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NOTES

An Investigation of the Effectiveness of Police Cruiser Doors as Protection From Handgun Attack

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The objective of this research was to investigate the degree to which automobile doors (especially police cruiser doors) may be used as protection by police officers when under handgun attack. This is a vital question, since the cruiser door is often the only defense a police officer has when encountering gunfire. Data were collected on door penetration capabilities of 3 calibers of handguns (selected based on FBI data on police officer assaults) at 2 different angles of fire. Results indicated that caliber has a significant effect, with the likelihood of penetration increasing with caliber. The oblique angle of fire (45°) was somewhat less likely to penetrate than an orthogonal angle, although the difference was not significant. Overall, 68% of the rounds penetrated the door regardless of angle of fire or caliber.

police police cruiser doors protection handgun attack

1. INTRODUCTION

Law enforcement personnel face life-threatening situations on a daily basis. Federal Bureau of Investigation (FBI) data show that since 1988, close to 700 have been killed in the line of duty, another 629 have been killed in duty-related accidents, and over 600,000 have been assaulted [1]. Law enforcement personnel may encounter armed suspects who are not necessarily intent on harming them, but who may use any force necessary to avoid capture. The objective of this research has been to ascertain the amount of protection offered by a car door (a police cruiser door) in the event of such an attack with a handgun or small weapon.

The FBI records data on deaths and injuries, but not on assaults that have not resulted in death. These records indicate that from 1992 to 2001 there were 594 firearm-caused deaths among police officers: these deaths were distributed among caliber of weapon as follows:

- 37%—9 mm,
- 11%—.45,
- 2%—.22, and
- 50%—other.

The records indicate that the calibers classified as "other" were closely related to three specified categories (although a breakdown was not provided by the FBI). For example, a .44 caliber is very similar in size and energy to a .45 caliber, but would have been classified as "other" [1].

Other data recorded by the FBI include distance at which fatal shot was fired, body region of fatal wound, and specific location of fatal wound. These

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data are pertinent in that they can be used to set experimental parameters.

Of the 594 fatalities recorded between 1992 and 2001, the following is the distribution of distances at which the shot was fired:

- 50%—≤5 ft (152 cm),
- 22%—6–10 ft (183–305 cm),
- 10%—11–15 ft (335–457 cm),
- 9%—16–20 ft (488–609 cm),
- 8%—>20 ft (609 cm), and
- 1%—unknown.

An important result of these data is that 82% of the fatal shots were fired from a distance of 15 ft (457 cm) or less [1]. This figure was instrumental in the choice of the distance of fire for the experiment.

Finally, the FBI data on specific location of fatal wounds indicate that of the 594 fatalities that occurred between 1992 and 2001, 78% were from shots to the front of the body. The data are distributed as follows:

- 35%—front of head;
- 14%—back of head;
- 39%—front of torso;
- 7%—back of torso;
- 4%—front, below waist; and
- 1%—back, below waist.

Finally, ballistic vests are commonly advocated in police training and practice. Over half (307 or 52%) of the 594 officers fatally shot were wearing body armor of some type.

These data show two things. The first is that a ballistic vest may not afford enough protection. The second is that 78% (460 out of the 594 fatalities) of officers were killed facing their opponents as may be inferred from a wound to the front. Together, these data emphasize the importance of the cruiser door as a potential source of protection from handgun assault. Whether or not the door offers sufficient protection is a potentially important aspect of police training, since it will allow police officers to use the door for this purpose or to preferentially seek other forms of protection (cover) that may be available.

A police-training center in Arizona, USA, teaches trainees that there are two different methods of protection. These two methods are cover and concealment. Cover is anything that is likely to stop or deflect a bullet round. However, concealment is any object that will hide the officer, but not necessarily stop a bullet round. Currently, this training academy considers the cruiser door as concealment and not cover [2]. In contrast, the New Hampshire Police Standards and Training Academy teaches trainees that a cruiser door may be considered a source of cover [3].

It is apparent that further research on this topic would be valuable, especially since there is a paucity of literature available either to the public or to the police training community. Inquiries indicated that several such studies were conducted but that they were proprietary in nature and never published [4, 5].

Therefore, the objective of this study is to contribute to this under-representation in the published literature by investigating the amount of protection that may be offered by a police cruiser door in the event of an attack with a handgun or small weapon.

2. METHODS

2.1. Material

Six car doors were obtained from a local automobile salvage lot: four Ford Taurus doors and two Chevrolet Lumina doors. FBI data indicate that all automobile doors are similar in that they consist of two pieces of 20-gauge steel 3 in. (7.6 cm) apart. The FBI uses this as a standard for ballistics testing [1].

The choice of handguns was derived from the FBI data presented previously. Three calibers of handguns were chosen for use in this experiment: .44 caliber, .22 caliber, and 9 mm. The specific handguns were a .44 magnum Smith and Wesson, a .22 caliber 10-22 Ruger, and a 9-mm High Point.

Although the FBI data showed that the highest number of officers was shot with a .45 automatic, a .44 magnum was used. The Remington .45 automatic has a 250-grain bullet that has a muzzle velocity of 262 m/s and the .44 magnum has a

muzzle velocity of 230 m/s with a 246-grain bullet [6]. Therefore, the .44 magnum was considered an adequate surrogate for the .45 automatic (the former being chosen based on availability and affordability).

2.2. Experimental Design

The following factors were used in the experiment:

- caliber—three levels (.44, .22, and 9 mm),
- angle of fire—two levels (45^o and 90^o), and
- location on door—10 levels (doors were divided into 10 segments and one shot was fired into each to maintain the integrity of the target).

This resulted in 6 conditions, repeated 10 times for each door. Location on the door was treated as a replicate. All shots were fired from a distance of 15 ft (457 cm), since FBI data indicated that 82% of officers were shot at distances of 15 ft (457 cm) or less [1].

Since the FBI data also showed that 78% of fatal shots were delivered while the officer was facing the assailant, the two angles of fire were chosen to be 90^o and 45^o. The angle of fire was defined as the angle between the path of the bullet round and the surface of the door. The underlying assumption was that an officer would not receive a shot to the front of the body at an angle smaller than 45^o.

Conditions were presented randomly to prevent any effects due to sequence of data collection. If a round completely penetrated the door, then the condition outcome was assigned a value of 1. Otherwise a value of 0 for no penetration was assigned to the condition outcome.

2.3. Analytical Techniques

Data were initially subjected to descriptive and graphical analysis. Subsequently, since the outcome variable was binary (penetration vs. no penetration), logistic regression was used as the inferential analytical method. The independent variables were caliber and angle of fire.

3. RESULTS

Descriptive and graphical analyses indicated that proportion of penetration increased with caliber and angle of fire (see Figures 1, 2, and 3). Overall, 41 of the 60 rounds (68%) penetrated the doors.

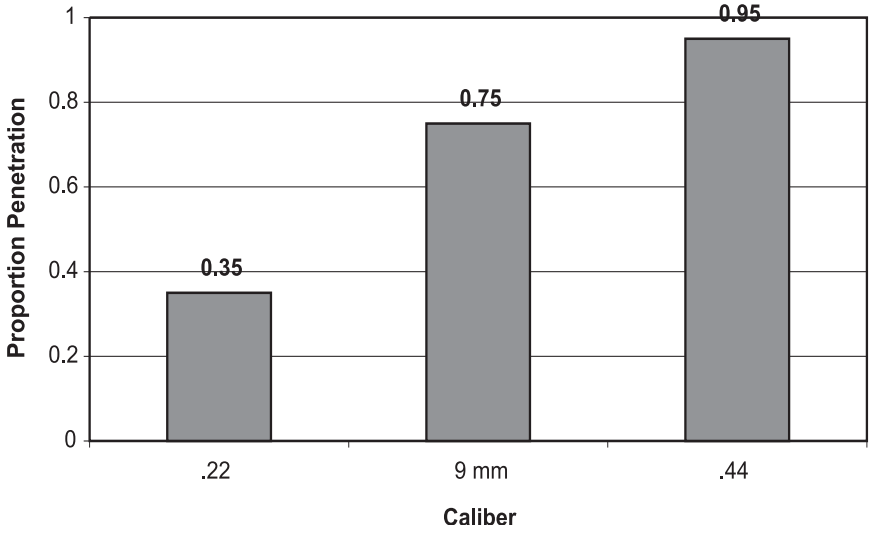

Figure 1. Comparison of the calibers and the associated proportion of penetration for each caliber.

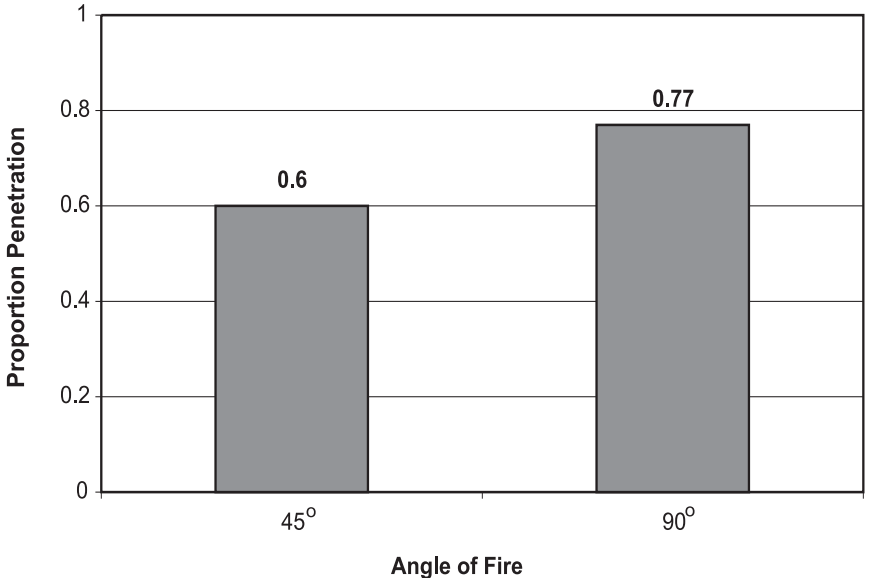

Figure 2. Comparison of the angle of fire and the associated proportion of penetration for each angle.

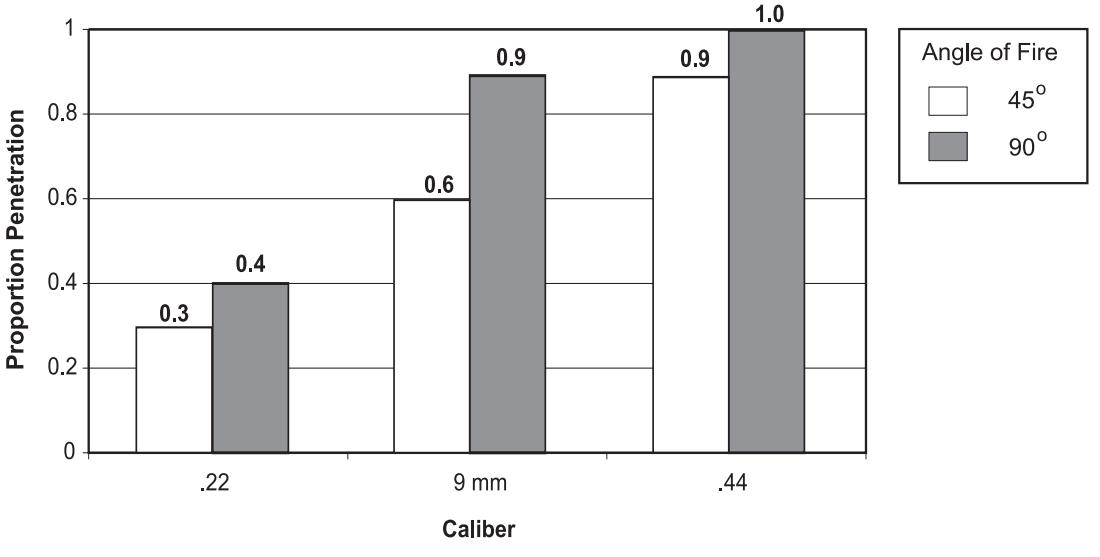

Figure 3. Comparison of caliber and angle of fire.

Figure 4. Proportion penetration by door position.

TABLE 1. Results of the Logistic Regression With the Main Effects of Caliber and Angle of Fire. Odds Ratios (OR) and 95% Confidence Limits (CL) for Caliber and Angle of Fire Are Also Shown

Variable	OR	Lower 95%CL	Upper 95%CL
Caliber (reference group: .22)			
.44	42.5*	4.4	416.2
9 mm	6.3*	1.5	26.9
Angle of fire (reference group: 45°)			
90°	3.1	0.8	12.3

Notes. *significant.

The location on the door into which the round was fired also showed some differences (see Figure 4). Position 10 showed somewhat lower penetration rates. This may be attributed to the fact that this position is near the rearview mirror and may have more hardware associated with it. However, a Kolmogorov-Smirnov Good of Fit test indicated that the data were uniformly distributed across the 10 door locations ($p > .05$).

Table 1 shows the result of the logistic regression. The .22 caliber was used as the reference value for caliber and 45° was used as the reference value for angle of fire. The table shows the odds ratios and the 95% confidence intervals.

The .44 caliber and the 9-mm showed a significantly elevated odds ratio as compared to the .22 caliber handgun. The 90° angle shows a slightly elevated odds ratio (when compared to the 45° angle), but this was not significant. The odds ratios are consistent with the observed level of penetration for each caliber and angle of fire.

Other observations that were made in the course of the experiment were as follows:

- The door never stopped the .44 caliber round at the 90° angle of fire. To further investigate this, four doors were placed in front of each other. In this case, the round penetrated three and lodged in the fourth.
- As the trials were conducted, it appeared that even when rounds did not penetrate the door completely, there was energy transfer, since material in the background was disturbed and debris from the door flew in the direction that a police officer would be standing.

4. DISCUSSION AND CONCLUSIONS

This experiment demonstrated that there is a significant difference in the proportion of penetration as the caliber of a handgun increases. It also implies, although the results were not significant, that as the angle of fire decreases, the proportion of penetration is likely to decrease. Furthermore, it appears that the calibers tested are equally affected by the angle of fire, since the proportion of penetration increased with caliber at both angles.

It is important to note that the potential for injury exists even though a round may not penetrate the door entirely, since a hazard exists in the form of material discharged from the door with sufficient energy to cause injury. Any material put in place to remedy the energy transfer to the inside of the door could effectively decrease injury.

All of these results indicate that there is very little protection afforded to a police officer using the cruiser door as cover. To allow the door to be used as cover, the best solution would be to retrofit doors with material that would prevent bullet round penetration. A material that could be considered is Kevlar. Kevlar is light and is in common use in protective vests. Furthermore, Kevlar is available in sheet form and would cost from US $500 to $1000 per door. Only the front doors would have to be retrofitted to transform the door into a safe form of cover.

This study implies that a stock car door is not sufficient protection for police officers from gunfire. It is also advisable that these results be made available to the law enforcement community so that officers may make informed decisions about

choosing cover and so that training programs may include this information.

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