Discharge Analysis of the Struggle over a Firearm

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Abstract
Cases often involve a struggle with a firearm. An important issue is the determination whether an unintended discharge could have occurred. This report defines the elements of a struggle that could lead to an unintended discharge during a struggle. A simple controlled experiment is defined and performed that evaluates some of these elements of a struggle for a specific firearm in evidence for a specific incident. The results of this experiment are presented probabilistically and confirmed that the potential for an unintended discharge during a struggle is greater if the firearm is in single action mode. Furthermore, the experiment confirmed that the potential for an unintended discharge during a struggle is less if the firearm is pointed upward. Of the two factors -- trigger mode and gun angle, the single action mode appears to be the more dominant factor.

Keywords: struggle over a firearm; accidental discharge; unintended discharge; controlled experiment; hypothesis testing.

Introduction

This article achieves a number of primary goals. The factors that determine whether a struggle over a firearm will result in an unintended discharge are defined and tested for a specific firearm. A formal methodology is provided and demonstrated for conducting a controlled experiment in order to evaluate these factors for a single firearm. Finally, the conclusions are presented in a probabilistic form, as required by a scientific approach -- an approach that is sorely missing in most "scientific" testimony in criminal trials.

In many shooting incidents, a struggle for the firearm occurs prior to the discharge. Inevitably, the issue of an unintended discharge arises. This article demonstrates the use of the scientific method to understand some of the struggle dynamics that could influence the unintended discharge of the firearm.
A firearm can discharge in one of three ways: accidental, unintended, and intended.

An accidental discharge can occur when something inside of the firearm is operating incorrectly, in spite of the proper operation of the firearm. Typically, this kind of discharge is the result of a design flaw causing the firearm to discharge or when parts inside the firearm are broken and operating incorrectly results in a discharge. An example of this type of discharge occurs when some external action causes the mechanical safety to be overridden. Since this experiment deals with a specific firearm in a specific incident that does not exhibit accidental characteristics, an accidental discharge is not of interest here.

An unintended discharge can occur when the firearm is fully functional and the operator takes actions that result in a discharge as a result of the operator incorrectly using the firearm. Often, this type of discharge results from violating the basic safety rules of firearm usage and some unforeseen event occurs that involuntarily causes the firearm to discharge. A very common example of this type of discharge occurs when an untrained operator has a finger on the trigger and is bumped or a struggle occurs for the firearm.

The Participants in a Struggle

When a struggle over a firearm takes place, for purposes of this experiment, two individuals participate. The **Holder** of the firearm has physical control over the firearm. The **Taker** of the firearm is attempting to gain control of the firearm.

The Elements of a Struggle

During a struggle, a number of factors affect the potential for an unintended discharge. This list of factors covers most of the possibilities. However, with any specific struggle, some of these factors will be more important than other factors. As a result, not every factor will be used in evaluation of a specific struggle.

**Holder/Taker Height And Weight:** these factors determine the amount of force that can be exerted by each participant during the struggle. A taller participant can exert greater force in all directions. However, a heavier person can establish greater stability against that force by squatting—crouching with knees bent and heels close to or touching the buttocks or the back of the thighs.

**Revolver Vs Semi-Automatic:** each of these categories of firearms possess different moving parts. The number, extent, and location of the moving parts can potentially retard discharge depend on their ability to move during the struggle. For instance, semi-automatics possess slides, while
revolvers possess cylinders and exposed hammers. Each of these parts plays a role in the discharge of the firearm. If movement of these elements is prohibited, the discharge possibly be prohibited.

**Dimensions Of The Firearm:** smaller and shorter firearms possess much less gripping area for the Taker and the Holder, making control over the firearm more difficult. On the other hand, larger and bigger firearms, which have more gripping surface area, can make grasping of the components that effect discharge difficult.

Specific factors include the length of the barrel -- short to long, the size of the frame -- compact or wide, and the grip dimensions -- also, compact/wide/short/long.

**Position Of Holder/Taker Relative To Environment:** the environment can be flat, angled, hilly, or ditched. Depending on the locations of the Holder and the Taker, one participant obtains better balance. Better balance leads to greater leverage over the other participant. Typically, the participant with greater leverage has better control over the firearm. Movement by the participant with greater leverage combined with lack of movement by the other participant can often lead to a discharge.

**Position Of Holder/Taker Relative To Each Other:** typically participants in a struggle for a firearm are facing each other. A face to face struggle is more likely because the Taker has more direct access to the firearm. Moreover, if the firearm is not positioned in between the Holder and the Taker, the Taker may not even have any access, because the body of the Holder blocks access completely. However, participants may also be to the side, above, or below. A Taker to the side or below has less leverage than a Holder above. This leverage results in the Holder having more leverage and greater control over the potential discharge of the firearm. The reduction in force by the Taker to the side or below occurs because a force is being applied at an angle. When a force is applied at an angle, that force is reduced by the sine of the angle, according to the laws of physics. [1]

**Position Of Hands Of Holder/Taker:** Taker and Holder can grip locations of the body, such as wrist, arm, neck, or shoulder. Grip may also be on various locations of the gun such as barrel, slide, cylinder, or grip.

**Location Of Gun At Discharge:** the firearm may be at a low height, at the middle height between the participants, or high up between the participants During the struggle, the firearm could also be moving from a low position between the low and high positions, and end up anywhere in between. However, focus on the low, middle, and high positions provides a framework for analysis, when the infinite number of positions in between cannot be fully evaluated due to time and cost constraints.
**Angle Of Gun At Discharge:** the firearm may be level, pointed upward, pointed downward, pointed to the left, or pointed to the right.

**Type of Trigger:** trigger systems include single action, double action, or both. In general, single action triggers possess a lighter pull weight. Thus, a cocked single action trigger is more likely to discharge during a struggle. An uncocked single action trigger cannot discharge without being cocked, so that a discharge during a struggle is relatively unlikely. Double action triggers can possibly discharge. But, double action triggers generally have a much greater trigger pull travel and weight to be overcome. If a firearm supports both modes of trigger operations, then the potential for an unintended discharge depends upon the mode in which the trigger is placed prior to the struggle.

**Trigger Pull Weight:** the amount of trigger pull weight is expressed in pounds. A lighter trigger pull weight is more likely to discharge during a struggle. A heavier trigger pull weight takes more force to overcome, reducing the likelihood of an unintended discharge during a struggle.

These factors are the elements that determine whether or not a discharge can occur during a struggle over a firearm.

**The Issues in a Struggle**

The conditions for an unintended discharge to occur are influenced by the factors listed above. However, these factors cause a number of issues to emerge that govern the possibility of an unintended discharge.

**Holder vs Taker Leverage:** a participant in a struggle with leverage has far greater capability to control the movement of the firearm during the struggle. This movement may prevent an unintended discharge or cause an unintended discharge, depending on the parts of the firearm that are affected by the exerted leverage. Leverage can be obtained a number of ways. A person who is more muscular may have more leverage. When one person is standing over another, the person above may have more leverage, or not, depending on the effects of squatting as described above.

**Natural Tendency Of Untrained To Put Finger On Trigger When Grab:** anyone who is untrained who picks up a firearm often places the trigger finger on the trigger. Untrained persons often do not understand the consequences of having a finger on the trigger. Trained firearm operators are taught an important safety rule: keep your finger off the trigger until your sights are on the target.
Natural Tendency Of Untrained To Hold With A Loose Grip: when a person unfamiliar with firearms holds a firearm, the grip tends to be very loose. This grip occurs because an untrained person usually does not know about recoil and its effect. Trained operators know that a tight grip is needed to control recoil.

Natural Tendency To Resist By Gripping Harder When Struggling To Take/Retain: when a person is holding an object and a struggle ensues, the Holder automatically grips the object harder. This harder grip is just a natural consequence of the intent to retain ownership of that object during the struggle.

Unintended Trigger Finger Response When Grip Harder To Retain: trained operators know about the unintended trigger finger response. When the firearm is gripped, the trigger finger tends to compress. If the trigger finger is placed on the trigger, this unintended trigger finger response can cause the trigger to depress, leading to an unintended discharge.

Taker/Holder BOTH Moving Back/Forth/Left/Right/Up/Down/Twist During Struggle: when a Holder and Taker are struggling over an object, both are attempting to overcome the grip of the other participant. In order to loosen the grip, each participant will be moving the object in all sorts of directions. When a firearm is moved in all different directions, pressure on the trigger finger can result.

Factors That Effect Unintended Trigger Finger Response Such As Balance: a discharge from an unintended trigger finger response is a well understood and well documented phenomenon. Perhaps the best experiment published that documents this phenomenon is provided by Heim, Niebergall, and Schmidtbleicher [2]. According to this article, and the medical articles referenced, a number of factors can result in a discharge from an unintended trigger finger response: sympathetic contractions, loss of balance, and startle reaction.

During trial testimony in 1995, Dr. Roger Enoka of the Human Performance Research Laboratories in AZ, identified the factors above that can lead to an unintended trigger finger response and discharge. Sympathetic reactions can result from any muscle movement anywhere in the body and translate into an unintended trigger finger response. For instance, squatting with a firearm in the hand and the finger on the trigger. Leg movements during the squat can translate into an unintended trigger finger response. When a person loses balance, the body automatically attempts to correct the balance. Muscles that move to correct the balance also can translate into an unintended trigger finger response. Finally, when something startles the body, such as a loud sharp noise, muscles in the body automatically contract. Contracting muscles also can translate into an unintended trigger finger response. Any time the finger on the trigger contracts, an unintended discharge can occur.
Heim, et al, [2] performed an experiment to test these assertions about trigger finger response. Both simple tests and real world scenarios were used. The results were also captured on video. According to the test results, the three conditions did regularly lead to the unintended trigger finger response and an unintended trigger press. These tests were performed with active duty police officers. Officers participating in the test claimed to be unaware of the trigger finger response. Using the video of the tests, the officers were shown that the trigger finger response actually took place as a result of sympathetic contractions, loss of balance, and startle reaction.

**Resistance To Discharge – Retention Of Slide/Cylinder:** When the components of a firearm are working correctly, these components and the manner of their interaction can contribute to an unintended discharge. Examples include the slide of a semi-automatic firearm and the cylinder of a revolver. If these components are unconstrained, a discharge might occur. If these elements are constrained, a discharge is far less likely to occur. Placement of the hands of the Taker can constraint the components so that the designed operation of the components is prohibited. For instance, in the example above, if the hands of the Taker are gripped around the slide, the slide may be constrained. A constrained slide can prohibit a discharge of the firearm during a struggle.

**Holding Trigger Finger Stiff But Gun Pulled:** the Holder of the firearm may stiffen the trigger finger, but still maintain a loose grip. If the taker is able to move the firearm during the struggle, the movement of the firearm during the struggle may cause the trigger to be pressed to the rear under the stiff finger. As a result, the firearm can discharge.

During a struggle over a firearm, the resolution of the issues will determine if an unintended discharge occurs. But, every struggle with every firearm resolves each of these issues in a different manner. *In order to resolve these for a specific firearm during a specific incident, a controlled experiment is necessary.*

**The Incident at Issue**

The victim was standing in front of his store attempting to clean out his vehicle. The victim was approached from behind by a suspect who pointed a firearm at his face from a short distance. The suspect asked the victim to hand over his chain and his wallet. At first, the victim did not believe that the suspect was serious. Possibly a struggle may have occurred but neither victim nor suspect is sure. The firearm discharged. The victim was wounded in the face. The suspect ran away and was later apprehended.

At issue is whether or not the firearm could have discharged if the firearm had been involved in a struggle.
The Firearm At Issue

A firearm was found by the police. This firearm is a Gerstenberger and Eberwein Revolver, chambered in 22 Short. The firearm possesses a 2 inch barrel with a cylinder capacity of 6 cartridges. Original grips were missing and have been replaced by tape.

![Photo 1: The Revolver In Evidence](image)

This firearm can operate in either single action mode or double action mode. In double action mode, the operator simply presses the trigger to the rear. Pressing the trigger both cocks the hammer, then releases the hammer, hence double action. Single action mode requires that the operator manually cock the hammer, then use the finger to press the trigger. Pressing the trigger performs the single action of releasing the hammer. In either case, releasing the hammer causes the firearm to discharge.

Preliminary testing of the firearm revealed that the trigger control system has a number of issues. In order to press the trigger in double action mode, the operator needs to first take up the slack in the trigger. Thus, in double action, the trigger operates with two stages -- a slack stage, and a cocking/releasing stage. In order to cock the hammer to enter single action mode, the operator must press the trigger a bit to the rear. These operating features are unique features about which only a person familiar with the firearm would know.

Trigger pull tests were performed with the firearm in both single action mode and double action mode. The revolver was secured in a vise. Five (5) sample pull weights were collected for each mode of operation. Pull weights were averaged. Range of the values was determined by subtracting the maximum value from the minimum value.
### Table 1: Single Action Trigger Pull Weight

<table>
<thead>
<tr>
<th>Sample</th>
<th>Weight (lbs)</th>
<th>Measured Weights (oz)</th>
<th>Computed Summaries</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>11.5</td>
<td>Avg Pull: 2 lbs, 9.5 oz</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>14.2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>2.9</td>
<td>Range of Pull: 0.71 lbs</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>13.0</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>6.1</td>
<td></td>
</tr>
</tbody>
</table>

**NOTE:** Must press trigger a bit to rear to cock hammer for Single Action Mode

Average trigger pull weight in single action mode was 2 lbs, 9.5 oz. The range of pull weights was 0.71 lbs or about 3/4 lb. Measured weights are in ounces, as reported by the trigger pull guage. Averages/Ranges are provided in lbs and oz's, consistent with the manner of reporting of trigger pull weights. This form of representing the results will be utilized in all of the tables that involve pull weights.

### Table 2: Double Action Trigger Pull Weight

<table>
<thead>
<tr>
<th>Sample</th>
<th>Weight (lbs)</th>
<th>Weight (oz)</th>
<th>Computed Summaries</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>9</td>
<td>15.0</td>
<td>Avg. Pull: 10 lbs, 7.2 oz</td>
</tr>
<tr>
<td>2</td>
<td>10</td>
<td>4.5</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>11</td>
<td>2.0</td>
<td>Range of Pull: 1.19 lbs</td>
</tr>
<tr>
<td>4</td>
<td>10</td>
<td>6.1</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>10</td>
<td>8.3</td>
<td></td>
</tr>
</tbody>
</table>

**NOTE:** Must take up slack in trigger to start measuring Double Action Mode

Average trigger pull weight in double action mode was 10 lbs, 7.2 oz. The range of these pull weights was 1.19 lbs, or about 1 1/4 lbs.
Table 3: Typical Trigger Pull Weight

<table>
<thead>
<tr>
<th>Firearm</th>
<th>Min Pull Weight (lbs)</th>
<th>Max Pull Weight (lbs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>.22 caliber rimfire rifles</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Military rifles</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>Single-action revolvers</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>Double-action revolvers</td>
<td>10</td>
<td>15</td>
</tr>
<tr>
<td>Semiautomatic pistols</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

Firearm Examiner Training Web Site, National Institute of Justice, US DOJ

In order to evaluate these weights, a standard of comparison is required. Typical trigger pull weights are provided by the Firearm Examiner Training Web Site, of the National Institute of Justice.

Typically, a revolver double action trigger possesses a trigger pull weight between 10 and 15 pounds. This revolver shows an average trigger pull weight of 10 lbs, 7.2 oz, ranging between 9 lbs, 15 oz (almost 10 lbs) and 11 lbs, 2 oz. The average and range double action trigger pull weight are within the 10 lb - 15 lb range stated by NIJ.

A single action revolver typically has a trigger pull weight from 4 - 6 lbs. The revolver in evidence exhibits an average single action trigger pull weight of 2 lbs, 9.5 oz or just over 2 1/2 pounds. The trigger pull ranges in single action range from 2 lbs, 2 oz to 2 lbs, 14.2 oz. Thus, the trigger pull weight of the revolver in evidence is well below the expected range of revolver single action trigger pulls.

The single action trigger of the revolver qualifies as a fairly light trigger pull, but not as a hair trigger. If the hammer was cocked and the firearm was in single action mode prior to the start of the incident, then a struggle over the firearm with the finger of the Holder on the trigger could potentially lead to an unintended discharge. The potential for a discharge exists because of the light weight of the single action trigger pull.
So, any experiment regarding this revolver a struggle, and an unintended discharge would have to include the trigger mode: single action or double action.

The Incident At Issue

According to the Investigation Report, the incident took place in front of the shop of the victim. This area is a normal, relatively flat city street. In this environment, many of the factors that affect an unintended discharge during a struggle are eliminated.

However, an examination of the photos of the victim and the police report indicate the angle of the firearm at the time of the discharge.

A photo of the victim indicates an entry wound in the left cheek. Furthermore, according to the Investigation Report, a nurse told the Investigating officer that the victim had suffered a loss of vision due to a torn retina in the left eye. The bullet was lodged into the neck, according to the nurse. A review of the medical report did not reveal that the doctor had made this observation. However, this fact was used in the preliminary hearing, and so makes sense to use here.

Photo 2: Victim Head Wound Showing Trajectory Angle

Photo 2 shows the actual head wound in the victim. The wound enters at the left cheek, and moves towards the retina of the left eye. According to the Incident Report, the victim was reported standing at the time of the incident. So, a path from the cheek to the eye would be upward angled. This angle would at least be about 20 degrees.
So, any experiment regarding this incident, a struggle, and an unintended discharge would have to include an upward angle at the time of the discharge.

The Scientific Method

The scientific method is a way to ask and to answer scientific questions by making observations and doing experiments. Any experiment must be a fair test. A "fair test" occurs when one or more factors (variables) are varied and most other conditions remain the same. From a practical point of view, no experiment can perfectly control all other conditions. The experimenter should identify the primary conditions that stay the same and justify emphasis on those conditions.

Steps in an experimental design include the following:

Formulate Hypotheses

Design an Experiment to Control Variables

Conduct the Experiment to Collect Data

Analyze the Data

Evaluate the Hypotheses Using the Collected Data

Any experiment proceeds from the hypotheses. A hypothesis is an educated guess that is going to be proved or disproved by an experiment. The hypothesis must be clear, concise, and measurable or observable in some manner.

If the hypotheses include measurable phenomena, then a statistical analysis can be performed upon the hypotheses. However, if the hypotheses include observable events, then the impact of the control factors in the experiment on the hypothetical events can be confirmed or denied.

In this experiment, the focus is on an observable event -- the occurrence of an unintended discharge during the struggle over a specific firearm.

The Hypotheses to Test

In this simple experiment, several hypotheses are of interest.

H1: The potential for an unintended discharge during a struggle is greater if the firearm is in single action mode.
H2: The potential for an unintended discharge during a struggle is less if the firearm is pointed upward.

These hypotheses are a direct consequence of the analysis of the firearm in this incident and the wound ballistics of this incident, as described above.

The focus of this experiment is an underlying event -- the occurrence of an unintended discharge during the struggle over a specific firearm. However, the hypotheses are formulated in a manner that allows a count of events to be used to determine if the hypotheses is proved or disproved.

For instance, consider the experiment in which the upward angle of the firearm is the control factor. Six different samples are taken under varying conditions. Two of those samples result in an unintended discharge. Four samples do not result in an unintended discharge. Then, two of the six samples resulted in an unintended discharge. This result would indicate that the potential for an unintended discharge during a struggle is less if the firearm is angled upward, proving hypothesis H2. Using less and greater on a comparative basis enables counting of events to prove or disprove the hypotheses.

The Experimental Design

When designing an experiment, control factors are identified. The simple experiment to test these hypotheses use four control factors.

- angle of the firearm: pointing straight ahead or upward;

- mode of the firearm: single action or double action;

- grip type: stiff or loose;

- grip location: barrel or cylinder;

In all of the samples, the finger of the Holder is placed on the trigger. This assumption is based on the basic knowledge that almost all untrained operators place a finger on the trigger when holding the firearm. The accused in this incident clearly admitted that he had no firearms experience.
A loose grip occurs when the Holder retains the firearm without much force, if any. Again, experience shows that this type of grip is often utilized by untrained operators, such as the accused in this incident. A stiff grip is used when the muscles of the hand, including the trigger finger are tightened, but still held loosely in the hand. This type of grip is typical of a Holder who is brandishing the firearm, but is concerned about its potential usage.

Since this firearms is so small, the Taker is limited to two possible grips -- around the short barrel or encapsulating the whole revolver in his grip by wrapping around the barrel and the cylinder.

**Data Collection Process**

This experiment was performed at a private shooting range. The range was flat and wide, so that environmental factors were eliminated as an issue, just as the level street conditions in the incident.

Two actors were used to simulate the struggle. One actor was the Holder, the other actor was the Taker. Holder and Taker were placed about 2-3 feet apart. Both Holder and Taker were instructed to keep their feet in the same location during the simulated struggle, rather than moving the body.

An individual sample in the experiment followed a specific protocol:

- An unloaded firearm in evidence was placed into one of the modes -- single action or double action.
- Holder took possession of the firearm using one of the specified grips -- stiff or loose, with finger on the trigger
- Holder pointed the unloaded firearm towards the Taker in a specified direction -- straight and level or upward.
- Taker gripped the firearm at one of the locations -- barrel or cylinder.
- Taker tried to take possession of the firearm from Holder using pushing/pulling/left/right/upward/downward and twisting motions.

If the hammer fell, making a clicking noise, an unintended discharge was recorded. If the hammer did not fall, then the failure to discharge was recorded.

Both Holder and Taker were given very specific instructions. For instance, with the loose grip, the Holder was instructed to freeze his hand stiffly and not to move any of the fingers of his hand during the struggle. This limitation enabled the experiment to determine if a stiff unmoving trigger finger could result in a discharge during a struggle.
Multiple perspective photographs of the setup of each experiment were taken to record the physical setup of the individual sample. All perspective shots were taken from the same locations around the struggle, three (3) perspectives on each side of the struggle setup.

Photos show a perspective view of the Holder and the Taker. The Holder has the firearm angled upward. The close-up view shows the hammer cocked, in single action mode. The Taker has gripped the barrel, since the cylinder is fully exposed. When the grip is loose, the pistol is more easily pulled forward, allowing the trigger finger to unintentionally exert rearward pressure on the trigger. A loose grip with a stiff trigger finger was used to simulate this condition.

A loose grip is demonstrated by the stiffened trigger finger and the small empty space below and to the right of the pistol grip of the firearm.

Several videos were also taken to specifically record the discharge and failure to discharge. In one video, the revolver is angled upward, the pistol is in single action, the Holder uses a stiff grip, and the Taker grips the cylinder. At the beginning of the video segment, the hammer is clearly cocked in single action. A distinct click is heard as the hammer falls during the struggle. At the end of the video segment, the hammer is clearly sitting against the frame after the falling of the hammer. A second video starts with the revolver being angled upward, the hammer is sitting against the frame in double action, the Holder is using a stiff grip, and the Taker is gripping the cylinder. At the beginning of the video segment, the hammer is clearly in double action position. During the duration of the video, the clicking sound of a hammer falling is not heard. At the end
of the video segment, the hammer is still clearly in the sitting position against the frame. Clearly, no discharge occurred in this video.

The Collected Data

Sixteen (16) sample struggles were performed under the control variables. The discharge/no discharge results were recorded into tables. These tables are organized into groups around the primary control variables identified in the hypotheses under test: firearm direction -- straight ahead or upward, trigger mode -- single action or double action.

Table 4: Revolver Pointing Straight Ahead, Single Action

<table>
<thead>
<tr>
<th>Mode</th>
<th>Grip Type</th>
<th>Grasp Location</th>
<th>Discharge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Action</td>
<td>Loose</td>
<td>Barrel</td>
<td>Yes</td>
</tr>
<tr>
<td>Single Action</td>
<td>Loose</td>
<td>Cylinder</td>
<td>Yes</td>
</tr>
<tr>
<td>Single Action</td>
<td>Stiff</td>
<td>Barrel</td>
<td>Yes</td>
</tr>
<tr>
<td>Single Action</td>
<td>Stiff</td>
<td>Cylinder</td>
<td>Yes</td>
</tr>
</tbody>
</table>

With the firearm pointing straight ahead and the firearm in single action, all struggles led to an unintended discharge.

Table 5: Revolver Pointing Straight Ahead, Double Action

<table>
<thead>
<tr>
<th>Mode</th>
<th>Grip Type</th>
<th>Grasp Location</th>
<th>Discharge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Action</td>
<td>Loose</td>
<td>Barrel</td>
<td>Yes</td>
</tr>
<tr>
<td>Double Action</td>
<td>Loose</td>
<td>Cylinder</td>
<td>No</td>
</tr>
<tr>
<td>Double Action</td>
<td>Stiff</td>
<td>Barrel</td>
<td>No</td>
</tr>
<tr>
<td>Double Action</td>
<td>Stiff</td>
<td>Cylinder</td>
<td>No</td>
</tr>
</tbody>
</table>
With the firearm pointing straight ahead and the firearm in double action, only a single struggle led to an unintended discharge. This discharge took place when the Holder employed a loose grip and the Taker grasped only the barrel. Under these conditions, the firearm was easily moved around allowing the unintended trigger finger response to overcome the heavier double action trigger pull weight.

**Table 6: Revolver Pointing Upward, Single Action**

<table>
<thead>
<tr>
<th>Mode</th>
<th>Grip Type</th>
<th>Grasp Location</th>
<th>Discharge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Action</td>
<td>Loose</td>
<td>Barrel</td>
<td>Yes</td>
</tr>
<tr>
<td>Single Action</td>
<td>Loose</td>
<td>Cylinder</td>
<td>Yes</td>
</tr>
<tr>
<td>Single Action</td>
<td>Stiff</td>
<td>Barrel</td>
<td>No</td>
</tr>
<tr>
<td>Single Action</td>
<td>Stiff</td>
<td>Cylinder</td>
<td>Yes</td>
</tr>
</tbody>
</table>

With the firearm pointing upward and the firearm in single action, three of the four struggles led to an unintended discharge. When the Holder used a stiff grip and the Taker grasped the cylinder, an unintended discharge occurred. When the firearm is in single action mode, the hammer is cocked and the cylinder has already rotated the next live round under the hammer. Therefore, retaining the cylinder in this situation does not create a problem. Furthermore, when the Taker grasps the cylinder, the Taker has more leverage over the firearm. Since the Stiff grip involves stiffened muscles but a loose grip on the firearm, the Taker can move the firearm around more with his greater leverage, causing the trigger to be pressed. Greater leverage by the Taker, stiff trigger finger on the trigger, and loose grip with room for the gun to be moved around led to greater movement in the firearm. One of the directions of movement was towards the taker, allowing the stiffened trigger finger to depress the trigger.
With the firearm pointing upward and the firearm in double action, none of the struggles produced an unintended discharge

**Analysis of Collected Data**

The results of the experiment can be collected together into counts for evaluation of the hypotheses. Primary factors revealed in the hypotheses include trigger mode -- single action or double action and firearm angle -- straight ahead or upward.

**Table 8: Revolver Pointing Upward, Double Action**

<table>
<thead>
<tr>
<th>Factor</th>
<th>Number Discharges</th>
<th>Total Experiments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Action Mode</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>Double Action Mode</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>Straight Ahead</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>Angled Upward</td>
<td>3</td>
<td>8</td>
</tr>
</tbody>
</table>

For instance, the Single Action Mode represents the total number of discharges that occurred OVER ALL EXPERIMENTS in Single Action Mode. In 1/2 of the Single Action experiments (4), the revolver was pointing straight ahead. In 1/2 of the Single Action experiments (also 4), the revolver was angled upward. Similarly, the Straight Ahead results combine the results across Single Action Mode and Double Action Mode.
H1: The potential for an unintended discharge during a struggle is greater if the firearm is in single action mode.

In single action mode, 7 / 8 (87.5%) samples resulted in an unintended discharge during a struggle. In double action mode, only 1 / 8 (12.5%) samples resulted in an unintended discharge during a struggle. Therefore, the potential for an unintended discharge during a struggle is greater if the firearm is in single action mode.

**Result: H1 is confirmed in this experiment.**

H2: The potential for an unintended discharge during a struggle is less if the firearm is pointed upward.

When the firearm is pointed straight ahead, 5 of 8 (62.5%) samples resulted in an unintended discharge during a struggle. When the firearm is angled upwards, only 3 of 8 (37.5%) samples resulted in an unintended discharge during a struggle. Therefore, the potential for an unintended discharge during a struggle is less if the firearm is pointed upward.

**Result: H2 is confirmed in this experiment.**

An additional insight is available from this data. With the firearm in single action mode, 7 of 8 (87.5%) samples resulted in an unintended discharge during a struggle. When the firearm is angled upwards, only 3 of 8 (37.5%) samples resulted in an unintended discharge during a struggle. This data clearly shows that the firearm being in single action mode has a much greater influence on the potential for an unintended discharge than does the firearm being angled in an upward direction.

**Limitations and Conclusions**

Admittedly, the sample size is somewhat small in this study. However, despite the sample size, the results do clearly demonstrate that the identified factors are at play during the struggle over a firearm. Furthermore, this simple experiment demonstrates that an unintended discharge can occur during a struggle over a firearm, especially when the Holder is an untrained operator – as in most criminal cases in which a struggle over a firearm occurs. The motivation for many of these cases is either armed robbery or attempted murder. Finally, again despite the small sample size, this experiment clearly demonstrates the steps that should be employed in a formal scientific experiment.
Results in this experiment are very specific to the firearm tested. This firearm is a revolver, possesses a short barrel, and has a fairly light single action trigger pull. These features clearly affect the result of the experiment. Semi-automatic pistols tend to be primarily single action fire control systems with somewhat lighter trigger pull weights. However, obviously every firearm is configured differently, so that this kind of experiment should be performed for a specific firearm in evidence in each criminal case.

However, the type of firearm, the trigger mode, the gun angle, the unintended trigger finger response, and the type of grip were identified as elements that contribute to an unintended discharge during a struggle over a firearm. The controlled experiment clearly demonstrates that these factors do have a contributory effect.

Two primary conclusions result from this scientific experiment. A revolver held in single action mode during a struggle is more likely (87.5%) to be unintentionally discharged than one held in double action mode (12.5%). Furthermore, a revolver pointing straight ahead (62.5%) during a struggle is more likely to be unintentionally discharged that one pointing upward (37.5%).

While these results may appear to be very simple, the results can have a significant impact on the result for the accused. If the trier of fact (the jury) determines that the discharge was unintended, the accused can be convicted of assault with a penalty of 10 years, out in parole in 4, with good behavior. However, if the trier of fact determines that the discharge was not unintended, then the accused can be convicted of attempted murder and serve 25 years to life. Clearly, these simple results can make a really big difference in the outcome of a trial in which the incident involved a struggle over a firearm.

From a scientific perspective, the conclusions are presented with attendant probabilities. These probabilities are important to reflect that the result of a struggle over a firearm can NOT be stated with absolute certainty. Now, the trier of fact needs to incorporate the uncertainty of real life into their determination of guilt or innocence. In the case described earlier, the pistol was clearly pointed upward (37.5% likelihood of an unintended discharge) and was in single action mode, according to the Investigation Report (87.5% likelihood of an unintended discharge). The joint likelihood of an unintended discharge is 32.8% (37.5% times 87.5%). Based on this likelihood of an unintended discharge, a jury is more likely to convict the accused of attempted murder.
As stated at the beginning, this article achieves a number of primary goals. The factors that determine whether a struggle over a firearm will result in an unintended discharge are defined and tested for a specific firearm. A formal methodology is provided and demonstrated for conducting a controlled experiment in order to evaluate these factors for a single firearm. Finally, the conclusions are presented in a probabilistic form, as required by a scientific approach.

References
