



Further analysis of the unintentional discharge of firearms in law enforcement

John O'Neill^{a,*}, Mark E. Hartman^{a,b}, Dawn A. O'Neill^a, William J. Lewinski^a

^a Division of Research, Force Science[®] Institute Ltd., Mankato, MN 56001, USA

^b Department of Kinesiology, Iowa State University, Ames, IA 50011, USA

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ABSTRACT

Empirical analysis of the contexts in which UD's occur in law enforcement have only recently begun to emerge. We analyzed a novel sample of UD reports ($N = 171$) that occurred between 1992 and 2016, collected from one non-U.S. and three U.S. law enforcement entities. Using an established antecedent-behavior-consequence (A-B-C) taxonomy, reports were analyzed by context, officer behavior, type of firearm, injuries, deaths, and property damages. This study is the first to empirically document reports of UD's caused by the startle response and the first to analyze a substantial sample of UD's that involved handguns with a double-action only trigger mechanism. An expanded analysis of UD consequences suggested that deaths and injuries might be more prevalent than previously reported.

1. Introduction

An unintentional discharge (UD) was operationally defined as “an activation of the trigger mechanism that results in an unplanned discharge that is outside of the firearm's prescribed use” (O'Neill et al., 2017). The phenomenon presents difficulty in research because occurrences are relatively rare and comprise only a small fraction of firearm injuries and deaths (O'Neill, 2015). Some departments release annual firearm reports that contain information on UD's, but empirical research (e.g., interviews, officer field reports, experimental analysis) has been sparse. Because UD's can result from involuntary muscle contractions, some officers report being unaware of exactly how the event unfolded. Previously, authors utilized deductive analytic approaches to understand UD's by generalizing well established principles from physiology (Charles, 2000; Enoka, 2003; Hendrick et al., 2008). However, very little physiological research addressed UD's directly in the context of law enforcement.

For example, Enoka (2003) opined that UD's (to the exclusion of accidental discharges) occur because of involuntary contractions, regardless of context, and may occur during a loss of balance, contralateral contraction, or startle response. During a loss of balance, postural contractions can evoke involuntary contractions in hand muscles (Corna et al., 1996; Dietz et al., 1989; Marsden et al., 1983), which has the potential to engage a firearm trigger. The second form of involuntary contraction occurs while one limb is performing a forceful action causing muscle contractions in the other limb, also known as

contralateral irradiation (Arányi and Rösler, 2002; Mayston et al., 1999; Zijdwind and Kernell, 2001). Contractions caused by contralateral irradiation have been shown to be directly related to the magnitude of force generated by contralateral limbs (Shinohara et al., 2003) as well as psychological stress (Noteboom et al., 2001; Weinberg and Hunt, 1976; Williams and Barnes, 1989). The third form of involuntary contractions occur during the startle response (Landis and Hunt, 1939). The startle response has been shown to cause an early execution of planned motor responses (e.g., pulling the trigger) or temporarily inhibit muscle contractions (e.g., “freezing”) depending on the individual and circumstances (Alibiglou and MacKinnon, 2012; Nonnekes et al., 2015; Valls-Solé et al., 2008). To date, UD's caused by the startle response have not been empirically documented or observed in law enforcement.

Hendrick et al. (2008) suggested UD's can occur over a broader range of circumstances related to the person and environment. In addition to concepts proposed by Enoka (2003), Hendrick et al. (2008) proposed a myriad of factors related to UD's, including stress, fatigue, divided attention, use of drugs or alcohol, memory impairments, lack of formal handgun safety training, and anthropomorphic variables (strength, perception, mental workload, physical size, response time, and negative transfer of training). Although these authors contributed pioneering work to the understanding of officer involved UD's, both relied on theory, general observations, and anecdotal evidence to support their claims.

Debate exists on whether muscle co-activations and startle induced

* Corresponding author.

E-mail address: john.oneill@forcescience.org (J. O'Neill).

involuntary contractions can independently cause UD (Charles, 2000). For most UD, the index finger ultimately engages the trigger. In theory, for muscle co-activation or startle induced involuntary contractions to discharge a firearm, the index finger must be positioned near or have direct contact with the trigger (Heim et al., 2006a,b). Law enforcement firearms training caters to this point, stipulating that the index finger must remain outside the trigger guard until the decision to fire (e.g., Illinois Law Enforcement Training and Standards Board, 2016).

Heim et al. (2006a,b) examined whether inappropriate finger placement on the trigger is a conscious decision. Results indicated that some officers contacted the trigger without realization. During a deadly force simulation, 34 officers reacted to a robbery suspect, where the use of a firearm was likely. At the end of the scenario, all officers reported that their finger remained above or on the trigger guard during the entire scenario. However, force sensors on the trigger detected one in five officers applied significant force for at least 1 s during the scenario. These results suggest that the index finger might be placed on or near the trigger without officer awareness.

Part two of the Heim et al. (2006a,b) study examined the effect of sub-maximal and maximal voluntary contractions (e.g., jumping, kicking, pushing a bar) while holding a firearm. Maximal force contractions caused participants to unintentionally grip their firearm with significantly more force, as compared to sub-maximal force contractions. During the leg contractions (the highest force action), the pressure exerted on the trigger was sufficient to discharge a cocked (> 4 lbs) firearm 20% of the time and an uncocked (> 10lbs) firearm 6% of the time. In addition, the authors demonstrated that voluntary contractions elicited muscle co-activation in other limbs. The effect of muscle co-activation following an unexpected loss of balance or startle response may have different effects on force applied to a trigger. However, a notable limitation to the study was that participants were students, not officers.

Recent research suggests a number of contextual and behavioral factors may predict and influence UD (O'Neill et al., 2017). The authors analyzed 137 reports from seven law enforcement agencies across the United States from 1974 to 2015. UD involved a broad range of factors related to the context (e.g., threat potential, location, and actions of others), the officer's behavior immediately preceding the UD (e.g., routine tasks vs. unfamiliar tasks), and the officer's equipment (e.g., firearm type, trigger action and weight, holster type, and clothing). Most of the reported UD occurred during low threat contexts, not during stressful or forceful actions. Approximately 25% of UD were attributed to muscle co-activation but nearly 75% of UD occurred during routine tasks (e.g., clearing, function check/attempted dry fire, holstering/unholstering, maintenance, storing/moving) and unfamiliar tasks (e.g., arm/hand crossover, equipment re-location, using an unfamiliar firearm, non-dominate hand transfers, and using new holsters or belts). Inanimate objects contacting the firearm or trigger (e.g., trigger catches on a radio antenna or clothing hook), contributed to a small proportion of UD. One limitation was the number of reports obtained from a relatively small number of law enforcement agencies. Only a small sample of double-action only handguns was available and the authors did not find sufficient evidence of a startle response. UD influenced by the startle response have not been empirically documented in law enforcement. Additional research might substantiate the role of the startle response as well as the notion that UD occur across different types of trigger action.

The purpose of the present study was to replicate the procedures employed by O'Neill et al. (2017) to validate the proposed antecedent-behavior-consequence (A-B-C) taxonomy. We analyzed novel UD reports from several law enforcement entities. The sample included handguns with a double-action only trigger mechanism and we conducted an expanded analysis of UD consequences.

2. Method

In line with the O'Neill et al. (2017) analysis, a UD was operationally defined as an activation of the trigger mechanism that results in an unplanned discharge that is outside of the firearm's prescribed use. Prescribed use refers to departmental policies and laws related to the operation of firearms. This excludes situations where a subject gains control of an officer's firearm and activates the trigger mechanism.

A request for information for pre-existing officer-involved UD was distributed via Force Science® News. A total of 203 individual UD reports that occurred between 1992 and 2016 were collected from one non-U.S. and three U.S. law enforcement entities. Instances of UD were provided in narrative form, redacted official documents, and raw spreadsheets. All other identifying information about the parties involved was withheld. Reports were coded following the procedures and definitions for UD in law enforcement described in O'Neill et al. (2017). Data were included if the information provided was adequate for determining one or more category within the A-B-C taxonomy. Reports containing ambiguous information were coded as unspecified. Data were excluded if the information did not pertain to a law enforcement officer ($n = 19$), a UD ($n = 6$), or a single classification category ($n = 7$). These exclusions resulted in a sample size of 171. The law enforcement agencies provided approval for the confidential analysis and publication of the data in this report.

2.1. Procedures

2.1.1. Context

On-or off-duty status of the officer at the time of the UD was determined. Threat potential at the time of the UD was coded as either low stress (locker room, processing area, firearm storage room, firing range, office, hotel, private residence, business, court house, air plane, and situations not otherwise specified), elevated stress (in the staging area of an operation, clearing an area, preparing to conclude a call, and situations not otherwise specified), or high stress (detaining a suspect, felony traffic stop, searching for an armed suspect, providing cover for a fellow officer, exiting a vehicle to make an arrest, and chasing a suspect on foot).

2.1.2. Officer behavior

Behaviors of the officer at the time of the UD were coded into one or more of the following six categories; contact (inanimate object, animate object, officer apparel), medical condition (seizures, twitch/tremor), muscle co-activation (loss of balance, loss of grip, use of other finger(s), use of leg(s), use of an arm(s), use of other hand), routine firearm task (clearing, storing/moving, function check, unholstering/reholstering, firearm maintenance), startle response (auditory stimulus, visual stimulus, vestibular stimulus, somesthetic stimulus), and unfamiliar firearm task (firearm, hand transfer, holster/belt, equipment location, and arm/hand crossover).

2.1.3. Firearm

The involved firearm was categorized by type (semi-automatics, revolvers, rifles, shotguns) and trigger action (single only, double only, double/single, pre-set).

2.1.4. Damages, injuries, and deaths

Property damage that occurred as a direct result of the UD was identified. UD related injuries and deaths of either the officer, a partner, the subject, or a bystander were identified.

2.1.5. Inter-observer agreement (IOA)

A trained secondary coder reviewed 30% ($n = 50$) of the reports and resulted in a high level of IOA across variables (9393.0%). IOA was calculated using the following formula: total number of agreements divided by agreements plus disagreements, multiplied by 100%.

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