.06	221
# of Officers Present		2.31	1.02	191	3.29	1.92	221

Table 3

Logistic Regression Models of OC or Taser Use

	OC Used			Taser Used		
	0=no 1=yes			0=no 1=yes		
Variable	B	p	Exp(B)	B	p	Exp(B)
Subject Race	-.579	.056	.560	.579	.056	1.785
Subject Age	.017	.093	1.017	-.017	.093	.983
Subject Sex	-.076	.836	.927	.076	.836	1.079
Subject Mental Disturbed	-1.193	.000	.303	1.193	.000	3.296
Subject Under Influence	-.316	.150	.729	.316	.150	1.372
Subject Believed Armed	-.619	.023	.538	.619	.023	1.858
Subject Actually Armed	.149	.704	1.160	-.149	.704	.862
Subject Fled Police	-.897	.000	.408	.897	.000	2.452
Subject Resistance	-.199	.207	.819	.199	.207	1.221
Subject Assaulted Police	.527	.079	1.694	-.527	.079	.590
No. of Subjects	.584	.041	1.794	-.584	.041	.558
No. of Officers Used Force	.202	.140	1.224	-.202	.140	.817
No. of Officers Present	-.512	.000	.599	.512	.000	1.668
Constant	1.301	.054	3.673	-1.301	.054	.272
Log likelihood	565.613			565.613		
Model Chi Square	103.617			103.617		
df	13			13		
Significance	.000			.000		
R Squared (Nagelkerke)	.258			.258		
N	483			483		

Notes: B=log odds, p=significance, Exp (B)=odds ratios

Table 4

OC and Taser Effectiveness

OC was Used in 259 incidents (no Taser used)

In 63 incidents only OC used
In 196 incidents OC and other form(s) of force were used

In 128 of the 196 incidents, OC ended the encounter
In 68 of the 196 incidents, another type of force ended encounter
(i.e., bodily force = 63; baton = 5)

63 + 128 = 191 / 259 = OC 73.8% effective rate

Taser was Used in 245 incidents (no OC used)

In 85 incidents only a Taser used
In 160 incidents a Taser and other form(s) of force were used

In 136 of the 160 incidents, a Taser ended the encounter
In 24 of the 160 incidents, another type of force ended encounter
(bodily force = 21; baton = 1; firearm = 2)

85 + 136 = 221 / 245 = Taser 90.2% effective rate

OC and Taser were Used in 24 incidents

In 22 of the 24 incidents, the Taser ended the encounter
In 2 of the 24 incidents, OC ended the encounter

Another Weapon was Used in 45 incidents (no OC or Taser)

In 22 of the 45 incidents, only a firearm was used
In 14 of the 45 incidents, bodily force and a baton were used
In 4 of the 45 incidents, only a baton was used
In 3 of the 45 incidents, bodily force and a firearm were used
In 1 of the 45 incidents, gas and a firearm was used
In 1 of the 45 incidents, bodily force and a flashlight were used

Table 5

Logistic Regression of OC and Taser Effectiveness

Variable	OC Effective 0=no 1=yes B	p	Exp(B)	Taser Effective 0=no 1=yes B	p	Exp(B)
Subject Race	.424	.434	1.528	-.317	.617	.728
Subject Age	.012	.451	1.012	-.014	.557	.986
Subject Sex	-1.433	.076	.239	-.419	.714	.658
Subject Mental Disturbed	-.423	.455	.655	-.001	.999	.999
Subject Under Influence	-.340	.323	.712	.071	.890	1.073
Subject Believed Armed	-.351	.411	.704	-.416	.456	.660
Subject Actually Armed	-.726	.251	.484	-.397	.556	.672
Subject Fled Police	-.265	.483	.767	-.768	.144	.464
Subject Resistance	-.664	.027	.515	.232	.516	1.261
Subject Assaulted Police	-.529	.189	.589	-.754	.255	.470
No. of Subjects	.661	.222	1.037	.657	.697	1.929
No. of Officers Used Force	-.414	.062	.661	-.531	.017	.588
No. of Officers Present	-.174	.286	.840	.000	.998	1.000
Constant	4.651	.001	104.660	3.647	.122	38.343
Log likelihood	244.171			139.531		
Model Chi Square	41.147			15.443		
df	13			13		
Significance	.000			.281		
R Squared (Nagelkerke)	.224			.134		
N	248			235		

Notes: B=log odds, p=significance, Exp(B)=odds ratios