Critical Issues in Police Discipline

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Introduction

Conducting traffic stops is a routine patrol duty of police officers. The most frequent and visible interactions between police officers and the public take place in motor vehicles, most commonly at roadside traffic stops (Eith & Durose, 2011; Harris, 1989; Pinizzotto, Davis, & Miller, 2008). Officers successfully complete the majority of “routine” traffic stops without facing the threat of injury; however, traffic stops can place officers at risk of injury or death either by intended or unintended actions by an assailant or others (Payton, 1964). According to the California Commission on Peace Officer Standards and Training (2005), traffic stops “can be one of the most dangerous duties a patrol officer can perform” (p. 1-3). In a study investigating officer attacks while performing routine traffic stops, one officer reported that as he approached the back door of the vehicle and informed the driver he was stopped for speeding, the driver’s only response was “two shots in the chest from a handgun . . . into my vest” (Pinizzotto et al., 2008). From 2001 to 2010, approximately 60 of 541 officers who were feloniously murdered in the line of duty were killed during a traffic stop, and 55,000 were injured during a traffic stop or pursuit (Federal Bureau of Investigation [FBI], 2010; U.S. Department of Justice, 2011).

Although many departments have added various adaptations to traffic stops, these tactics, created by some of the best tactical officers in the United States, were not developed from scientific research. As noted by Justice Scalia, there is a paucity of research on officer safety in relation to the dangerousness of traffic stops (Maryland v. Wilson, 1997). This article is an effort to form discussion on the current research involving officer traffic stop procedures.

One of the more common training procedures is the position an officer takes in relation to the vehicle. Officers are often instructed to stand on the passenger or driver’s side and at some distance or angle to the B-Pillar of the automobile (Adams, McTernan, & Remsberg, 2009; Payton & Amaral, 1996; Perry, 1998; Remsberg, 2003). The B-Pillar is the second pillar from the front of the vehicle in the passenger compartment and is located just past the seat or in alignment with the front passenger seat. Historically, officers have assumed positions at the B-Pillar that are in front of or behind the pillar and at the classical angles of 45°, 90°, and 180°. For example, an officer can stand at the driver’s door with his or her right leg close to the B-Pillar and his or her body in front of the pillar at a 45° angle alignment with the vehicle. This places the officer at an opportune position to view inside the front passenger compartment of the vehicle as well as offers time to react if the driver were to pull a weapon (Adams et al., 2009; Perry, 1998; Remsberg, 2003).

In addition to B-Pillar alignment, officers are taught to consider the “threat zones” of vehicles when performing traffic stops. As defined by Remsberg (2001), these threat zones are areas relative to an offender’s vehicle in which officers are vulnerable to an attack. For the present study, Remsberg’s “crisis zone” was used to determine the Mitigation Zone (MZ) for the driver’s side of the vehicle. The “crisis
“zone” or MZ is an area where the officer is at a position of reduced risk because the configuration of the vehicle being stopped impairs or restricts the driver’s visual access or weapon alignment on the officer. The MZ on the driver’s side is defined by a 10º angle, extending outward from the B-Pillar and facing the rear of the vehicle.

As addressed by Remsberg (2001), the more an officer is caught offguard, the larger their startle response will be and, consequently, it will take them longer to react. Reaction time is the length of time it takes to perceive a stimulus and prepare a response, whereas movement time is the duration of time it takes to complete the response (Remsberg, 2001; Vickers, 2007). Kinesthetic reaction time occurs faster than auditory or visual reaction time at 0.12 to 0.14 seconds (s) (Vickers, 2007).

This human startle response, or kinesthetic reaction, is a person’s physical response to a sudden, intense stimulus (Davis, 1984). Most often, a startle response will cause a person to experience a series of muscular contractions taking place within milliseconds of the onset of the stimulus and may end just as quickly. Common responses of the body are fist clenching or hand grasping, occasional teeth baring, forward movement of the shoulders, bending at the hips, and so on (Davis, 1984). In relation to possible officer response reactions, according to Jones and Kennedy (1951), the sound of a pistol shot can induce a startle response in the trapezius muscle, causing a shrugging motion, within 25 to 50 ms (Davis, 1984). These responses were often completed within 0.2 to 0.5 s (Jones & Kennedy, 1951). In addition to muscular contractions, this startle response evokes an elevation of heart rate, although this varies considerably among different individuals (Eves & Gruzelier, 1984). As officers often anticipate risk or prepare themselves for action when performing traffic stops, similar to athletes preparing for competition, officers’ heart rates may increase as much as 25 beats per minute (bpm) prior to even performing a task (Sime, 1985). Overall, reaction time, startle responses, and choice of tactical movement may assist in playing a detrimental role in the amount of time officers take to respond to a deadly threat and reach a safe zone.

The primary purpose of this study was to assess the various positions officers take after walking up to a vehicle while conducting a traffic stop and to evaluate whether those positions inherently have some element of safety that an officer can rely upon, before, during or after an assault. A secondary purpose of this study was to observe the automatic reactions, tactical responses, and movements made by the officers. In particular, reaction and movement times were measured in relation to threat presentation. Because the body can begin to process and react to information faster than the eyes and ears, officers’ startle responses to the presented threat were also observed for study purposes. When observing officers in the following traffic stop scenario, the goal was to investigate the types of startle responses they had during retreat, in addition to how these responses influenced their reactions and movement speed. Prior to this study, there had been no formal assessment of officer reactions in a threatening traffic stop scenario.

**Methods**

**Participants**

An original sample of 94 participants from police agencies from the states of Oregon and Washington volunteered for the study. Of the 94 participants, one was eliminated from data analysis due to equipment malfunction during the experimental trial, resulting in a total sample of 93 participants (13 females and 80 males). The sample included the following rankings: one Captain, two Corporals, three Deputies, two Deputy Sheriffs, 10 Detectives, 68 Officers, one School Reserve Officer, four Sergeants, and three Senior Reserve Officers. The participants’ experience in law enforcement was 12.4 ± 7.4 years. All participants were told that the primary purpose of this research project was to “better understand officer movement in response to a threatening traffic stop.” Participants were not informed of any specifics of the study until meeting with
an investigator in the warehouse. All participants completed informed consent waivers before entering the warehouse.

Participants also completed a health screening and fitness level questionnaire (range 0 to 10) (George, Stone, & Burkett, 1997). The participants’ demographics were as follows: age = 38.8 ± 7.3 years; body mass index = 28.9 ± 4.23 kg/m²; maximum oxygen uptake (VO₂max) = 38.59 ± 7.04 ml/kg/min, where VO₂max was estimated using the regression equation by Jackson et al. (1990). The results from these forms were used to detect any medical conditions or previous injuries that would cause serious risk to the participants during experimentation or compromise results. All participants had received a physical and completed regular fitness testing prior to the experiment as part of the requirements for being on active duty. All procedures were pre-approved from the sponsoring institutional review board for the protection of human subjects.

Additionally, as Remsberg’s (2001) “crisis zone” only defined areas on the driver side of a vehicle, to define an MZ for the passenger side, pilot testing was done on multiple vehicles to determine the angle of the area deemed safest from threats presented by the driver. A 60° angle from the passenger side B-Pillar was determined to mitigate most threats; however, for research purposes, a more rigorous 45° angle was used in order to accommodate any prospective error associated with our video analysis (see Figure 1 for defined Mitigation Zones).

In order to investigate the influence of officer positioning on safety during a traffic stop, a number of positions that officers either take on initial approach or evolve into as the stop develops were established (see Figure 1 for designated officer positions). These positions were developed by senior author (WL), who has observed officers on traffic stops for over 40 years and instructed traffic stop conduct in an academy or clinical setting for over 25 years.

**Equipment**

For each trial, participants began standing beside a police department cruiser. A confederate was seated in a 2004 Ford Taurus and both vehicles were aligned with the police cruiser off-center to simulate a roadside traffic stop (Figure 1) (Payton & Amaral, 1996; Perry, 1998). Before entering the warehouse, each officer was required to safety-check their firearm for an approved training gun with one round of Simunition, nonlethal training ammunition, and a magazine. They were also given a SOLO 915 Men’s wrist heart rate monitor, ear plugs, safety glasses, identification information, and an orange armband to indicate they had attended the safety-check portion of the study. The confederate driver was equipped with a handgun and Simunition ammunition.

Participants were video-recorded from an overhead position with aid of a scissor lift (Genie, Redmond, WA, USA). The third trial for each participant was video-recorded at 30 Hz and zoomed in sufficiently to prevent the need for panning (Flip Video Ultra HD, Flip Technology, Irvine, CA, USA). The area was marked off with one-meter strips to allow for calibrating screen pixels. All officers wore black shoes, and the warehouse floor was white tile, which aided our ability to detect foot positioning. Each video was digitized on a frame-by-frame basis using commercial software (Dartfish Prosuite 6.0, Dartfish, Alpharetta, GA, USA). XY coordinates for the front tip of the right and left shoes were determined, and the center of gravity (CG) was estimated as the equal distance between the right and left shoes. The video analysis software was also used to measure the designated MZ angles for both the passenger and driver side positions (Figure 1).

The primary purpose of this study was to examine the influence of officer position relative to the B-Pillar of a vehicle on tactical responses to a lethal threat in a traffic stop scenario. The secondary purpose of the study was to observe the responses, reactions, and
movements made by the officers. These times were used to observe whether or not one position might be deemed safer than others. Using the digital video analysis, we determined times for the following events: Driver Movement Initiation, Driver Weapon Presentation, Officer Reaction Initiation, Mitigation Zone Reached, Officer Weapon Presentation, Driver Weapon Discharge, Officer Weapon Discharge, and, if applicable, Officer Neutralization Attempt (see Table 1 for event definitions for data analysis and Figure 1 for Mitigation Zone).

**Procedures**

Prior to beginning the experimental phase, participants were informed that they would be completing a number of trials of a traffic stop scenario that may or may not escalate. Participants were neither informed of the exact number of trials nor when nor how the traffic stop would escalate in order to ensure that his or her reactions were as close to natural as possible. Using a predetermined script, the same instructor directed all participants, one at a time, that the scenario was a roadside traffic stop occurring because the driver exceeded the posted speed limit by 10 mph. Participants were instructed that once they approached the driver’s vehicle, they must stand with the toes of at least one foot on a line at a predetermined angle, taped on the ground, and were not to move from that alignment unless necessary. Participants were also directed to keep their hips and torso aligned with the tape on the floor relative to the vehicle. These angles consisted of 45°, 90°, 180° in Front of the B-Pillar on the driver’s side, and 180° Behind the B-Pillar on the driver’s side, in addition to 45° in Front of the B-Pillar on the passenger’s side or a self-selected position on the driver’s side (Figure 1). The use of predetermined positions was to preserve internal validity, whereas the addition of the self-selected position was to preserve external validity. Heart rate measures were taken upon officers’ arrival (for baseline), after entering the warehouse and receiving instructions for the scenario procedures, and immediately following each of the traffic stop trials. Heart rates are expressed relative to the officer’s
<table>
<thead>
<tr>
<th>Event Title</th>
<th>Coding Definition</th>
<th>Event Time (s) M (SD) by Position</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>90° (Driver’s Side)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NA</td>
</tr>
<tr>
<td>Driver Movement Initiation</td>
<td>Any movement or shift in the driver’s body that indicates the driver is presenting their weapon. This event represents the zero time point to the events below.</td>
<td>0.38 (0.12)</td>
</tr>
<tr>
<td>Driver Weapon Presentation</td>
<td>The point in time which the driver’s gun is fully presented in open view of the officer and no longer in motion upwards.</td>
<td>0.37 (0.13)</td>
</tr>
<tr>
<td>Officer Reaction Initiated</td>
<td>Any movement or shift in the officer’s body that indicates their reaction (to the driver’s weapon presentation) was beginning.</td>
<td>2.27 (0.25)</td>
</tr>
<tr>
<td>Mitigation Zone Reached</td>
<td>The precise frame/point in time in which the officer’s entire body was within the designated Mitigation Zone.</td>
<td>1.96 (0.47)</td>
</tr>
<tr>
<td>Officer Weapon Presentation</td>
<td>The point that the officer had fully drawn their weapon and had their weapon paused and aligned on target.</td>
<td>0.53 (0.13)</td>
</tr>
<tr>
<td>Officer Neutralization Attempt</td>
<td>If the officer attempted to neutralize the weapon, the time the officer’s hand made contact with the driver’s gun.</td>
<td>2.20 (0.05)</td>
</tr>
<tr>
<td>Weapon Discharge (Officer)</td>
<td>The point in time the officer’s gun was first fired.</td>
<td>0.57 (0.14)</td>
</tr>
<tr>
<td>Weapon Discharge (Driver)</td>
<td>The point in time the driver’s gun was first fired.</td>
<td>2.20 (0.05)</td>
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Note: M = average; SD = standard deviation

*Not all participants in this positioning attempted to neutralize the driver.

'This time was significantly faster in comparison to all of the other positions, except 180° Behind the B-Pillar.
age-predicted maximal heart rate using the following equation (Tanaka, Monahan, & Seals, 2001):

\[
\text{Age Predicted Heart Rate Maximum} = 208 - (\text{Age} \times 0.7).
\]

Participants were instructed that they could begin the trials when the researcher told them to begin, and the trials would end when the researcher blew the whistle. All trials began at the driver’s side door of the police vehicle. Officers then walked to either a predetermined position or a self-selected position relative to the confederate’s vehicle. The first two trials consisted only of a verbal confrontation lasting 45 seconds. The confederate driver’s script included his proclamation that he was a sovereign nation, no longer a part of the United States, and therefore was not required to follow U.S. laws. The confederate used a given script consisting of argumentative phrases such as “Do you even know what you’re doing?,” “I am in my own nation,” and “I don’t think you understand—I need to leave.” He was also supplied with two pieces of documentation: (1) a homemade “conveyance pass” and (2) declaration of his sovereign nation status; however, he did not have any state-issued identification, registration, proof of insurance, or a driver’s license. The first two trials were intended to distract the participants from the true intent of the study: to evaluate their response to a lethal threat during a traffic stop.

The third trial began with a verbal exchange, similar to the first two trials. The trial escalated when the confederate pulled and fired a weapon multiple times at the participant. This trial was video-recorded and used for movement analysis of the participant’s response to the deadly threat. Following each participant, the warehouse was ventilated between trials to remove the excess smoke created by the firearms and to prevent participants from detecting that there would be gunfire during the experiment. The participants also were debriefed as to the true intent of the study by a retired police psychologist and were given the opportunity to review footage of the third trial.

**Data Analysis**

The last seven events in Table 1 represent the dependent variables. The times for each of the seven variables were found by subtracting the time at which the event took place in each video from the time in the video for Driver Movement Initiation. A second investigator evaluated a total of 22 participants (~25% of the sample) for the purpose of establishing inter-rater reliability. These data were evaluated using intraclass correlation coefficient (ICC) and coefficient of variation (Hopkins, 2000). Each dependent variable was examined using a one-way ANOVA with repeated measures and Bonferroni-adjusted post-hoc testing. The criterion used to reject the null hypothesis was \( p < 0.05 \). All descriptive statistics are reported as mean ± SD.

**Results**

Each traffic stop trial evoked higher heart rate responses in comparison to pre-trial measures (Figure 2) \( (F = 163, p < 0.01) \). The third trial evoked the highest heart rate responses in comparison to the other trials, which would indicate the third trial evoked a genuine startle response. Inter-rater reliability for the digital analysis of time for each event (Table 1) was extremely high (ICC = 0.99 and coefficient of variation = 2.85%). No time differences between positions were observed for Driver Weapon Presentation \( (F = 0.75, p = 0.43) \), Driver Weapon Discharge \( (F = 0.31, p = 0.90) \), or Officer Reaction Initiated \( (F = 0.38, p = 0.99) \). Likewise, no time differences were found between positions for Officer Weapon Presentation \( (F = 0.05, p = 0.99) \), Officer Neutralization Attempt \( (F = 0.54, p = 0.67) \), or Officer Weapon Discharge \( (F = 0.59, p = 0.71) \) (Figure 3).

In each of the trials, all officers approached the confederate’s vehicle with their weapons holstered. For all of the experimental trials, the confederate was able to draw and aim his gun at the officers; however, 12 officers made
an attempt to neutralize the confederate’s weapon, and three were successful. One officer deflected the confederate’s weapon while drawing and discharging their own weapon, whereas another officer applied a defensive choking maneuver. Both officers prevented the driver from firing his weapon (NB, the researcher with the whistle, ended the trials to avoid injuries to the confederate and officers). A third officer was able to sweep aside the confederate driver’s gun at the time of discharge while firing their own. A total of 81 of 93 (87%) officers engaged the confederate driver by attempting to neutralize and/or by drawing their weapon and returning fire. A total of nine of 93 (10%) officers neither attempted to neutralize nor engage the driver and simply retreated from the threat. Of the officers self-selecting their approach ($n = 13$), five chose the 180° Behind the B-Pillar (position c, Figure 1), three stood in the 45° Driver’s Side (position b, Figure 1), four selected a 45° Behind the B-Pillar, and one chose the 180° in Front of the B-Pillar (position d, Figure 1).

Analysis of the videos revealed two primary startle responses regardless of positioning to the confederate vehicle: (1) a response of the non-weapon hand “guarding” the face and back pedaling while drawing their weapon and returning fire ($n = 53$), and (2) a reaction of side-stepping or carioca stepping to retreat, followed by drawing their weapon and returning fire ($n = 19$). Mean times to reach the MZ for the startle responses were very similar (backpedaling: 2.10 ± 0.73 s; side-stepping: 2.16 ± 0.52 s). A total of 17 of the 93 officers did not reach the MZ as defined in Figure 1. In analyzing the two primary startle responses, nine (17%) of the participants who backpedaled and two (11%) of those who side-stepped did not reach the MZ.
Video analysis also revealed that when participants drew their weapon, either before \((n = 39)\) or after \((n = 20)\) reaching the MZ, influenced the amount of time it took to reach the MZ. The participants who began drawing their weapon after they had already reached the MZ \((2.04 \pm 0.41 \text{ s})\) were faster at reaching the MZ \((F = 5.99, p = 0.02)\) in comparison to officers who began drawing their weapon early in their retreat \((2.43 \pm 0.64 \text{ s})\). Participants who did not make it to the MZ were not included in data comparison due to failure to qualify for criterion. Additionally, participants who were positioned on the 45° Passenger Side were not included in the data comparison because there was a lack of distinguishable difference in the two variables being compared as a result of the close proximity of the passenger side MZ.

Positioning (Figure 1) effected the time to reach the MZ \((F = 5.82, p < 0.01)\). The MZ was reached significantly faster \((M = 0.56 \text{ s})\) when beginning in the 45° Passenger Side position in comparison to all other positions, with the exception of 180° Behind the B-Pillar (Figure 1). The 180° Behind the B-Pillar position was the fastest of the positions beginning on the driver’s side; however, the difference was not statistically significant (Table 1). For all of the officers, the dependent variables noted in Table 1 were evaluated.

**Discussion**

The primary purpose of this study was to examine the influence of officer position relative to the B-Pillar of a vehicle on any adherent safety elements of the officer’s tactical responses to a lethal threat in a traffic stop scenario. A secondary purpose of the study was to observe the responses, reactions, and

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*Denotes significant value
movements made by the officers during a threatening traffic stop scenario.

For each participant, our confederate was able to aim and, in most cases (90 of 93), discharge his pistol at the officer. The heart rate data indicates that a genuine startle response was evoked in the third trial, reaching an average of 70% age-predicted heart rate maximum (Figure 2) for which a 70% maximum is regarded as a high level of aerobic exercise (Sime, 1985). As such, the preceding two trials effectively distracted the officers from our true purpose of the study: to evaluate their realistic response to the threat of lethal force during a traffic stop scenario. No differences between positions were observed for the time it took the confederate to present and discharge his pistol. Thus, we are confident our comparison of response times from the various positions relate to the mechanics of the positions relative to the vehicle and is not due to the timing differences of our confederate’s actions. Moreover, we observed high intra-rater reliability of our timing method, reducing measurement error as a likely cause for unrealistic findings. All self-selected trials were completed on the driver’s side with a majority of officers standing in one of the preselected experimental positions, with 180° Behind the B-Pillar position being the most commonly selected. As such, we are confident the results of this study reflect how police officers would realistically position themselves at an apprehended vehicle and respond to an actual lethal threat.

One of the primary observations made during our study were the participants’ startle responses upon threat presentation. Although it was observed that officers who backpedaled and side-stepped had very similar times in reaching the MZ, a considerably higher percentage of those who backpedaled were unsuccessful in reaching the MZ. We also noted that officers who backpedaled exposed their center of mass and head to the driver for a greater amount of time. These reactions seem to have little to do with previous training and are more heavily based on human instincts. One of the most common gestures made during officers’ startle responses was the “blocking” movement in which they raised their hands or arms to shield themselves from the gun and then began to backpedal while drawing their weapon.

Officers are trained to neutralize a suspect’s weapon in very close proximities rather than retreat and try to draw their own because drawing their own simply takes too much time (Adams et al., 2009; Davis, 2006). However, this neutralization was only seen in three of 93 participants, while the remaining 90 participants were often shot multiple times. Although nine officers made an attempt to neutralize the driver’s weapon, none followed through with or finished the attempt, resulting in the need for retreat and further exposure to the driver’s gunfire. Such an observation reaffirms the necessity for officers to engage regularly in tactical training along with visualization strategies toward neutralizing a weapon in close proximity with this type of assault during a routine traffic stop.

The other notable observation made on officer retreat times was the significant difference in the amount of time it took officers to reach the MZ. Officers who waited until after they had already reached the MZ to draw their weapons were able to retreat 0.39 s faster than if they were to simultaneously draw and retreat. This difference can be attributed to the more complex motor movement and attention resources needed to draw and retreat as opposed to simply retreating and then engaging.

When examining the influence of position on officers’ response times to a threat during a traffic stop, we observed that officers who approached the vehicle on the passenger side were able to reach the MZ by an average of 0.56 s faster than if they were to approach on the driver’s side, with the exception of officers starting at a 180° angle behind the vehicle’s B-Pillar on the driver’s side. Therefore, approaching the passenger side of a vehicle during a routine traffic stop allows officers to reach a zone—considered to mitigate potential threats presented by the driver—much more quickly.
According to previous research (Lewinski, 2000), the time it takes a suspect in the driver’s seat to pull a concealed weapon and fire at their target is 0.25 s on average, with the fastest recorded time being 0.15 s. The results of this study demonstrate slightly longer shooting times as the driver took time to align his weapon to the moving center mass of the participant, resulting in a mean Weapon Discharge (Driver) time of 0.53 ± 0.18 s (Table 1). Factoring in the average time it took officers to react to the driver’s movement (M = 0.37 ± 0.09 s) shows officers are left with less than 0.20 s to either present and discharge their weapon or reach the MZ. As previously noted, it was demonstrated that officers who pulled their weapon after they were already in the MZ were able to get there 0.39 s faster than officers who pulled their weapon during retreat from the driver’s side window. Additionally, officers positioned on the driver’s side of the vehicle took an average of 2.29 ± 0.60 s to reach the MZ, while officers who approached on the passenger side were able to reach the MZ in an average of 1.50 ± 0.52 s, thus possibly giving the officers an additional 0.50 s to reach safety. Such a small window of time could mean the difference between life and death in the field. Prior research indicates that once a target is acquired, it takes 0.25 to 0.36 s, dependent upon the type of weapon and speed of trigger stroke, to fire off just one additional round (Lewinski, 2002). Given the current findings of the study, a suspect could fire two to three shots at a retreating officer before the officer is able to get to safety, emphasizing the importance of officer responses to the presentation of a deadly threat.

Conclusion
This is the first study to systematically evaluate police officer responses to the threat of lethal force during a routine traffic stop. Our findings indicate that the positions most commonly used during driver’s side traffic stop procedures fail to adequately protect officers against the threat of lethal force. Conversely, a robust finding of the study was that approaching a vehicle on the passenger side during a traffic stop is the safest option for officers because they can reach the Mitigation Zone faster and spend less time in the line of fire. We also observed officers who waited until reaching the MZ to draw their weapon retreated more rapidly than those who drew their weapon simultaneously to retreat. These two findings show the only two significantly influential approaches officers can use to maximize their safety when conducting a routine traffic stop. If officers, regardless of the current findings, still choose to approach vehicles on the driver’s side during a traffic stop, the development of skills in close proximity neutralization and visualization strategies to increase officers’ chances of survival in a threatening situation is highly recommended.

Acknowledgments
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