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# Personal Protective Clothing: Law Enforcement Officers' Attitudes and Safety Behavior Assessments Toward High-Visibility Safety Apparel

So Young Song

# PERSONAL PROTECTIVE CLOTHING: LAW ENFORCEMENT OFFICERS' ATTITUDES AND SAFETY BEHAVIOR ASSESSMENTS TOWARD HIGH-VISIBILITY SAFETY APPAREL

By
So Young Song

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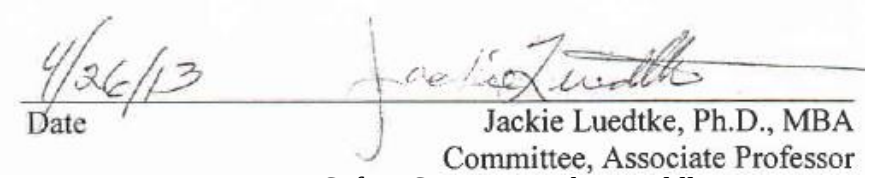
Approval of Committee:

Committee Chair

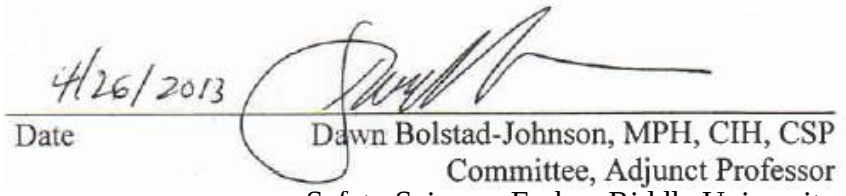
Date

Maxwell Fogleman, Ph.D., MPH, CPE
Committee Chair, Associate Professor
Safety Science, Embry-Riddle University



Date

Jackie Luedtke, Ph.D., MBA
Committee, Associate Professor
Safety Science, Embry-Riddle University



Date

Dawn Bolstad-Johnson, MPH, CIH, CSP
Committee, Adjunct Professor
Safety Science, Embry-Riddle University

To my husband, Woong Yeol Joe,

my children, Anna and Adam,

and my parents.

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## ABSTRACT

Traffic related fatalities are one of the most common workplace hazards in the law enforcement community. They accounted for approximately 44% of all fatalities within the law enforcement occupational field between 2002 and 2011. Although many law enforcement officers' deaths are due to being struck by vehicles, these could be prevented with the use of High-Visibility Safety Apparel (HVSA). The importance of raising traffic protective behavior compliance is largely overlooked by misperceptions in the workplace. Relatively few studies have examined HVSA wearing behaviors associated with social-psychological human elements. It has still remained unclear as subjective or objective experiences. Proper assessment of law enforcement officers' attitudes and safety behaviors are imperative in efforts to reduce traffic-related fatalities; and to improve the overall health and workplace safety in the law enforcement community. This study contributes to the research on law enforcement officers by providing information about what factors influence HVSA wearing decisions. It informs safety training officers and law enforcement organizations to develop successful training and practice programs that improve voluntary compliance.

*Keywords*: High Visibility Safety Apparel, Personal Protective Clothing.

# CHAPTER 1. OVERVIEW

The study examines law enforcement officers' attitudes, safety behavior and social-psychological dimension toward Personal Protective Clothing (PPC) specifically high-visibility safety apparel (HVSA). The intention is to bring a clearer understanding of PPC wearing behavior and assessing the need for the potential of safety training tactics with an emphasis on human and environmental factors toward HVSA use. The term, PPC, falls into a category of Personal Protective Equipment (PPE) and is used for the specific purpose of this study and to apply as a traditional category of clothing throughout this study.

The need to be visible is critical for safety workers, including law enforcement officers, and especially for workers who perform tasks in traffic and on streets near moving vehicles or equipment (ISEA, 2013). Efforts to reduce traffic-related fatalities and to improve the overall health and workplace safety in the law enforcement community can be tailored to meet their particular needs, which will be revealed by this study.

## 1.1 Introduction and Background

Traffic related fatalities are one of the most common workplace hazards in the law enforcement community. They accounted for approximately 44% of all fatalities within the law enforcement occupational field between 2002 and 2011; including 9% of the cause of death from being struck by a vehicle (NLEOMF, 2011). Traffic increases every year, and it leads to more congestion and to greater risks to emergency response

personnel. Conditions at dawn, dusk, night and during inclement weather increase the risks. Personal visibility is crucial to responder safety (USFA, 2008). Although many law enforcement officers' deaths are due to being struck by vehicles, these could be prevented with the use of HVSA. The importance of raising traffic protective behavior compliance is largely overlooked by misperceptions in workplace.

HVSA is defined as PPC intended to provide conspicuity during both daytime and nighttime usage that meets the American National Standards ANSI/ISEA (American National Standards Institute., & International Safety Equipment Association) 107-2010 (revision of ANSI/ISEA 107-2004) Class 2 or 3 standard (Title 23 CFR Part 634.2). Although PPC is designed to enhance worker's comfort or safety, they can adversely affect worker performance such as heat stress, decreased mobility, and reduced task efficiency (Adams P. S., 1993). Discomfort and reduced efficiency (i.e. degradation in the performance) may lead to user rejection of PPC (Bensel C.K., et al., 1987), thus increase the risk of worker's injury, disease, or fatality (Rosenblad-Wallin E., 1981; Abeysekera, J.D.A 1989).

Studies have shown that wearing HVSA with retroreflective materials increases a worker's conspicuity. The evaluation of human behaviors and attitudes toward HVSA associated with its regulation, workplace/field practice, and cultural and psychological influences have not been studied much in previous research.

Most law enforcement officers are on patrol in the field between calls and HVSA may have been stored in the trunk of a patrol car. Time and financial resources for training is limited in addressing the protection needs, which creates another weakness to the effective use of HVSA in the law enforcement community. Yet, they encounter

widely diverse environments and scenarios over the course of a work shift (LaTourrette, T., et al., 2003). Through this regulation review, it appears that law enforcement officers make the decision as to whether or not to use HVSA in day-to-day tasks based on tactical necessitates. There is a need to assess how the regulation would impact law enforcement officers' decision making process while exemptions on regulations would exist for emergency responders in limited situations.

To systematically improve the protective behavior problems associated with PPC, it is necessary to understand their psychological state behind them. This requires identifying human factor parameters that contribute to the reduced usage of HVSA. It is also important to identify those organizational and cultural aspects of how the environment causes the effects. A better understanding of human elements in PPC use can lead to improved PPC training program management. Once the relationship among law enforcement officers and HVSA characteristics are understood, more effective training tactics can be developed that would improve PPC wearing behavior and the routine use of HVSA.

## 1.2 Purpose of the Study and Problem Statement

This study is to conduct a field survey pertaining to the psychological effect and role of HVSA in the law enforcement community; document the law enforcement officers' attitudes and behaviors on HVSA; and to evaluate the need of better safety training tactics and education. People naturally act in a manner that is consistent with their beliefs, attitudes, and values. When people change their beliefs, attitudes, or values,

certain behaviors change as a result (Fishbein and Ajzen, 1975). The improvement of the generalized beliefs, attitudes, intentions, and behaviors psychological model is the Safety Triad model (Geller E.S., et al.1989; Geller E.S., 2000) used as a conceptual framework in this study. The research is performed in four cities of Yavapai County (i.e. Prescott, Prescott-Valley, Chino-Valley, and Cottonwood) in the state of Arizona.

Despite the known risks and the availability of HVSA, some law enforcement officers fail to comply with regulations and recommendations. This study explores the influences that affect decision making by law enforcement officers to wear or not to wear HVSA. Ultimately, to explore what specific actions taken by safety officers and law enforcement agencies would stimulate the consistent use of HVSA.

Emphasis was placed on an examination of social-psychological attributes, human perception, protective behavior, and wearing behavior of HVSA through their decision making process influenced by perceived risk. In evaluating such safety behavior, it is important to understand people's perception of relative risks proceeding from the true measures of risk and the communication of risk information among workers, technical exports, and policy (Slovic, 1987). Other purposes of this study are to determine the relationship between selected variables (i.e. experience, knowledge, misperception, organization, culture, etc.), and how it affect law enforcement officers' attitudes toward HVSA, and to assess the overall social-psychological dimension in HVSA.

To accomplish the objectives of this study, the following research goals were pursued:

1. Identify the influence (social-psychological, culture, organization factors) on HVSA wearing decision.

2. Examine law enforcement officers' perceived risks in traffic-related duties and their attitude toward HVSA use.
3. Examine law enforcement officers' safety behavior toward HVSA use.
4. Determine if a relationship exists between selected variables and law enforcement officers' attitudes or safety behavior toward HVSA use.
5. Summarize the existing literature on HVSA and traffic related occupational safety in law enforcement community.
6. Identify the challenges that policymaker and law enforcement officers face in improving the practice and safety enforcement in workplace.

### 1.3 Significance of the Study

Relatively few studies have examined HVSA wearing behavior associated with social-psychological human elements. Until now, most research dealing with PPC has focused on mobility, other physical aspects, or wearing comfort properties or notions. Social-psychological wearing behavior has still remained unclear as it is filtered through subjective or objective experiences. Although such studies answer specific questions of aspect of wearing PPC, the social-psychological assessment of human wearing behavior has not been evaluated in depth.

Finally, this study contributes to the research on law enforcement officers by providing information about what factors influence HVSA wearing decisions. It informs safety training officers and law enforcement organizations to develop successful training and practice programs that improve voluntary compliance. The use of a traditional safety

training approach shows limited effectiveness to change PPC wearing behavior and neglects the importance of human elements. It is an essential safety and health effort to aim at understanding the risk perceptions and PPC decision making process of this special occupation so that future traffic-related injuries interventions can be incorporated proactively into safety training programs.

By raising awareness of wearing HVSA, numerous injuries and fatalities from struck-by hazards in complex work environments can be prevented when the ability to be seen at all times is necessary (ISEA, 2013).

# CHAPTER 2. REVIEW OF LITERATURE

The review of literature addresses criteria on HVSA's concept, social-psychological theories, occupational fatality risk analysis, regulation, and safety practice. For the focus of this present research, protective behavior and social-psychological factors of how personal preference and perception can influence the effectiveness of PPC studied through this literature review.

## 2.1 Personal Protective Clothing (PPC)

Clothing covers great parts of our body on the one side and having a large surface area in contact with the environment on the other side. Therefore clothing is most suitable as interface between environment and human body, resulting in the ideal tool to enhance personal protection and provide occupational safety (Jayaraman, S., et al., 2006). PPC is worn to protect the wearer from a variety of environmental and occupational hazards, but PPC can have detrimental effects on worker performance and can frequently introduce ergonomic challenges by its use (Adams P. S., 1993). As stated in previous chapter, the physical and psychological discomfort along with degraded performance may lead to user rejection of PPC (Bensel C.K., et al., 1987), thus increase the risk of worker's injury, disease or fatality (Rosenblad-Wallin E., 1981; Abeysekera, J.D,A 1989).

In 2003., LaTourrette, T., et al. investigated several factors associated with the use of PPC. The challenges in law enforcement officers were that patrol officers are typically the first to arrive on a scene and they do not know what to expect on the situation. They make their own assumptions that protective safety gear could possibly impair a law

enforcement officer's performance such as foot pursuits, the use of firearms, and physical altercations in the event of an emergency. HVSA may have been stored at the trunk of a patrol car which has proven to be inadequate for storing protective gear due to heat, accessibility, soiling, and dirt. As law enforcement officers are not wearing HVSA while driving, they do not have time to put it on, or it may not be accessible as a result.

### 2.1.1 High-Visibility Safety Apparel (HVSA)

As defined earlier, HVSA provides conspicuity that meets the ANSI/ISEA 107-2010 (revision of ANSI/ISEA 107-2004) Class 2 or 3 standard (Title 23 CFR Part 634.2). For public safety employees working in traffic control areas, ANSI/ISEA 207-2011 standard provides a consensus industry standard on high-visibility Public Safety Vests for law enforcement officers. The benefit of HVSA is that it allows motorists and equipment operators to see roadside workers including law enforcement officers conspicuously, reducing the risk of fatality or worker injury.

The ANSI/ISEA 107-2010 and 107-2011 standards provide performance criteria for materials to be used in HVSA and specifies minimum areas and, where appropriate, recommends placement of the retroreflective or combined-performance materials. Performance requirements focus on the color, the brightness of garments and headwear relative to the work environment as well as the combined use of fluorescent and retroreflective materials to make a person conspicuous in all light conditions, day and night. One of the most significant features of ANSI/ISEA 107-2010 and 107-2011 standard is that it requires 360 degree visibility of the wearer in all classes; implying the wearer can be seen from all sides. Workers should not be the same color as traffic barrels

or traffic sign. HVSA should stand out from other visibility equipment, and it should be looking like a person when worn.

### 2.1.2 HVSA types and Performance Class

The visible material of HVSA is consisted of three parts: background material, retroreflective material, and combined-performance material. The background material is defined as colored fluorescent material that is intended to be highly conspicuous. The retroreflective material is the band of material on apparel, intended to reflect and return a relatively high portion of light back to the source. The combined-performance material is a retroreflective material that is also a fluorescent material. It can be counted toward the minimum area requirements for background materials in accordance with Table 1 (ANSI/ISEA 107-2010/207-2011).

According to ANSI/ISEA 107-2010 standard, garments types are classified as Performance Class 1, 2, 3, E, Headwear. ANSI/ISEA 207-2011 standard provides sub-category, Public Safety Vest as a secondary classification. Figure 1 shows examples of Performance Class and Types in HVSA. The minimum area of required visible material increases with each Performance Class. Only Performance Class 2 apparel and Performance Class 3 apparel are acceptable to wear within the right-of-way (ROW) of Federal-aid highways (Title 23 CFR Part 634.2). Performance Class 3 offers the greatest visibility to the wearer through a full range of body movements. Regardless of the area of material used, Performance Class 3 apparel must have either sleeves with retroreflective material between the shoulders and elbow, or ensembled with Class E trouser or shorts. A

sleeveless garment or vest alone shall not be considered Performance class 3. Performance Class E apparel is a waistband trouser, bib overalls and shorts with retroreflective materials that is intended to be worn with Performance Class 2 or 3. High-visibility headwear is an accessory that enhances visibility to the head of a moving worker and helps define the shape of the human form (ANSI/ISEA 107-2010). Performance Classes give users a way to specify the most suitable garment for the use in roadside hazardous environment based on work activities (ATSSA, 2009).

Vehicle and moving equipment speeds not exceeding 25mph are typically suggested to use Performance Class 1, and Performance Class 2 under certain conditions. Vehicle and moving equipment speeds exceeding 25mph but not significantly high such as busy street are generally suggested to use Performance Class 2. Workers who are exposed to significantly higher vehicle speeds and/or reduced sight-distance, and to be seen at a minimum of 390m (1,280feet) are recommended to use Performance Class 2 or 3 based on certain conditions as shown in Table 2. There were not many references found that could provide standardized/regulated vehicle speed guideline for the selection of Performance Class for users rather than ANSI/ISEA 107-2010 Suggested Performance Class Guidelines and Scenarios, of which ambiguous information allow the user's wide range of interpretation leading to a wrong Performance Class selection. The Table 2 summarizes typical recommended Performance Class guideline for various types of occupations suggested from ANSI/ISEA 107-2010 serving as an assessment tool. In case of emergency responder such as law enforcement officers, if they respond to expressway incidents, a Performance Class 2 may be sufficient; however, if they respond to highway incidents, a Performance Class 3 would better fit their needs.

Finally, Public Safety Vest (ANSI/ISEA 207-2011) is a type of apparel that provides functional features such as shorter torso coverage for access to belt-mounted equipment and tearing-away shoulders. These functional features provide more flexibility to accommodate the tactical needs for law enforcement personnel, emergency responders and firefighters.

**Table 1**
Minimum areas of visible material (ANSI/ISEA 107-2010, 207-2011)

| | **ANSI/ISEA 107-2010** | | | | | **ANSI/ISEA 207-2011** |
|---|---|---|---|---|---|---|
| | Performance **Class 3** | Performance **Class 2** | Performance **Class 1** | **Class E** | **Headwear** | **Public Safety Vest** |
| Background material. | 0.80 m² (1240 in²) | 0.50 m² (775 in²) | 0.14 m² (217 in²) | 0.30 m² (465 in²) | 0.05 m² (78 in²) | 0.29 m² (450 in²) |
| Retroreflective or combined-performance material used with background material. | 0.20 m² (310 in²) | 0.13 m² (201 in²) | 0.10 m² (155 in²) | 0.07 m² (108 in²) | 0.0065 m² (10 in²) | 0.13 m² (201 in²) |
| Photometric performance. * | Level 2 or Level 1 | Level 2 or Level 1 | Level 2 or Level 1 | Level 2 or Level 1 | Level 2 | Level 2 or Level 1 |
| Combined-performance material used without background material. | NA | NA | 0.20 m² (310 in²) | NA | 0.05 m² (78 in²) | NA |
| Photometric performance. | NA | NA | Level 2 or Level 1 | NA | Level 2 or Level 1 | NA |
| Minimum width of retroreflective or combined-performance material. | 50 mm (1.97 in) | 35 mm (1.38 in) | 25 mm (0.98 in) or 50 mm (1.97 in) w/o background material. | 1.97 in (50 mm) | | 50 mm (1.97 in) or 25mm (0.98 in) in split-trim design |

*Note*. Photometric performance*: ANSI/ISEA 107-2010 specified that retroreflective mateirals shall comply with the requirement of minimum coefficient of retroreflection in level 1 or 2, as applicable.

**Table 2**
Performance Class Guidelines summarized from ANSI/ISEA 107-2010 Appendix B

Suggested Performance Class Guideline and Scenarios

| | **Performance Class** | | |
|---|---|---|---|
| **Type of Jobs** | **Class 1** | **Class 2** | **Class 3** |
| Vehicle and movement speed. | Less than 25mph | Higher than 25mph | Significantly higher speeds (in excess of 50mph) |
| Road classification. | Residential | Busy Street | Highway, High risk-environment |
| Shopping cart retrievers. | o | | |
| Warehouse workers. | o | | |
| Delivery truck drivers. | o | | |
| Roadway construction worker. | | o | o |
| Utility workers. | | o | o |
| Surveyors. | | o | o |
| Emergency responder. | | o | o |
| Flaggers. | | | o |
| Law enforcement officer. | | o | o |
| Parking or toll gate personnel. | o | o | |


**Figure 1** Examples of Performance Class and Types in HVSA**.** Source from High Visibility Apparel in Work Zones, Characteristics of High-Visibility Safety Apparel, Pocket guide, The American Traffic Safety Services (ATSSA, 2009).

### 2.1.3 Law enforcement uniform

A uniform is a means of belonging and of making people belong; promotes discipline and pride in one's appearance, provides authority, and it should also be functional. This duality gives modern uniform designers an ever more difficult job in finding the right balance between respect, empathy and functionality (Dunn, B., 2009). Clothing, including law enforcement uniform, has been found to have an influential psychological impact on those who view it. Such as color of clothing, has a considerable impact on perceptions of the wearer (Gundersen, D.F., 1978). The uniform of law enforcement officers conveys the power and authority of the wearer, and it is an essential tool for every patrol officers for their own protection.

In addition to above sociological perspective on a uniform, the law enforcement uniform also has its occupational functions; It must be durable, must identify the wearer as a law enforcement officer, and must provide some protection from other external environmental conditions while provide comfort without hindering mobility (Welson and Co., NILECJ, 1978). For the purpose of present study, several questionnaires of overall uniform comfort were constructed to identify those social-psychological characteristics of general law enforcement uniform, and to correlate the safety concerns with their duties.

### 2.1.4 Conspicuity

Configuration of HVSA significantly affects worker's conspicuity. Old HVSA design looking like a traffic barrel from distance had been known to bring driver's detection problem especially at night. Such as ANSI/ISEA 107-2010 Performance Class

3 that includes placement of retroreflective material on sleeve can improve this detection distance through a full range of body movement representation.

One of primary causes of traffic road crashes related to pedestrians is lack of conspicuity. Conspicuity is defined as the characteristics of an object influencing the probability that it comes to the attention of an observer, especially in a complex environment (ANSI/ISEA 107-2010). Various researches have shown that HVSA worn at night and day can considerably increase pedestrians' visual conspicuity.

A research conducted by Sayer & Mefford (2004) in the areas of detection of pedestrians, first-responders, and road construction workers, pertains to the effects of retroreflective markings and safety apparel design. Their field study assessed the attributes of HVSA on pedestrian conspicuity at night using instrumented vehicles on a closed track. It indicated that configuration of the retroreflective trim, trim color, placement in the work zone, and driver age significantly affected pedestrian conspicuity. The results emphasized the importance of personal safety garment design with retrospective trim. The three levels of HVSA configuration were Class 2 vest, Class 3 vest (without sleeves), and Class 3 jacket in combination of three different retroreflective trim colors (white/silver, blaze orange, fluorescent red). However, the most recent standard (ANSI/ISEA 107-2010) was updated that Performance Class 3 must be with retroreflective materials to the arms (on sleeves) and/or legs. Mean detection distances for each garment are plotted in Figure 2, with the Class 3 jacket being most conspicuous (355m) and statistically significant (Student-Newman-Keuls test), followed by the Class 3 vest (311m) . The difference between the Class 3 or Class 2 vests was not significant. Mean detection distances for each of the three trim colors are plotted in Figure 3, with

blaze orange being most conspicuous (344 m) and statistically significant (Student-Newman-Keuls test), followed by white/silver (329 m).

Similarly, their another study examined the effects of high-visibility garment design on daytime pedestrian conspicuity in work zones, which factors assessed were clothing colors, amount of background material, pedestrian arm motion, scene complexity, and driver age. The study findings provide information to safety apparel manufacturers about characteristics of HVSA which make them effective for daytime use (Sayer & Mefford, 2008).

A study related to Safety Service Patrollers (SSP) by Brich, S.C. (1998) evaluated various colors and configurations of retroreflective materials for use on SSP uniform. The author developed a recommended HVSA design to maximize patrol officer's safety by examination of the reaction times for different colors. The research has shown that fluorescent orange and fluorescent yellow-green are the two best colors for use on HVSA. It was also concluded that circumferential retroreflective bands on the limbs and major hinge points (knees and elbows) enhanced recognition as a person during nighttime.

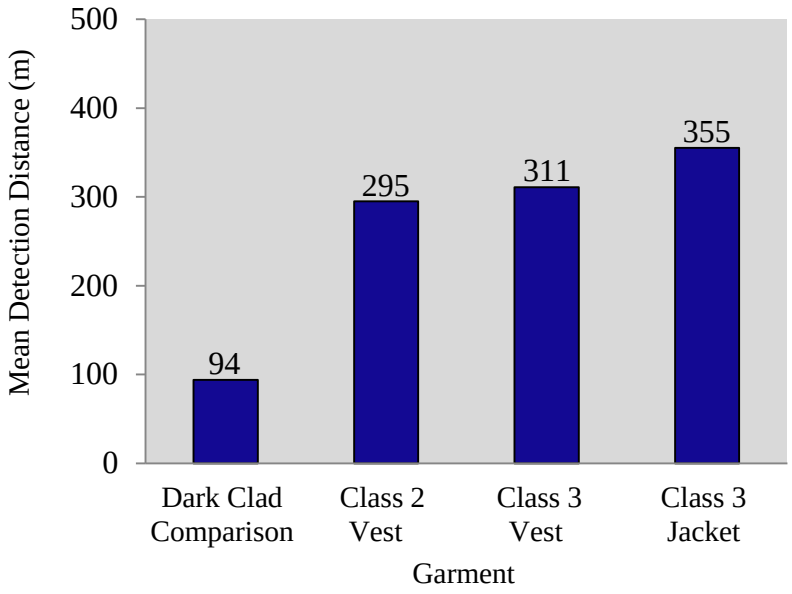



**Figure 2** The main effect of garment classification/configuration on conspicuity. Source from "High-visibility safety apparel and the nighttime conspicuity of pedestrians in work zones." by Sayer, J. R. & Mefford, M. L., 2004. *Journal of Safety Research, 35, pp.541.*

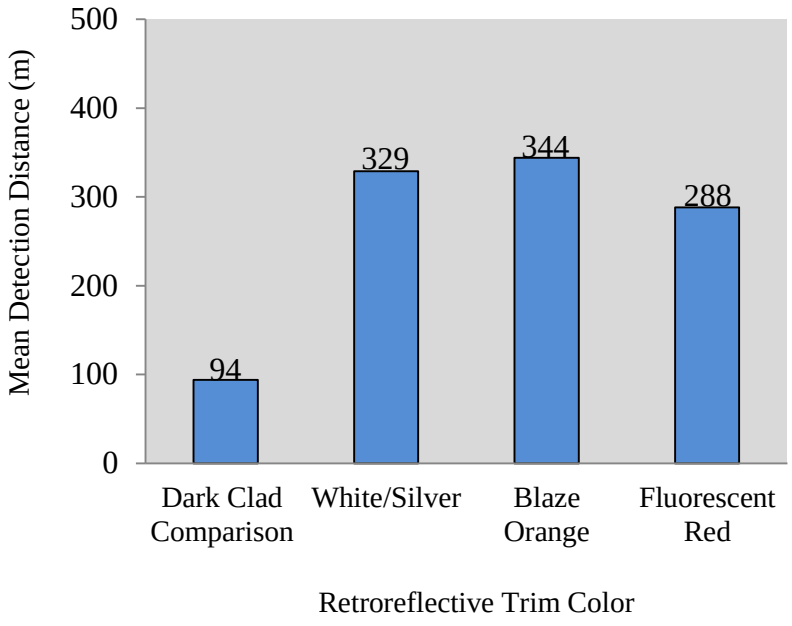



**Figure 3** The main effect of garment retroreflective trim color on conspicuity. Source from "High-visibility safety apparel and the nighttime conspicuity of pedestrians in work zones." by Sayer, J. R. & Mefford, M. L., 2004. *Journal of Safety Research, 35, pp.541.*

## 2.2 Psychology of Attitude and Behavior, and Safety-related Factors

### 2.2.1 The generalized beliefs, attitudes, intentions, and behavior

When people behave inconsistently with their cognitions, they feel discomfort, and they naturally inclined to adjust their mental attitude to parallel their actions (Festinger, L., 1957). Thus, this study starts with assumptions that changing one's attitude and values to safety can influence behavior either directly or indirectly.

This paper explores these speculations by applying the generalized theory of beliefs, attitudes, intentions, and behavior (Fishbein and Ajzen, 1975) as Figure 4 to safe or at-risk actions. It permits explaining a theoretical basis on law enforcement officers' beliefs and attitudes towards HVSA resulting in a certain behavior; use or non-use of HVSA.

### 2.2.2 A conceptual framework: the Safety Triad

The Safety Triad proposed by Geller (Geller E.S., et al.1989; Geller E.S., 2000), the conceptual framework of this study explained the importance of person, environment, and behavior factors for improvement of organizational safety as illustrated in Figure 5. These three factors are interactive and eventually impact one to the other two for any changes resulting in safety performance of an organization. Person factors include people's attitudes, beliefs, knowledge, and personalities that influence one's willingness to guard for their own safety and the safety of others. Environmental factors include equipment, tool, physical layout, procedures, standards, and organizational cultural

factors such as management support that influence safety. Behavior factors include safe and at-risk practices as well as going beyond the call of duty to intervene on behalf of another person's safety which impact organizational safety.

The person factors and behavior factors represent human elements of occupational safety and the psychology of safety. Effectively managing for health and safety is not only having management provision or regulation but it also includes the human dimensions and organizational safety culture. The Geller's Safety Triad (Figure 5) was used as grounded theory for safety culture supporting this study.

Based on Geller's theory, there are three approaches that produce beneficial changes in people and organizations for achieving safety culture. Most can be classified into person-based approaches, behavior-based approaches, and integrating approaches. Person-based approaches are aimed to alter individual attitudes, intention, subjective interpretation or thinking process, and give them insight into the origin of their unhealthy thoughts, attitudes, or feelings. In contrast, behavior-based approaches are intended to modify their behavior directly. It identifies observable behaviors targeted for change and the environmental conditions or contingencies that can be manipulated to influence the target behaviors in desired directions. In other words, behavior can be objectively studied and altered by identifying and manipulating environmental conditions that immediately precede and follow a target behavior. The person-based approaches can be integrated with the behavior-based approaches, so called integrating approaches. Figure 6 describes the distinction between person-based and behavior-based approaches. The author emphasized that long term behavior change requires people to change "inside" as well as "outside" to consider both external behavior and internal person factors.

With Geller's conceptual framework of the Safety Triad, this study aimed to use person-based approaches for guiding law enforcement officers' safety and health improvement through promoting HVSA use.

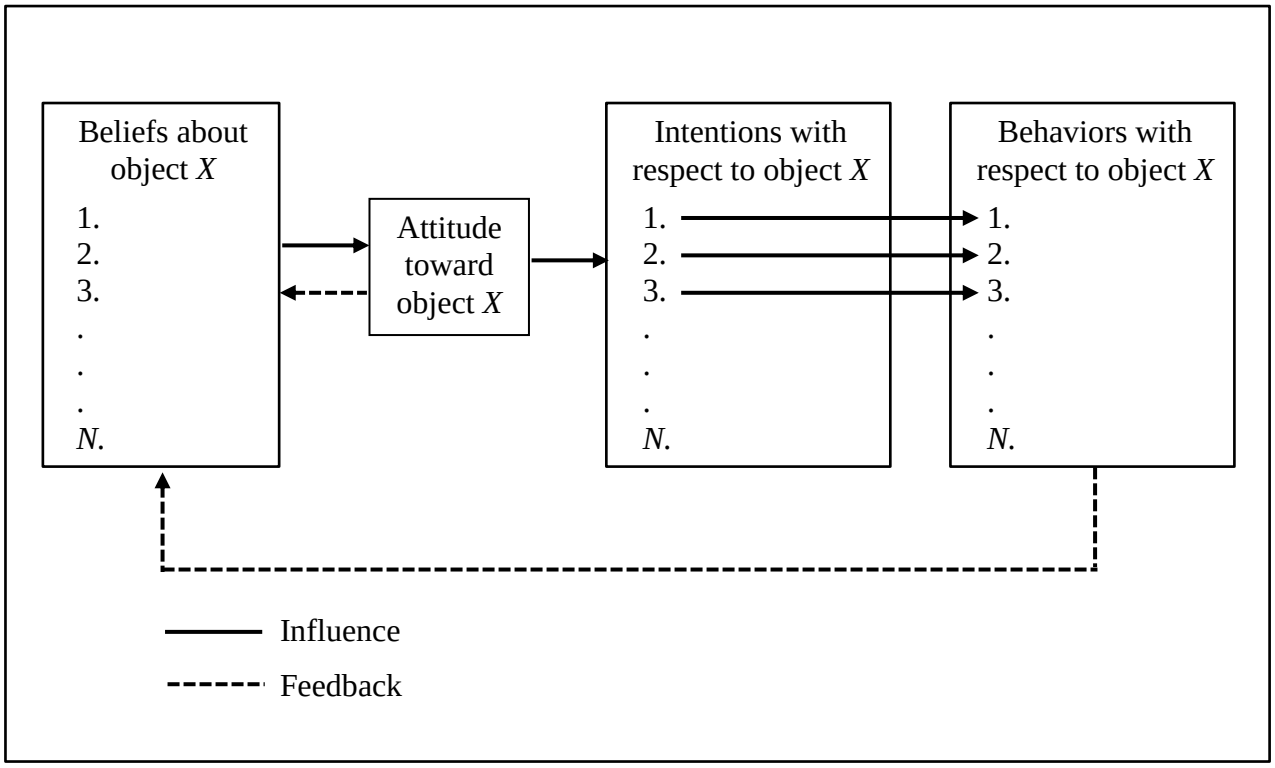



**Figure 4** Schematic presentation of the generalized beliefs, attitudes, intentions, and behaviors with respect to a given object. Adapted from Fishbein, M., & Ajzen, I. (1975), *Belief, Attitude, Intention, and Behavior: An Introduction to Theory and Research*. pp.15. Reading, MA: Addison-Wesley.

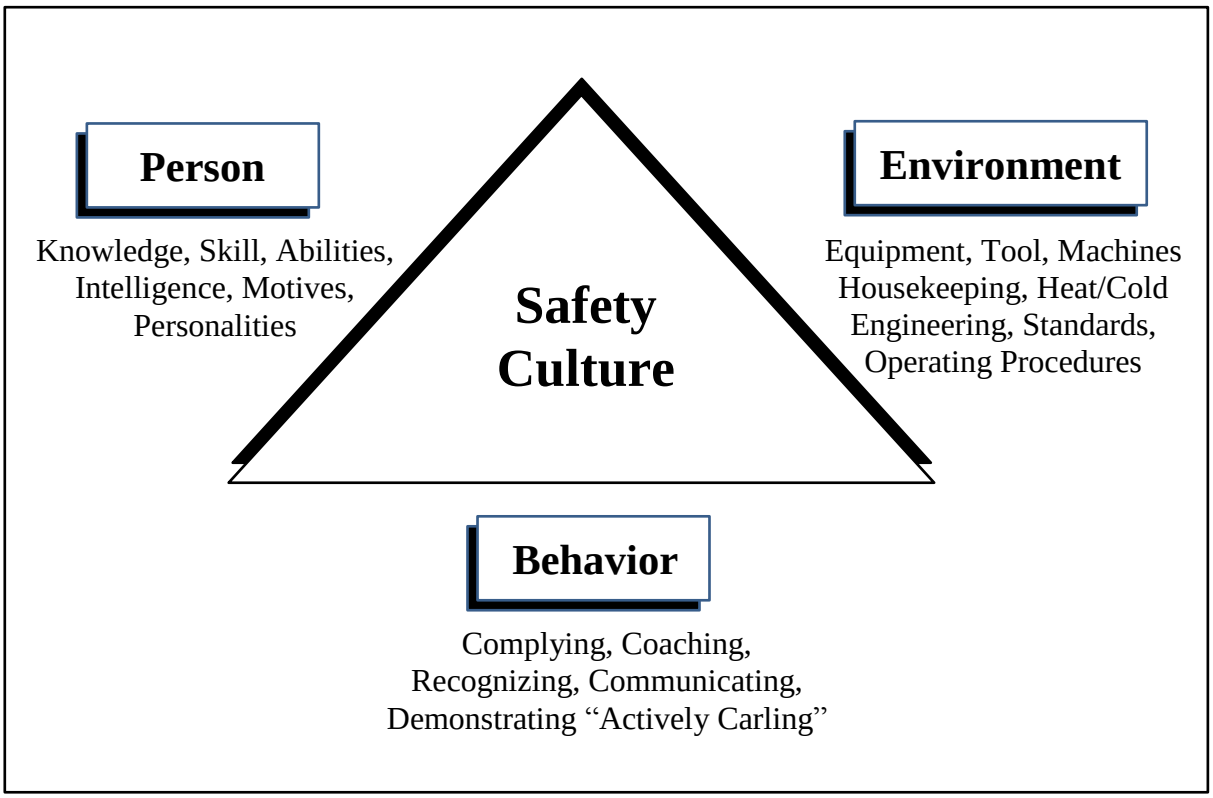



**Figure 5** The Safety Triad. A Total Safety Culture requires continual attention to three types of contributing factors; the schematic presentation of conceptual framework. Adapted from Geller, E. S. (2000), *Psychology of safety handbook (2nd edition)*, Boca Raton, FL, USA: CRC Press.

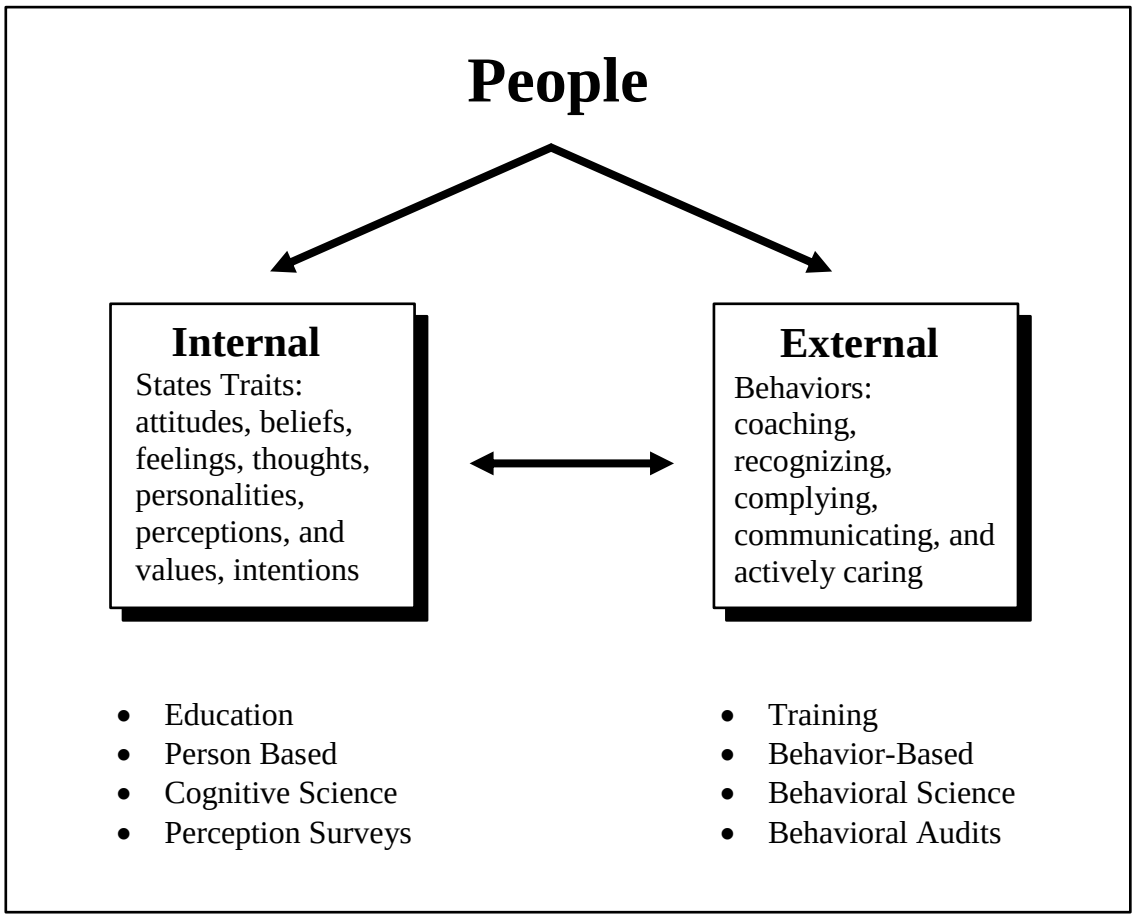



**Figure 6** The internal and external aspects of people determine the success of a safety process. Adapted from Geller, E. S. (2000). *Psychology of safety handbook (2nd edition)*, Boca Raton, FL, USA: CRC Press.

### 2.2.3 Perceived Risk

The survey instrument in this study includes law enforcement officers' perspectives of risk and health. Through literature review on perceived risk, it appears that experiences on the job may lead workers to perceive a relatively low level of risk than actual risk toward safety hazards. Risk is relative, and people are likely to behave according to the way they perceive their risk. A study by Yates, J.F., and Chua, H.F. (2002) examined judgment phenomenon and human decision making process in risky driving. It schematically illustrated the phenomenon called "experience/perception effect" (Figure 7), adapted from a study of DiLillo, D. et al (1998). The author suggested that the more experience people have with a certain hazard, the less risk they judge that hazard to be. People might become accustomed to the danger and be insensitive to the true measures of risk. Thus, an understanding of risk perception and how people assess risk is essential for understanding both risky-taking behavior and developing traffic safety messages.

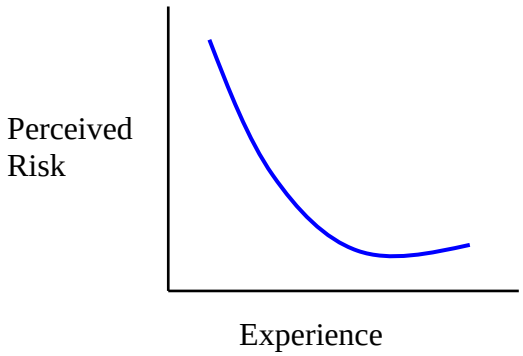



**Figure 7** The experience/perception effect. Source from Yates, J.F., H.F. Chua (2002), Risky Driving From A Decision Making Perspective. *Proceeding of the 16th Conference of the International Council on Alcohol, Drug, & Traffic Safety*, Montreal, August 4-9.

There are factors that influence the risk perceptions. The risk perceptions associated with the workplace are reduced when exposure is voluntary, when hazard is familiar, forgettable and affects anyone, and when hazard is understood, controllable and preventable (Sandman P.M., 1991). It implies that workers do not perceive the risk on the job as high as it should be.

### 2.2.4 Risk perceptions and safety behavior in PPE use

When there is no appropriate practice established, PPE is often an elective accessory. Workers' risk perception would be involved in their decision making process whether to wear PPE or not in hazardous environments.

A Noth's study of risk perception and safety behavior of Latino migrant farm workers (LMFW) on eyewear use, defines how workers consider being at risks to themselves, and how they decide whether or not to take protective action to prevent injuries. The study result revealed that farmworkers had inadequate awareness of long-term health effect, specifically of eye diseases. The lack of understanding and experience with adverse health consequences appeared to weaken sense of risk. The author also noted that greater risk perception together with obtaining safety knowledge in work tasks can reduce illness or injury. (Noth I. M., 2005). The Noth's study was referenced for constructing research instrument regarding relationship between risk perception and law enforcement officer's decision to use HVSA.

## 2.3 Law Enforcement Workplace Fatality

There are more than 900,000 sworn law enforcement officers now serving in the United States. Every 53 hours on average one law enforcement officer is killed in the line of duty. There were 163 law enforcement officers killed in 2011. In total more than 19,000 U.S. law enforcement officers have died on duty since the first known line-of-duty death in 1791 according to National Law Enforcement Officers Memorial Fund (NLEOMF) fatality data (NLEOMF, 2011).

Motor vehicle accidents are one of major causes of deaths and injuries for law enforcement officers. In 2011, sixty-four officers were killed due to traffic related causes. Forty-four officers were killed in vehicle crashes, eleven officers were struck by automobiles, and seven were killed in motorcycle crashes and two were struck by train. For the first time in 14 years, traffic-related fatalities were lower than firearms-related fatalities. Despite of a 10% decrease of traffic related incidents, the overall trend of traffic-related fatalities has continued to increase since the 1960s, which averaged 60 officer fatalities on the roadway each year. The average of traffic-related fatalities in the 2000s was 72 officer deaths, a 20% rise over the past fifty years (NLEOMF, 2011).

Law enforcement officer fatality data (NLEOMF) from 2002 to 2011 is graphed in Figure 8. The causes of deaths are classified as shown in Figure 9. The results show that total traffic-related fatalities on average are 44%, including 9% of the cause of death from being struck by vehicle.

### 2.3.1 Fatal work injuries in law enforcement occupation

The Census of Fatal Occupational Injuries (CFOI), part of the U.S. Bureau of Labor Statistics (BLS) Occupational Safety and Health Statistics (OSHS) program, observes a count of all fatal work injuries occurring in the U.S. to identify fatal occupational injuries.

For the 2010 data from B.L.S., a total of 4,690 fatal work injuries were recorded in the United States. The number of fatal workplace injuries among law enforcement officers increased by 40%, from 96 in 2009 to 134 in 2010. Of the 134 fatal work injuries among law enforcement officers, 57 involved highway incidents and 48 involved homicides. It indicates that 42.5% of fatal injuries were caused by traffic-related incidents in law enforcement occupation field (B.L.S., 2010).

There is some available information about traffic-related fatal injuries of law enforcement officers, but not much comprehensive data examined or classified by specific cause of these injuries. As a result, the number of law enforcement officers who did not die from being struck by automobiles, but may have ended their careers, may not be included in the traffic-related fatality risk assessment as based on these data analyses.

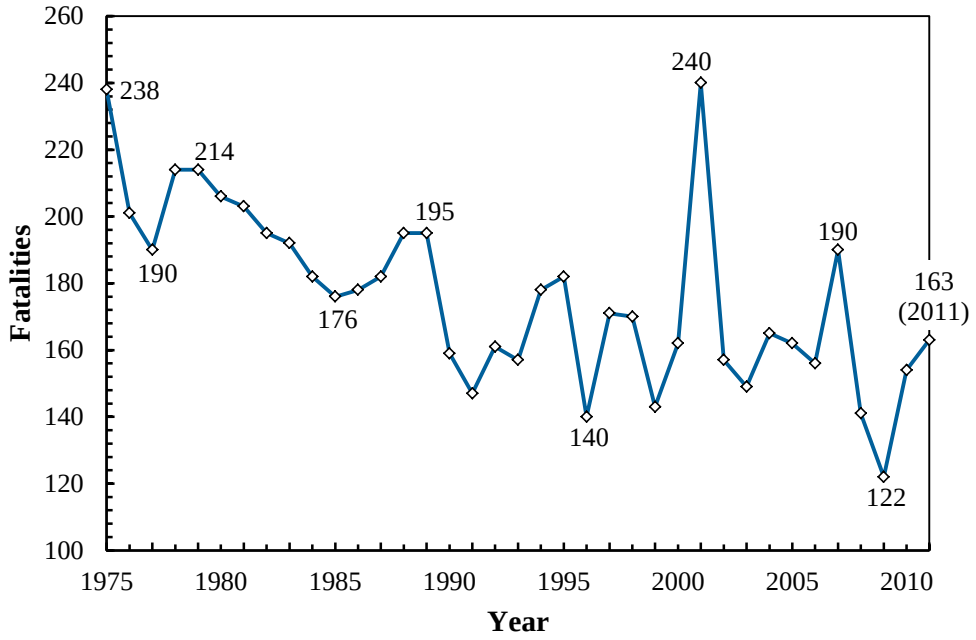



**Figure 8** Total Fatalities of Law Enforcement Deaths (2002-2011). Data Source: The National Law Enforcement Officers Memorial Fund (NLEOMF), Officer Fatality Data.

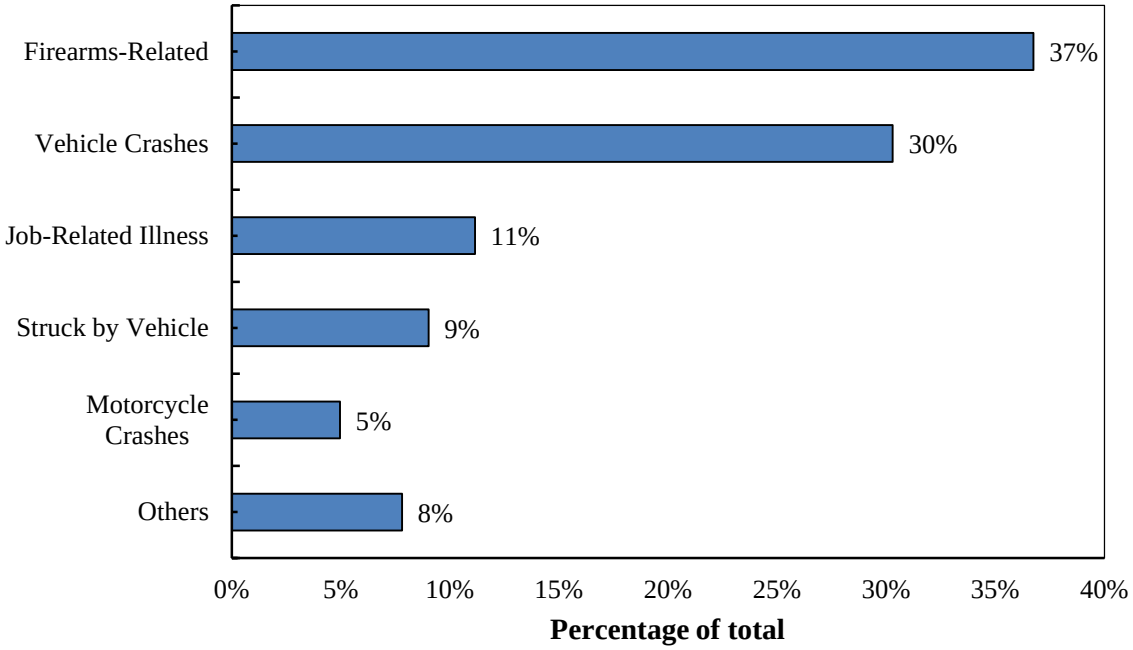



**Figure 9** Causes of Law enforcement Deaths (2002-2011). Data Source: The National Law Enforcement Officers Memorial Fund (NLEOMF), Officer Fatality Data.

## 2.4 Safety Enforcement and Practice

### 2.4.1 American National Standard ANSI/ISEA: HVSA

The general industry standard for highway workers for HVSA is the American National Standard ANSI/ISEA 107-2010, High-Visibility Safety Apparel and Headwear, published by International Safety Equipment Association (ISEA). It is an occupational industry standard that specifies requirements for apparel and headwear that enhance visibility of the user's presence. Since the first published in 1999, the standard has been established and compliance required by federal, state, and local authorities as well as private industry sectors. Currently, the U.S. Department of Transportation's Federal Highway Administration (FHWA) mandates almost all workers in or near highway roadside to wear safety clothing that complies with the standard (ISEA 2012).

In 2006, ISEA first published ANSI/ISEA 207-2006 (revision in 2011), American National Standard for High-Visibility Public Safety Vests. It is intended for firefighters, emergency responders, and law enforcement officers, who may have problematic use of general industry standard HVSA due to their tactical needs. The major difference between ANSI/ISEA 107 AND ANSI/ISEA 207 is that ANSI/ISEA 207 Public Safety Vest standard represents the vest configuration of apparel only with one Performance Class, whereas ANSI/ISEA 107 general industry standard identifies a variety of apparel items with several Performance Classes (ISEA, 2013). The Public Safety Vest provides more flexibility and functional features to accommodate law enforcement officers' tactical needs.

ANSI/ISEA standard itself is a voluntary industry guide of standard measurement and requirement for HVSA; however, its compliance is mandated by U. S. Federal regulations of 23 CFR (Code of Federal Regulations) Part 634, Worker Visibility, and the Federal Highway Administration's Manual on Uniform Traffic Control Devices (MUTCD).

### 2.4.2 Federal regulation

In November 2006, Title 23 CFR Part 634, Worker Visibility rule was published as the first U. S. Federal regulation. It was applied to all workers within the right-of way on Federal-aid highway, who are exposed either traffic or to construction equipment, such as highway construction, maintenance, utility crews, and responders, which required the use of ANSI/ISEA 107-2010 Performance Class 2 or 3 garments.

During the comment period of this regulation, the FHWA received numerous comments submitted by State and local law enforcement agencies and private industries. An exception for law enforcement personnel was requested for law enforcement activities, as opposed to traffic control type activities, because an officer wearing a HVSA would stand out in situations where the additional conspicuity could be hazardous. In November 2008, the FHWA provided Interim Final Rule (IFR) with limited exceptions that are incorporated in the definition of "workers" for law enforcement personnel as well as other emergency responders.

The definition of "workers" in IFR is stated as follows:

> "Workers means people on foot whose duties place them within the right-of-way of a Federal-aid highway, such as highway construction and maintenance forces; survey crews; utility crews; responders to incidents within the highway right-of-way; firefighters and other emergency responders when they are not directly exposed to flame, fire, heat, and/or hazardous materials; and law enforcement personnel when directing traffic, investigating crashes, and handling lane closures, obstructed roadways, and disasters within the right-of-way of a Federal-aid highway".
>
> (Passage cited is from Title 23 CFR Part 634.2, IFR).

The Title 23 CFR Part 634 regulation has been incorporated into MUTCD 2009 edition. The MUTCD is a national standard for all traffic control devices installed on any street, highway, bikeway, or private road open to public travel. The MUTCD is published by FHWA under Title 23 CFR Part 655, Subpart F. When uniformed law enforcement officers direct traffic; investigate crashes; or handle lane closures, obstructed roadways and disasters, HVSAs shall be worn as described in the MUTCD, Section 6D.03 (paragraph 06). Law enforcement personnel engaged in activities other than those identified are exempt from the HVSA requirement (MUTCD, 2009).

In addition, the Occupational Safety and Health Administration (OSHA) references the MUTCD as compliance guide to ensure worker safety (29 CFR 1926 Subpart G, 2012). OSHA standard (OSH Act, 29 U.S.C. §654(a)(1), also known as the General Duty Clause) and its interpretation (Standard Interpretation#20080829-8611, 2009) require HVSAs for flaggers, workers exposed to vehicle traffic, and cite the regulation Title 23 CFR Part 634, Worker Visibility.

While general industry rule of wearing HVSA enhances law enforcement officers' safety within Temporary Traffic Control (TTC) zones, the exceptions that are granted to law enforcement officers left up to individual interpretation.

### 2.4.3 HVSA practice in law enforcement community

A recent study by Nisenson, A., et al (2011) evaluated reflective vest options for law enforcement officers, and conducted a survey of HVSA. Their study includes several examples of law enforcement agencies' varying policies related to safety gear; which states that "a reflective vest of mesh or other suitable material may be worn when working traffic assignments.", or "officers are expected to wear their issued ANSI 2 reflective vest when directing traffic or otherwise on the scene of a crash for more than 15 minutes." The vague agency policy is the reflection of HVSA wearing practice.

On average, the HVSA users among their survey respondents rated the efficiency of HVSA as "neither ineffective nor effective" using a five-point Likert scale. The respondents generally do not believe that wearing HVSA enhances their professional appearance. Furthermore, the respondents believe that a HVSA makes them a target in situations where they do not wish to be seen. The frequency of HVSA use of five agencies was recorded as 33.2% of "never or rarely", 41.3% of 1-3 times per month, 22.7% of 1-3 times per week, and 1.6% of once per day (Nisenson, A., et al, 2011).

Through this literature review on HVSA practice in the job field, it is appeared that varying law enforcement agency polices, insufficient HVSA safety training or

education, and lack of organizational safety enforcement affect the decision of law enforcement personnel whether or not to use HVSA.

## 2.5 Summary

Pertinent literature was reviewed, and applied to the context of the specific aim of this study related to HVSA in law enforcement community. The review of HVSA, social-psychological theories, workplace traffic fatality, HVSA regulation, and its practice in law enforcement organization were reviewed. By presenting this correlated information, the relationships between varying aspect of law enforcement HVSA, human perception and protective behavior toward PPC were described.

# CHAPTER 3. METHODOLOGY

## 3.1 Survey Procedure

The study objectives were accomplished using survey research methods to assess law enforcement officers' attitudes and safety behavior perspectives toward HVSA. The survey was completed by law enforcement officers in four cities of Yavapai County (i.e. Prescott, Prescott-Valley, Chino-Valley, Cottonwood) in state of Arizona, both male and female, who are required the use of HVSA when directing traffic, investigating crashes, and handling lane closures, obstructed roadways, and disasters within the right-of-way of a Federal-aid highway according to Federal regulation (23 CFR Part 634.2, IFR).

The procedure for administrating this survey involved the submission of a formal, signed survey request form to Police Chief or Safety Manager. Appendix A contains a copy of the cover letter to police departments used in survey proposal. Appendix B includes a copy of survey informed consent form and questionnaire. This research instrument was anonymous and utilized voluntary survey methods. The questionnaire took about 20 minutes to complete. The survey was administrated and distributed on site to the respective City Police Departments over 3 months period between September 2012 and December 2012. Each survey was pre-assigned a code number for verifying its return.

There were no known risks in conducting this survey, and participants were permitted to withdraw the completion of survey at any time without penalty if they did not wish to continue for any reason. This research involves human participants. The research instrument and protocol application was reviewed by Institutional Review Board (IRB) for the

protection of human subjects in university research according to Code of Federal Regulation, Title 45 CFR Part 46. Appendix C includes a copy of Human Subject Research Approval Letter from IRB with approval Number IRB 13-113 at the bottom of the format.

The survey proposal and the cover letter were sent to six City Police Departments and a county sheriff's office across the Northern Arizona region, which six hundred forty-six (646) of survey statements in total were distributed. The requests for survey participation in two major City Police Departments and a county sheriff office allocated for four hundred fifty (450) surveys were declined. Four City Police Departments in Yavapai County participated in this study. A total of one hundred ninety-six of surveys (196) were distributed to Prescott, Prescott-Valley, Chino-Valley, and Cottonwood City Police Departments. The surveys were answered through pen and paper, and ninety-eight (98) completed surveys were returned. The deadline date for collection was assigned and two to three reminders to safety/training manager were sent to stimulate responses for survey data collection in timely manner.

### 3.2 Survey Instrument Description

The law enforcement officer HVSA survey questionnaire contained 31 questions. However, under question 23, there were 26 sub-multiple parts constructed in Visual Analogue Scale (VAS) for attitude assessment. VAS was used as a simple method for measuring subjective experience consisting of a ten centimeter line anchored at each end by descriptive words, at the very left side "Strongly Agree" and at the other end "Strongly Disagree". Participants were asked to mark the appropriate point on the line with a cross, which describes best how they feel at each of the statement. At the end of the survey

instrument, there was space to allow for suggestions or general comments under question 31 for the improvement on any issues regarding HVSA including but not limited to design, material, regulation, agency rule, safety training, etc.

The data collected were limited within four cities in Yavapai County in state of Arizona, where environmental conditions are exceedingly hot and dry. Results can only be generalized to the officers involved in the study and not to all law enforcement officers. The law enforcement uniforms were of standard type of Yavapai County police: they consist of dark navy, matching shirt and trousers, and a black leather law enforcement duty belt which carried handcuffs, portable lighting (i.e. flashlights), baton, radios, hand-held protection devices such as firearm, and the magazine pouch. Sometimes officers use suspenders, or harnesses which transfer some of the duty belt weight (average weight nearing 19-21 pounds) to the shoulders, lowering the amount of load concentrated at the waist and the back. Body armor (i.e. bulletproof vest) is often issued to law enforcement officers, typically in the form of a lightweight vest that can be worn under the shirts.

The initial task of the planned survey research was to construct a safety attitude questionnaire that could be employed to measure an officer's general attitude and perception toward HVSA. This was accomplished by writing VAS key multiple questionnaires. The demographic characteristics of the survey group were also contained in this research instrument prior to proceeding to attitude items.

The questions in the survey covered the following areas:

1. Demographic characteristics of the survey participants.

2. The basis for law enforcement uniform.
3. The basis for HVSA for law enforcement officers.
4. Influence on HVSA wearing decision.
    - Social-psychological (Human) factor.
    - Culture factor.
    - Organization factor.
    - Environmental and physical factor.
5. Perception and safety behavior in HVSA use
    - Attitude toward HVSA use
    - HVSA wearing behavior
    - Risk perception
    - HVSA comfort perception
6. knowledge and experience of traffic safety and HVSA
7. Policy, regulation, and practice in HVSA use

The following Table 3 demonstrates how each survey question was constructed in consideration of variables grouped by category.

**Table 3**
Consideration for constructing the survey

| No. | Description of question | Demographic characteristics | Basis for law enforcement uniform | Basis for HVSA |
|---|---|---|---|---|
| Q1 | How long have you been a law enforcement officer? (years) | O | Consideration for perceived risk vs. experience. | |
| Q2 | What is your current rank? | O | | |
| Q3 | Gender | O | | |
| Q4 | Marital Status | O | | |
| Q5 | Age (years) | O | | |
| Q6 | What is your race? | O | | |
| Q7 | Mark your highest level of education completed. | O | | |
| Q8 | Mark your current job assignment. | O | | |
| Q9 | Mark all other previous job assignments. | O | | |
| Q10 | Mark the type of environment setting you work. | O | | |
| Q23w (VAS) | Overall comfort of HVSA is satisfactory. | | | O |
| Q23x (VAS) | Overall comfort of the law enforcement uniform is satisfactory. | | O | O |
| Q23y (VAS) | General law enforcement uniform enhances the officer's professional look and authority. | | O | |
| Q23z (VAS) | I believe a darker color of law enforcement uniform such as black, dark blue, or brown is more authoritative and more tactical. | | O | O |

**Table 3 (continued)**
Consideration for constructing the survey

| No. | Description of question | Influence on HVSA wearing decision | | | | Perception & Attitude for HVSA | | | | Knowledge /experience in HVSA | Policy/ regulation and practice | HVSA safety training |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Social/ psychologi-cal factor | Culture factor | Organiza -tion factor | Environ-mental/ physical factor | Attitude toward HVSA | HVSA wearing behavior | Risk perception | HVSA comfort perception | | | |
| Q11a | Do you have HVSA? (Yes/No) | | | | | | | | | | O | |
| Q11b | If yes (Q11a), how old is your HVSA? | | | | | | | | | | O | |
| Q11c | If yes (Q11a), what Performance Class is your HVSA? (Knowledge) | | | | | | | | | O | O | O |
| Q11d | If yes (Q11a), how many do you own HVSA? | | | | | | | | | | O | |
| Q11e | If yes (Q11a), how often do you replace your HVSA? (months) | | | | | | | | | | O | |
| Q11f | If yes (Q11a), do you wash or clean HVSA? | | | | | | | | | O | | O |
| Q11g | If yes (Q11a/f), how do you wash or clean your HVSA? | | | | | | | | | O | | O |
| Q12 | Describe how you store your HVSA when you're not wearing it. | | | | | | | | | O | | O |
| Q13a | Are you required to wear HVSA during certain duties? (yes/no) | | | | | | | | | | O | O |
| Q13b | If yes (Q13a), describe those duties required to wear HVSA. | | | | | | | | | | O | O |

**Table 3 (continued)**
Consideration for constructing the survey

| No. | Description of question | Influence on HVSA wearing decision | | | | Perception/Attitude/Behavior in HVSA use | | | | Knowledge /experience in HVSA | Policy/ regulation and practice | HVSA safety training |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Social/ psychology -cal factor | Culture factor | Organiza -tion factor | Environ-mental/ physical factor | Attitude toward HVSA | HVSA wearing behavior | Risk perception | HVSA comfort perception | | | |
| Q14 | Identify the most important influence on your attitude toward HVSA. | O | O | O | O | | | | | | | |
| Q15 | What percentage of deaths do you estimate or know are due to being struck by automobile? | | | | | | | O | | | | |
| Q16a | Have you had other officers struck by vehicle accidently? | O | | | | O | | O | | | | |
| Q16b | If yes (Q16a), did other officer's traffic accidents influence your attitude on traffic safety and wearing HVSA? | O | | | | O | | O | | | | |
| Q17 | Who provides HVSA? | | | | | | | | | | O | |
| Q18 | How many hours of each month do you actually wear HVSA? | | | | | | O | | | | O | |
| Q19 | How many hours of each month are you required to wear HVSA accordingly your duties? | | | | | | O | | | | O | |

**Table 3 (continued)**
Consideration for constructing the survey

| No. | Description of question | Influence on HVSA wearing decision | | | | Perception/Attitude/Behavior in HVSA use | | | | Knowledge /experience in HVSA | Policy/ regulation and practice | HVSA safety training |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Social/ psychologi-cal factor | Culture factor | Organiza-tion factor | Environ-mental/ physical factor | Attitude toward HVSA | HVSA wearing behavior | Risk perception | HVSA comfort perception | | | |
| Q20 | Place marks for all factors that make you inclined not to wear HVSA. | O | O | O | O | O | O | | | | | |
| Q21 | What factor causes you to be least inclined to wear your HVSA? | O | O | O | O | O | O | | | | | |
| Q22 | What is the greatest cause of injury/fatality to patrolmen in your agency. | | | | | | | O | | O | | |
| Q23a (VAS) | HVSA prevents officers getting struck by vehicle. | | | | | O | | | | | | |
| Q23b (VAS) | I feel worried about my safety during patrol duty. | | | | | O | | O | | | | |
| Q23c (VAS) | Officers wearing HVSA are less likely to get injured. | | | | | O | | | | | | |
| Q23d (VAS) | Safety education programs are helpful for traffic-related accidents awareness. | | | | | O | | | | | | O |
| Q23e (VAS) | Safety education programs induce officers to wear HVSA more frequently. | | | | | O | | | | | | O |

**Table 3 (continued)**
Consideration for constructing the survey

| No. | Description of question | Influence on HVSA wearing decision | | | | Perception/Attitude/Behavior in HVSA use | | | | Knowledge /experience in HVSA | Policy/ regulation and practice | HVSA safety training |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Social/ psychologi-cal factor | Culture factor | Organiza -tion factor | Environ-mental/ physical factor | Attitude toward HVSA | HVSA wearing behavior | Risk perception | HVSA comfort perception | | | |
| Q23f (VAS) | Environmental conditions (e.g. hot temperature) have impact on wearing HVSA. | | | | O | O | | | O | | | |
| Q23g (VAS) | HVSA provides better conspicuity at night than at day. | | | | | | | | | O | | O |
| Q23h (VAS) | HVSA does not help improve conspicuity during the day. | | | | | | | | | O | | O |
| Q23i (VAS) | I dislike wearing a HVSA. | | | | | O | | | | | | |
| Q23j (VAS) | I feel safer when wearing a HVSA. | | | | | O | | O | | | | |
| Q23k (VAS) | I feel comfortable when my uniform and HVSA vest look professional. | O | | | | O | | | O | | | |
| Q23l (VAS) | HVSA help to enhance officer's professional look and authority. | O | | | | O | | | | | | |
| Q23m (VAS) | Being safe is more important than being comfortable. | O | O | | | O | | | | | | |

**Table 3 (continued)**
Consideration for constructing the survey

| No. | Description of question | Influence on HVSA wearing decision | | | | Perception/Attitude/Behavior in HVSA use | | | | Knowledge /experience in HVSA | Policy/ regulation and practice | HVSA safety training |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Social/ psychologi-cal factor | Culture factor | Organiza -tion factor | Environ-mental/ physical factor | Attitude toward HVSA | HVSA wearing behavior | Risk perception | HVSA comfort perception | | | |
| Q23n (VAS) | I feel inclined not to wear a HVSA since it makes me look like a highway worker. | O | | | | O | O | | | | | |
| Q23o (VAS) | My HVSA vest is uncomfortable. | | | | | O | | | O | | | |
| Q23p (VAS) | HVSA does not hinder access to weapons or the utility belt. | | | | O | | | | | | | |
| Q23q (VAS) | HVSA makes me a target in situations that I do not wish to be seen. | | | | | O | O | | | | | |
| Q23r (VAS) | The decision to wear a HVSA should be at an officer's discretion. | O | | | | O | | | | | | |
| Q23s (VAS) | Wearing a HVSA is too much of a hassle. | | | | | O | | | | | | |
| Q23t (VAS) | I feel safe without a HVSA. | | | | | O | | O | | | | |
| Q23u (VAS) | I feel that wearing HVSA has a negative impact on my command presence. | O | | | | O | | | | | | |

**Table 3 (continued)**
Consideration for constructing the survey

| No. | Description of question | Influence on HVSA wearing decision | | | | Perception/Attitude/Behavior in HVSA use | | | | Knowledge /experience in HVSA | Policy/ regulation and practice | HVSA safety training |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Social/ psychologi-cal factor | Culture factor | Organiza -tion factor | Environ-mental/ physical factor | Attitude toward HVSA | HVSA wearing behavior | Risk perception | HVSA comfort perception | | | |
| Q23v (VAS) | HVSA helps officers to avoid traffic-related injuries/fatalities. | | | | | O | O | | | | | |
| Q23w (VAS) | Overall comfort of HVSA is satisfactory. | Consideration for basis for HVSA | | | | O | | | O | | | |
| Q23x (VAS) | Overall comfort of the law enforcement uniform is satisfactory. | Consideration for basis for uniform | | | | O | O | | | | | |
| Q23y (VAS) | General law enforcement uniform enhances the officer's professional look and authority. | Consideration for basis for uniform | | | | O | O | | | | | |
| Q23z (VAS) | I believe a darker color of law enforcement uniform such as black, dark blue, or brown is more authoritative and more tactical. | Consideration for basis for uniform & HVSA | | | | O | O | | | | | |
| Q24a/b | Are there certain activities that make you inclined not to wear HVSA? | | | | | O | O | | | O | | |
| Q25a/b | Do you have any other experience that affected your attitude of wearing HVSA? | | | | | O | O | | | O | | |

**Table 3 (continued)**
Consideration for constructing the survey

| No. | Description of question | Influence on HVSA wearing decision | | | | Perception/Attitude/Behavior in HVSA use | | | | Knowledge /experience in HVSA | Policy/ regulation and practice | HVSA safety training |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Social/ psychologi-cal factor | Culture factor | Organiza -tion factor | Environ-mental/ physical factor | Attitude toward HVSA | HVSA wearing behavior | Risk perception | HVSA comfort perception | | | |
| Q26 | Describe your most uncomfortable experience of wearing HVSA. (physically/psychologically) | | | | | | O | | | O | | |
| Q27a | Have you had any safety training for use of HVSA? (yes/no) | | | | | | | | | | | O |
| Q27b | If yes (Q27a), mark all of training for use of HVSA. | | | | | | | | | | | O |
| Q28 | How many total hours of training have you received regarding HVSA use in past 3 years? | | | | | | | | | | | O |
| Q29a | Does your agency maintain a written policy for HVSA use? (yes/no) | | | O | | | | | | | O | |
| Q29b | If yes (Q29a), how often do you comply with agency policy in wearing HVSA? | | | O | | | | | | | O | |

**Table 3 (continued)**
Consideration for constructing the survey

| No. | Description of question | Influence on HVSA wearing decision | | | | Perception/Attitude/Behavior in HVSA use | | | | Knowledge /experience in HVSA | Policy/ regulation and practice | HVSA safety training |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Social/ psychologi-cal factor | Culture factor | Organiza -tion factor | Environ-mental/ physical factor | Attitude toward HVSA | HVSA wearing behavior | Risk perception | HVSA comfort perception | | | |
| Q29c | If yes (Q29a), what is consequences of failing to comply with agency policy in wearing HVSA? | | | O | | | | | | | O | |
| Q30a | Does your agency inspect HVSA after issued? (yes/no) | | | O | | | | | | | O | |
| Q30b | If yes (Q30a), how often HVSA is inspected? (months) | | | O | | | | | | | O | |
| Q31 | List any suggestions or comments for the improvement on any issues regarding HVSA including but not limited to design, material, regulation, agency rule, safety training and etc. | | | O | O | O | | | O | O | O | O |

## 3.3 Hypotheses

Using several grounded theories in literature review, the following hypotheses were formulated and tested to fulfill the study's purpose and research goals. From the design stage of formulating attitude correlations and hypotheses, they were set with a two sided test. This study was considering the possibility of a positive or a negative correlation avoiding restriction in one direction from a one sided test, and left the direction of correlations unsettled at the outset. The value of statistical significance reported is $p<0.05$ (at the 95% level of confidence) or $p<0.01$ (at the 99% level of confidence). The hypotheses are as follows.

### 3.3.1 Person factor: attitudes correlations

**$H_o$ (H1~H6):** There is no correlation between the two variables.

- **H1:** A correlation exists between law enforcement officers' levels of disliking HVSA use and the belief of effectiveness of HVSA preventing traffic accidents (Q23i/Q23v).
- **H2:** A correlation exists between law enforcement officers' levels of anxiety toward traffic-accident fatality and levels of feeling safe when wearing HVSA (Q23b/Q23j).
- **H3:** A correlation exists between levels of disliking wearing HVSA and the fact that the officer judges the HVSA wearing decision as an officer's discretion (Q23i/Q23r).

- **H4:** A correlation exists between the levels of disliking the wearing of a HVSA and an officers' perception that "the HVSA has a negative impact on my command presence" (Q23i/Q23u).
- **H5:** A correlation exists between the levels of feeling inclined not to wear HVSA since it makes the officers look like highway workers and the officers' perceptions that HVSA has a negative impact on their command presence (Q23n/Q23u).
- **H6:** A correlation exists between the positive perception of safety education programs being helpful for awareness of traffic-related accidents and the level of disliking in HVSA use (Q23d/Q23i).

### 3.3.2 Experience, risk perception and behavior factor

**$H_o$ (H7~H8):** There is no correlation between the two variables.

- **H7:** A correlation exists between the level of job experience (or exposure to traffic-hazardous environment) and the amount of risk a law enforcement officer judges toward traffic-accident fatality (Q1/Q15).
- **H8:** A correlation exists between the amount of risk a law enforcement officer judges toward traffic-accident fatality and HVSA wearing behavior (Q15/Q18).

**$H_o$ (H9~H10):** There is no difference between two independent groups.

- **H9.** There is a difference of attitude of feeling safe when wearing a HVSA between law enforcement officers with basic knowledge of their HVSA and officers without it (Q11c transformed/Q23j).

- **H10.** There is a difference of HVSA wearing behavior between law enforcement officers with basic knowledge of their HVSA and officers without it (Q11c transformed/Q18).

#### 3.3.3 Organizational safety behavior and individual's safety attitude

**$H_o$ (H11~H12):** There is no difference between two independent groups.

- **H11.** There is a difference of risk perception between law enforcement officers with and without safety training in HVSA use (Q27a/Q23t).
- **H12.** There is a difference in an individual's attitude toward traffic safety education, based on whether the law enforcement agency inspects HVSA or not (Q30a/Q23d).

### 3.4 Reliability and Validity of Measures

Cronbach's alpha (Cronbach, L. J., 1951) was performed to examine internal consistency of scale for multiple VAS questions. It was initially tested on a sample size of 12 law enforcement officers from Chino Valley City Police Department at early stage of survey administration. Number of items were removed for analysis until the index of alpha coefficient was greater than 0.7 the cut-off which Nunnally (1978) suggested. The ending index of the first sample data set of attitude items (16 remained items) was 0.701. After collecting the second data set group from Prescott Valley Police Department, the reliability was re-examined on a sample size of 31 law enforcement officers. The Alpha coefficient of attitude items of the second data set group was 0.719. Although there was slight reliability increase, the level of Cronbach's alpha consistently exhibited adequate internal consistency in two subsequent tests for 16 remained attitude items in analysis.

Next, this study used a group of experts of 6 people to review the survey instrument for content validity. It is a non-statistical type of validity that involves "the systematic examination of the test content to determine whether it covers a representative sample of the behavior domain to be measured" (Anastasi, A. & Urbina, S., 1997). Clarity and readability of survey items were reviewed for establishing face and content validity. Several survey items were revised for clarity or discarded for analysis. A minimum of 83.3% of reviewers agreed that remained survey items identified as measuring each research criteria what it sets out to measure.

The final set of attitude variables for analysis was summarized in Table 9 (see page 94; Q23a, Q23b, Q23d, Q23i, Q23j, Q23k, Q23n, Q23o, Q23q, Q23r, Q23s, Q23t, Q23u, Q23v, Q23x, Q23z) through the procedure of performing Cronbach's alpha, and establishing face and content validity. Question 10 and question 22 were also discarded for analysis through screening process.

### 3.5 Data Analysis

The statistical program, Statistical Package for the Social Science (SPSS) 19 was used for data analysis generating bivariate correlation analysis, distributions, trends, and descriptive statistics for characteristics of participants including means, median, minimum, maximum, frequencies, standard deviations and quarterly percentile. The degree of agreeing or disagreeing of VAS statement under question 23 was measured directly from a ten centimeter line from 0 to 10, where 0 at the very left was the most positive value, and 10 at the very right the most negative.

Shapiro-Wilk test (Shapiro, S. S. and Wilk, M. B., 1965; Conover, W.J., 1999) was run to test normality of VAS survey data. The test result was reported in Table 10 as part of process checking statistic measure of correlation. In addition to Shapiro-Wilk test, normal Q-Q Plots and histograms for variables were examined. Scatterplots were created for all dependent variables against independent variables, and then visually inspected for checking linearity.

As the survey data for correlation test failed to meet the assumption of normality for variables, a Spearman's rank correlation coefficient ($\rho$, also signified by $r_s$), non-parametric measure of statistical dependence was run to assesses the strength and direction of association between two ranked variables, which reduces the impact or leverage of outliers and does not require the normality of both variables. Student's t-distribution (two-tailed) was used for testing significance in correlation.

Correlation matrix was generated for graphic representation of the correlations as shown in Figure 19. It contained Spearman's rank correlation coefficient and color-coded classification by two levels of statistical significance (i.e. $p<0.05$*, $p<0.01$**) and the direction of correlation (positive or negative).

Non-Parametric Mann-Whitney U tests (two-tailed) were conducted to test the differences between two independent groups in regard to experience, risk perception, and individual/organizational behavior factor. Statistical significance was set at $p<0.05$ for Mann-Whitney U tests statistics. The Shapiro-Wilk test for normality and Levene test for homogeneity of Variance test (based on Median) were run to check the assumption for choosing a test analysis method.

The demographic data and other supporting information were analyzed quantitatively (i.e. bar charts, histogram, descriptive statistic tables, and multiple response frequency tables). It provides summary of the population that the sample of data represented. No pilot test of the survey instrument was conducted. The item analysis was conducted after the study data was collected.

### 3.6 Summary

As can be seen, the research design had to accomplish three primary goals. The first was that person factors such as attitudes, belief, perception, and knowledge toward HVSA among law enforcement officers were needed to be measured. The second was to investigate behavior and environment factors influencing the decision of HVSA use. The third was to test significance of relationship between variables and proposed hypotheses. The next chapter will cope with the result of the survey methods.

# CHAPTER 4. RESULTS AND CONCLUSION

## 4.1 Participant Characteristics: Demographics

The total number of respondents was ninety-eight (98) from one hundred ninety-six (196) surveys distributed to sworn officers in Prescott, Prescott-Valley, Chino-Valley, and Cottonwood City Police Departments, yielding a 50% average response rate. Table 4 shows the breakdown of the number of law enforcement officers employed at the time of the survey and the survey participation rate. The overall mean age was 37.6 years (median=36 years, N=98, *SD*=8.24) ranging from 23 to 61 years old; and the average job experience was 10.7 years (median=9.5 years, N=98, *SD*=7.35) ranging from 5 months to 38 years. The majority of participants fell into the White/Caucasian ethnic group (N=98, *n*=87, 88.8%) followed by the Hispanic ethnic group (N=98, *n*=7, 7.1%). The percentage of female participants was 6.1% (N=98, *n*=6). The following simple bar charts of Figure 10 and Figure 11 were intended to describe demographic backgrounds (i.e. rank, current assignment, education level, and marital status) of the survey participants.

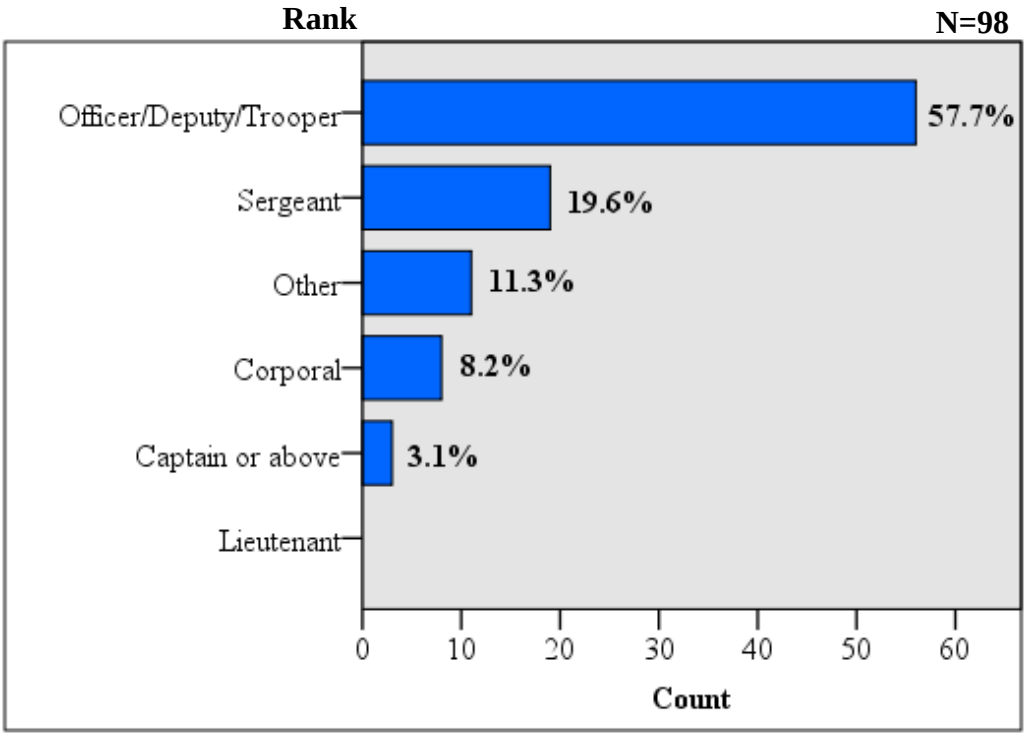
All other job assignments in which law enforcement officers had been served (question 9) was utilized to sort out the population without having patrol and traffic-safety duty experience. The majority of participants (N=98, n=95, 96.9%) served in general patrol/traffic-safety assignment at least once in their career years. The classification of type of environment setting in the workplace, question 10 was discarded for analysis because the combined Police Departments comprised one type of environment, namely, a small sized urban area.

**Table 4**
Police Department organization and survey participation

| City Police Departments | Prescott | Prescott Valley | Chino Valley | Cottonwood | Total |
|---|---|---|---|---|---|
| Sworn officers (Patrol duties). | 41 | 50 | 23 | 23 | 137 |
| Other sworn officers. (Detective/Traffic control/Supervisor) | 33 | 13 | 3 | 10 | 59 |
| Total no. of sworn officers. (Survey distributed population) | 74 | 63 | 26 | 33 | 196 |
| Civilian employees. (Administrative/Animal control) | 50 | 13 | 7 | 17 | 87 |
| Grand Total no. of employees. | 124 | 76 | 33 | 50 | 283 |
| Total no. of sworn officers participated in survey. | 38 | 31 | 12 | 17 | 98 |
| Survey participation rate (%) : among sworn officers | 51.4% | 49.2% | 46.2% | 51.5% | 50.0% |
| Percent of survey data population. | 38.8% | 31.6% | 12.2% | 17.3% | 100.0% |

*Note.*

- Police Department organization structure specified above was obtained during a 3 month period between September 2012 and December 2012.
- Survey participation rate (%) = (Total no. of sworn officers that participated / Total no. of sworn officers' population) x 100



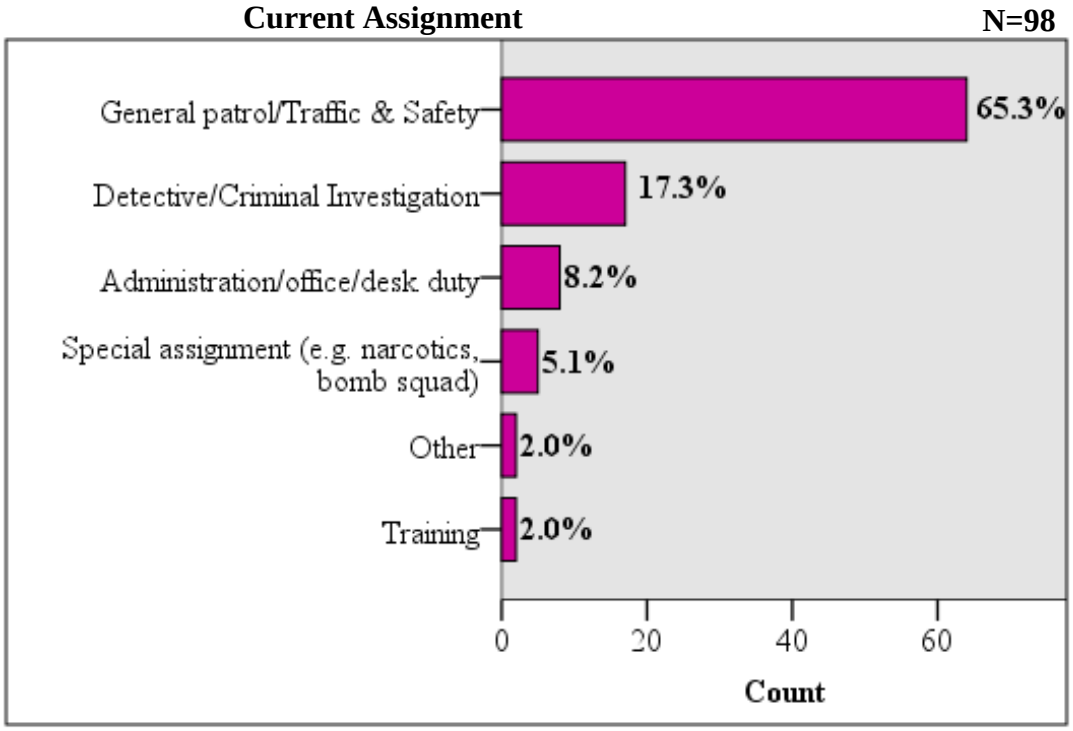
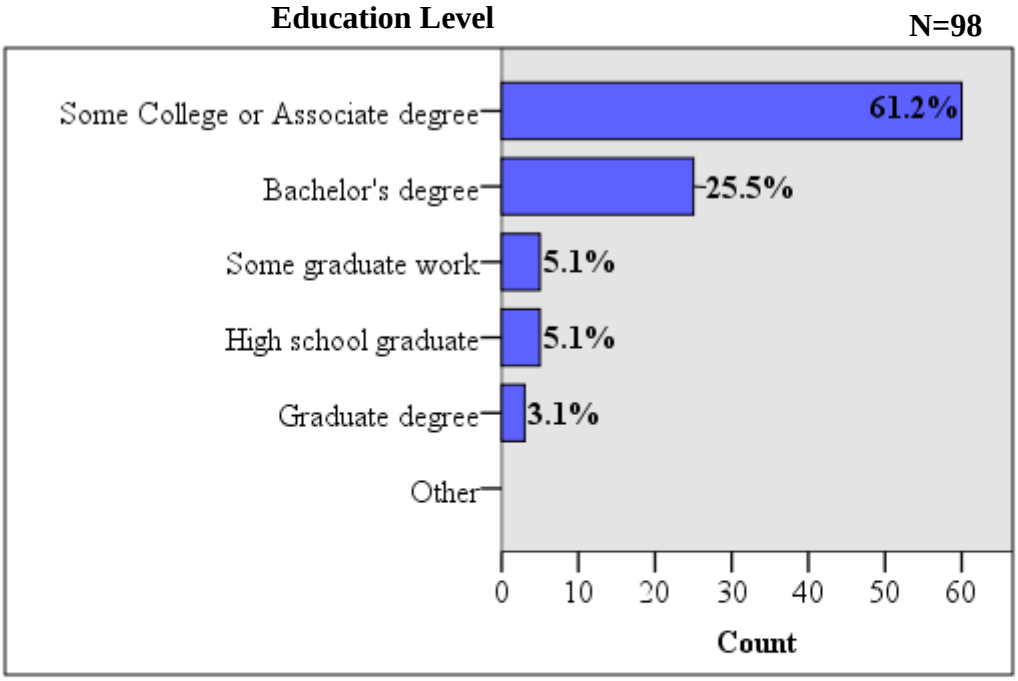




**Figure 10** Rank and current assignment: demographic background of survey participants.



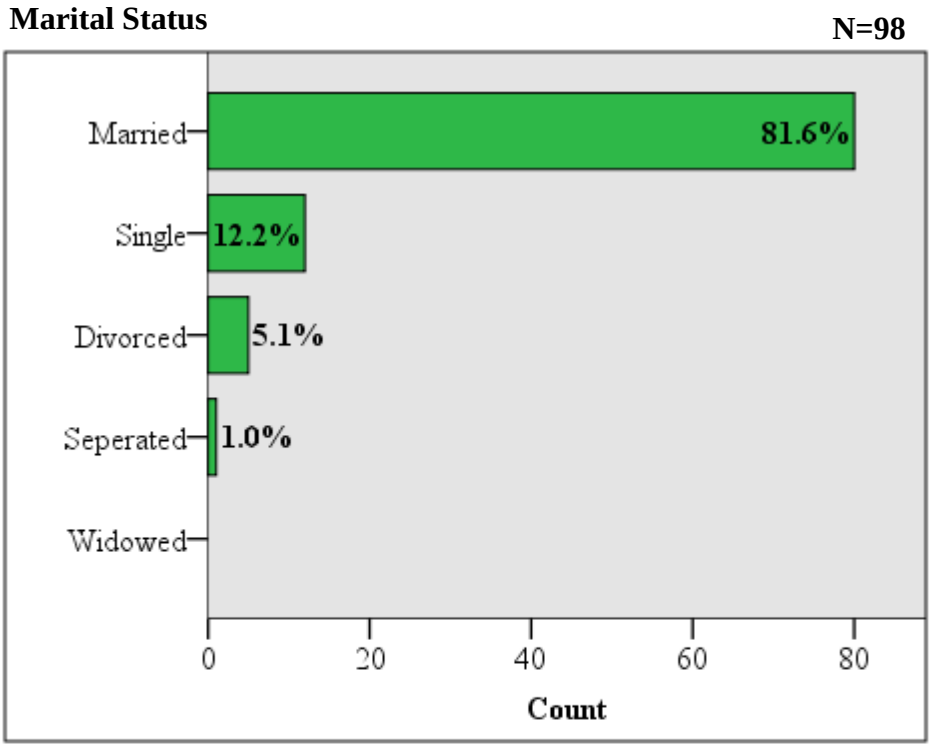




**Figure 11** Education level and marital status: demographic background of the survey participants.

### 4.2 Knowledge, Training, and Environment

The unsafe actions contributing to occupational health problems arise not only because untrained workers do not take safety precautions (such as wearing HVSA when they could have), but also because the HVSA is not available when protection is needed. HVSAs that are no longer able to provide minimum acceptable levels of conspicuity as a result of soiling, fading, contamination, physical damage (i.e. wear and tear, age), or if they are not visible at 1,000 feet should be replaced. They should be considered to be unusable if they are owned by law enforcement officers. Unless there is an internal policy, clothing item service life is an end user decision, depending upon the costs and risks associated with clothing decontamination and reuse (OSHA, 2013). Typical useful service life of HVSA that is worn on a daily basis has a service life expectancy of approximately 6 months. Apparel that is not worn on a daily basis may have a useful service life of up to three years (ATSSA, 2008).

Six sub-multiple statements to determine HVSA availability was contained in question 11. Ninety-nine percent of the participants owned HVSA (N=98, *n*=97), and sub-parts (11b~11g) were answered among these law enforcement officers. They were asked to indicate the age of their HVSA, the Performance Class, the number of HVSAs they owned, the replacement frequency, and their cleaning methods of HVSA. The mean age of currently owned HVSA is 3.01 years (N=96, *SD*=2.64), and the average number of HVSA owned is 1.25 (N=92, *SD*=0.78) as shown in the following Table 5. It indicated

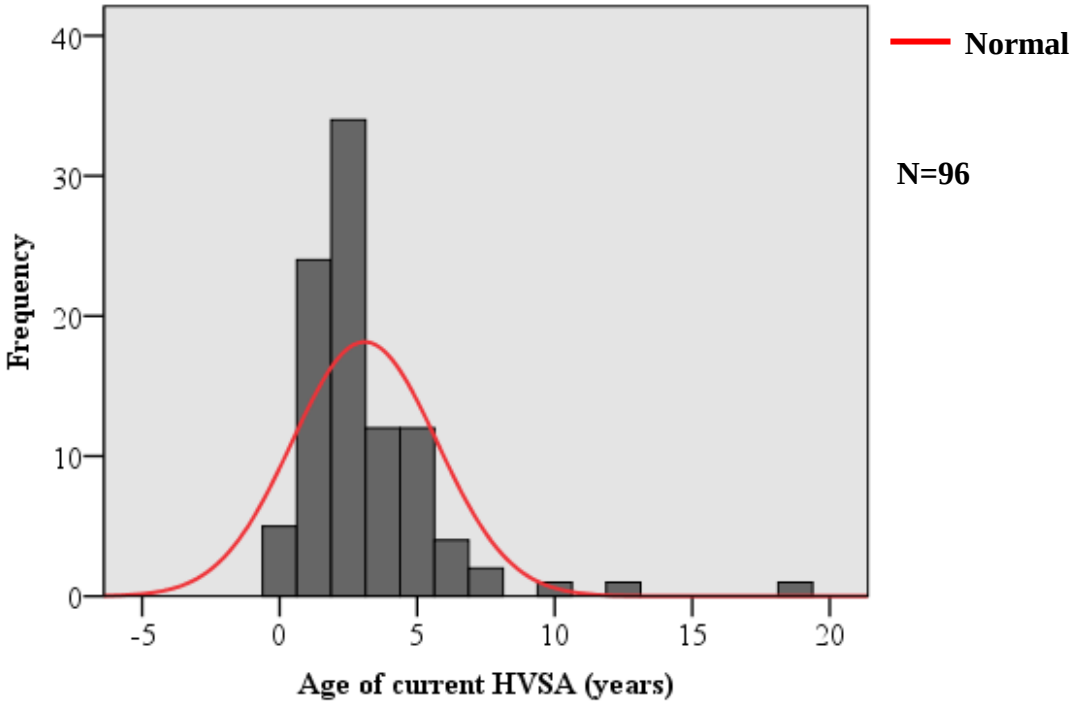
that 34.4% of HVSA validity period was over, and passed through the recommended service life up to 6 months for daily use and 3 years for occasional use. The percent of law enforcement officers that owned more than one or multiple garments of HVSA was 26.1%; despite the fact that 95% of the participants did not wash or clean their HVSA.

**Table 5**
Age of current HVSA and number of HVSA owned

| | N | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|---|
| Age of HVSA (years) | 96 | 0 | 19 | 3.086 | 2.6375 |
| Number of HVSA owned | 92 | 0 | 5 | 1.25 | 0.779 |
| Valid N (listwise) | 91 | | | | |

The Figure 12 contains a histogram for the age of owned HVSA, and a bar chart which describes the distribution of actual Performance Class of HVSA currently owned. The question 11c of actual Performance Class of HVSA owned was constructed to consider the level of knowledge and safety training collaterally. The majority of participants (N=97, n=82, 90.1%, see Figure 12) who owned HVSA indicated that they did not know the Performance Class of their HVSA.

For question 11e, participants were asked to indicate replacement frequency of HVSA. For data analysis purpose, responses were collapsed into groups and presented by bar chart as following Figure 13. “Never” is indicated by 34.6% (N=78, n=27) and 16.7% (N=78, *n*=13) indicated “When needed or no longer effective”. The majority of participants (N=97, *n*=93, 94.9%) indicated that they do not wash or clean their HVSA.



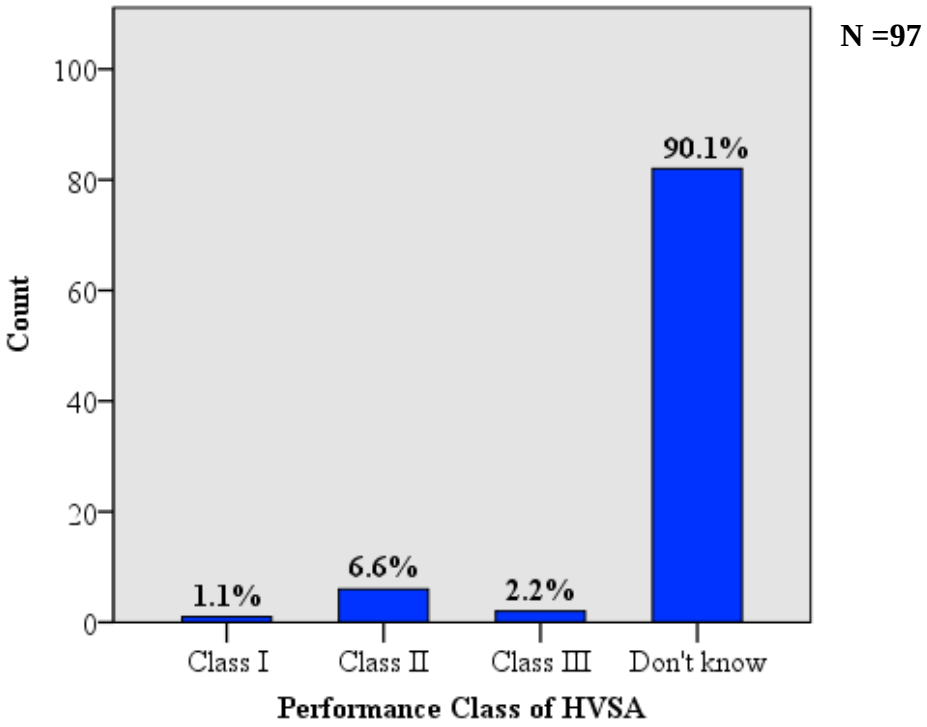




**Figure 12** Age and Performance Class of current HVSA owned.

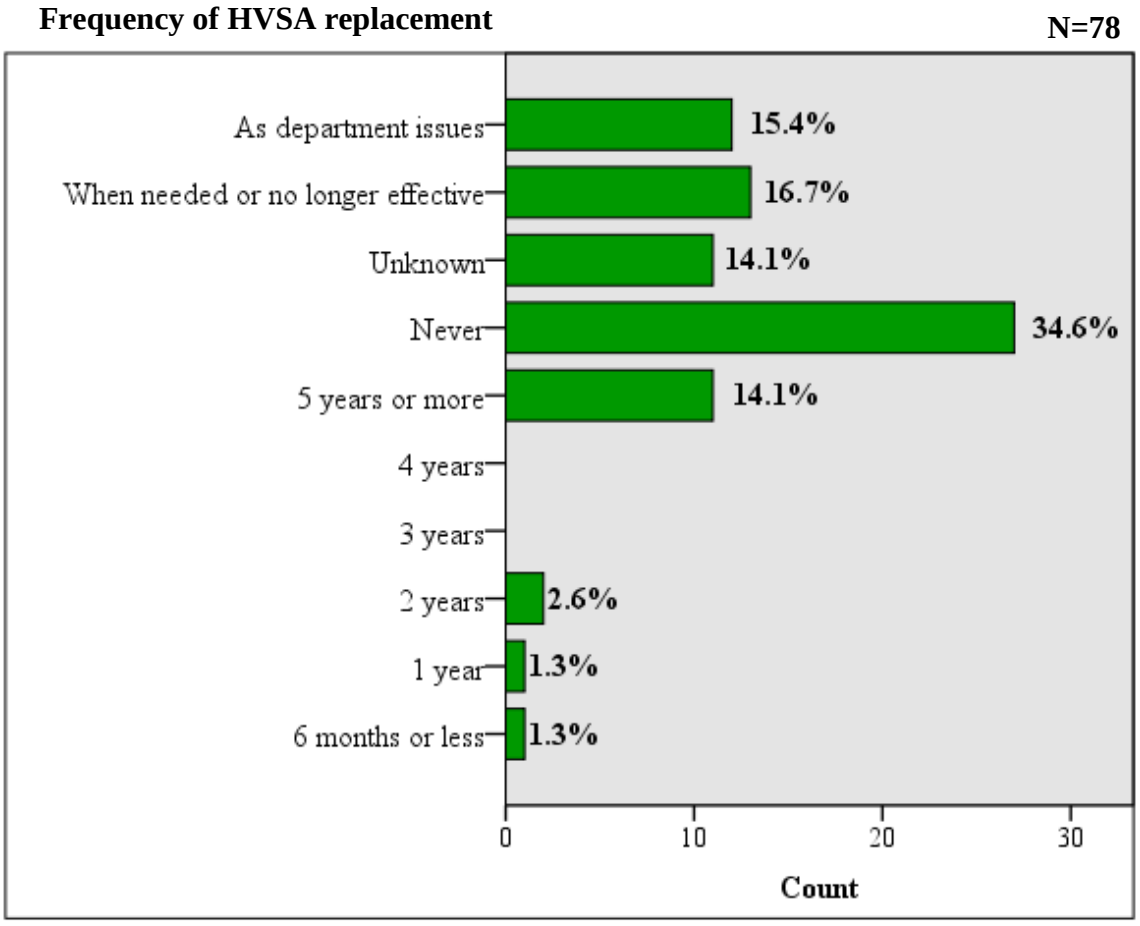



**Figure 13** Frequency of HVSA replacement.

HVSAs that are soiled should be cleaned per care label instructions as soon as possible. Routine inspections should be conducted as part of compliance in order to ensure proper HVSA usability. If the safety apparel is questionable on its protective functionality, replacement is recommended. Once new HVSA is received, old apparel should be cut in half so that it can't be reused and then disposed properly to avoid having multiple sub-standards HVSA in use (ATSSA, 2008). The survey result of an average number 1.25 of HVSA currently owned and its distribution may be an indicator that old HVSAs may be not being discarded as recommended.

PPC must be stored in a clean and sanitary condition ready for use to prevent damage or malfunction from exposure to dust, moisture, sunlight, damaging chemicals, extreme temperatures and impact in accordance with manufacturer instructions (OSHA, 2013). In question 12, participants were asked to indicate how they stored HVSA. Thirty-eight and one-half percent (N=96, *n*=37) of participants stored HVSAs in their patrol bag, followed by 32.3% (N=96, *n*=31) stored in other locations in a vehicle rather than in the door panel, in the back of the seat, or the rear of a vehicle (see Figure 14). When HVSA is stored in the rear of a vehicle (n=11, 11.5%), in the office (n=4, 4.2%), or back seats, it is unlikely law enforcement officers would be able to put it on before they get out of the patrol vehicle especially for emergency incidents, or when they investigate crashes, or directing traffic.

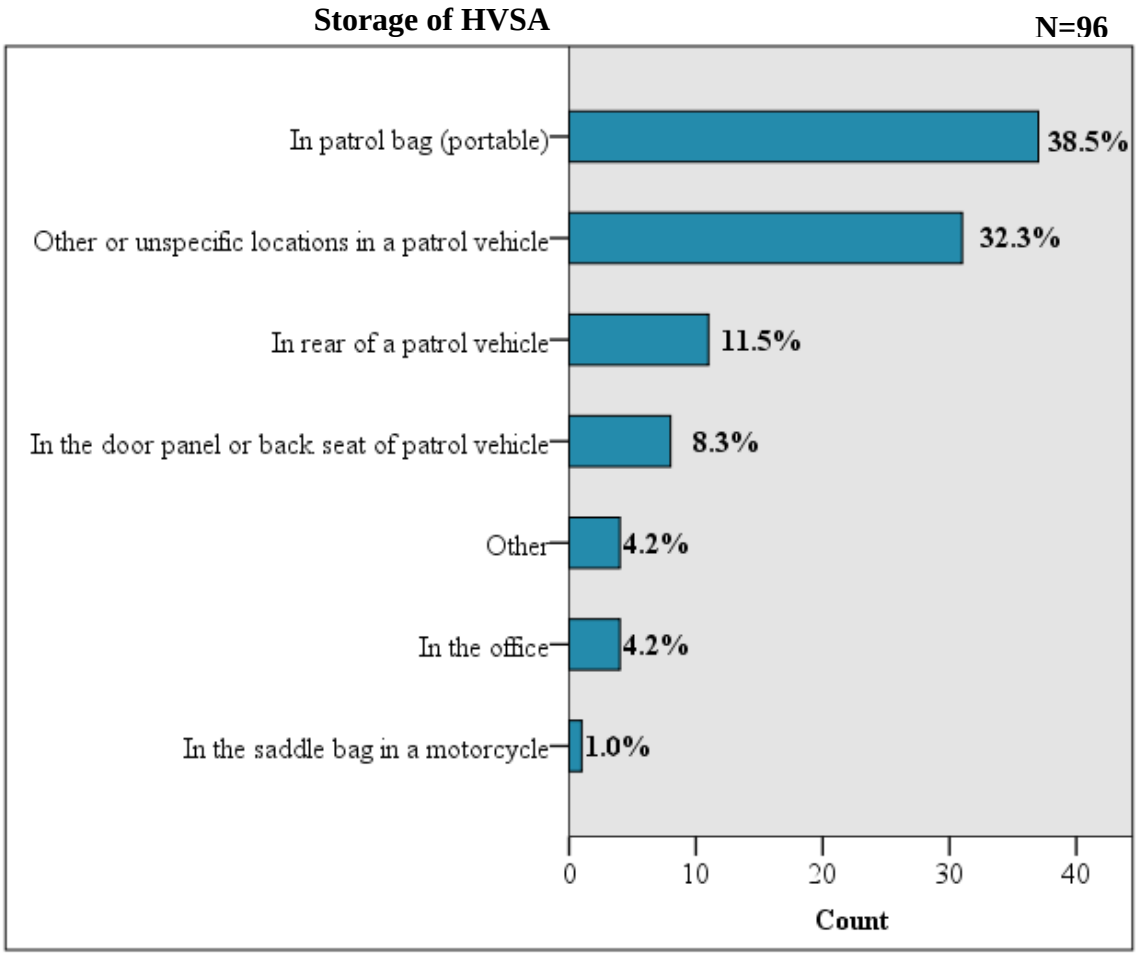



**Figure 14** Storage of HVSA.

### 4.3 Environment Factor: Regulation, Practice, and Training

The majority of participants (N=98, *n*=97, 99%) indicated that they were required to wear HVSA during their traffic-safety/patrol duties by agency regulation. The most important influence on law enforcement officer's attitude toward HVSA was the regulations and department rules (N=92, *n*=29, 31.5%), supervisor or higher authorities (N=92, *n*=26, 28.3%), and followed by practice in the law enforcement community (N=92, *n*=16, 17.4%) as shown in Figure 15.

When law enforcement officers failed to comply with HVSA wearing policy, it was reported that they would receive minor reprimands (N=67, *n*=48, 71.6%) primarily a verbal or written reprimand, or no reprimand (N=67, *n*=14, 20.9%) as summarized in Figure 16. It appears that agency policy and practice of HVSA provide neither the guidance nor the expectation for compliance in HVSA use. The number of participants, 72.6% (N=95, n=69), indicated their agency maintained a written policy for HVSA use. The number of participants, 26.3% (N=95, *n*=25), did not know if there was a written policy or not. However, Prescott Valley and Cottonwood City Police Departments had a written policy related to HVSA (see Appendix D), yielding a 48.9% (*n*=48) of survey population in fact.

Among the participants who indicated that their agency maintained a written policy, 34.8% (N=69, *n*=24) of participants indicated that they 'always' comply with agency policy in wearing HVSA, and 55.1% (N=69, *n*=38) indicated 'often' (Figure 16). It infers that the enforcement of HVSA rules and regulations is the top important factor affecting law enforcement officers' wearing decision of HVSA.

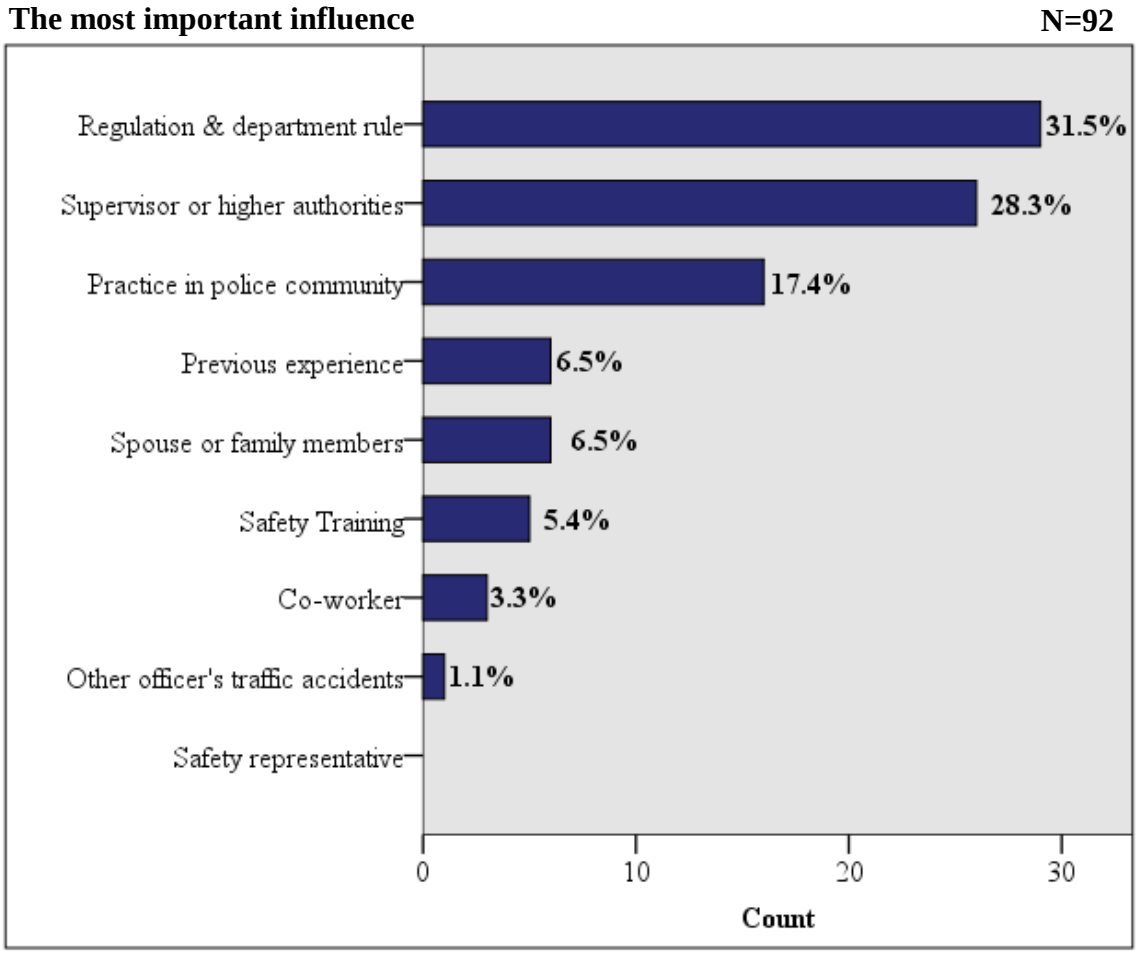



**Figure 15** The most important influence on law enforcement officers' attitudes toward HVSA use.

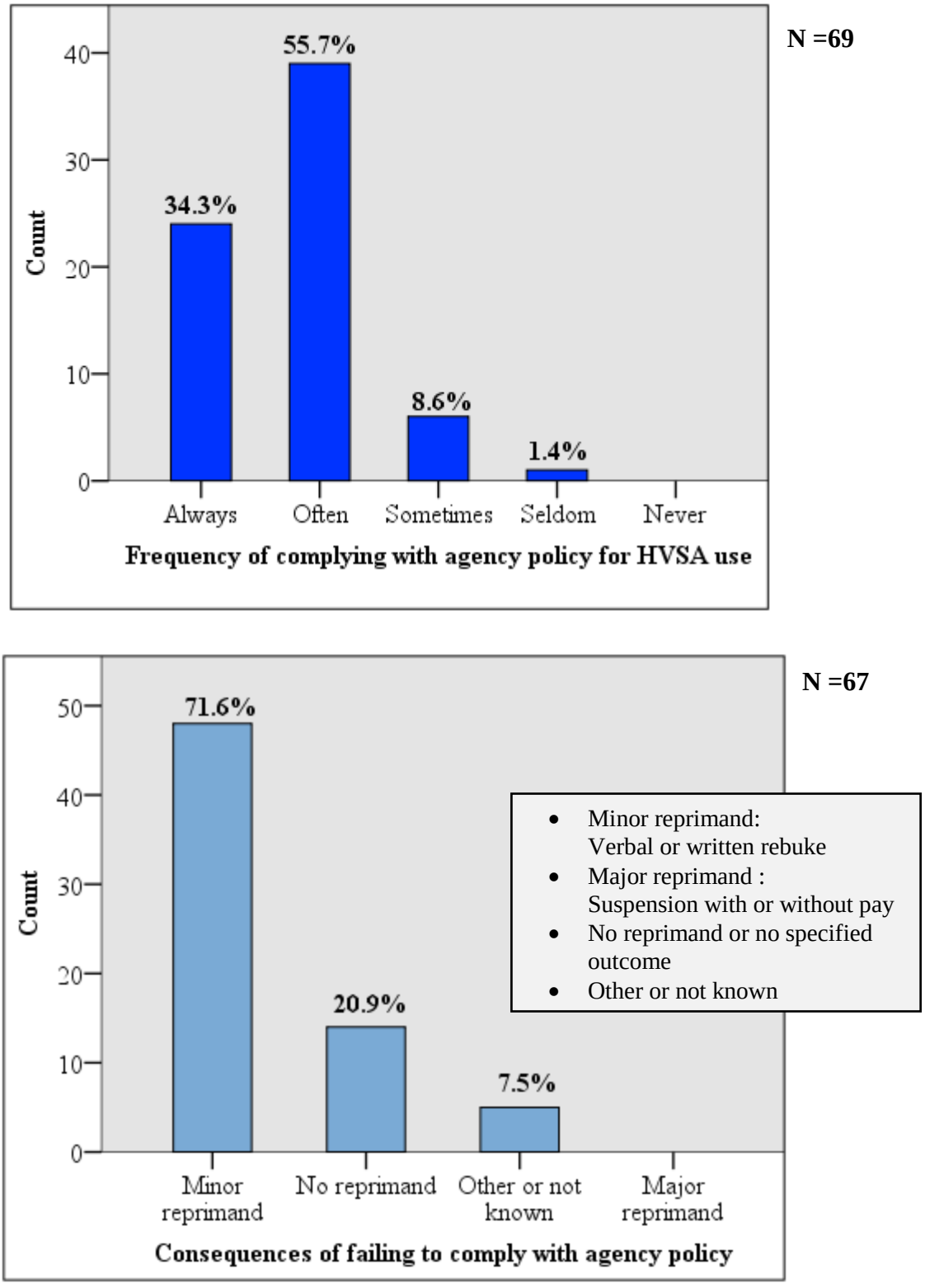



**Figure 16** Law enforcement agency policies for HVSA (compliance/consequences).

The end user in PPC must take all required steps to ensure that the protective ensemble such as HVSA will perform as expected, and be available when protection is needed. During emergencies or at the scene of crashes is not the right time to detect discrepancies in PPC (OSHA, 2013). Most of the participants (N=97, *n*=94, 96.9%) indicated that their law enforcement agency purchased HVSA and provided them to each individual officer. In question 30, participants were asked to indicate if their agency inspected HVSA. The number of participants, 23.2% (N=95, *n*=22), indicated that their agency inspected HVSA after issued. Among those participants, the frequency of inspection was asked and responses were collapsed into groups as shown in Figure 17. Twenty-five percent (N=20, *n*=5) indicated yearly inspection followed by 20% (N=20, *n*=4) of monthly inspection.

Question 18 and 19 were constructed to elicit HVSA wearing behavior in numeric scale as well as to compare with the required HVSA wearing hours per month. The overall mean of required HVSA wearing hours per month during patrol or traffic safety duties was 1.95 hours (median=1.0 hour, *SD*=3.18), versus the mean of actual wearing hours per month 2.42 hours (median=1.75 hours, *SD*=2.35) as following Table 6.

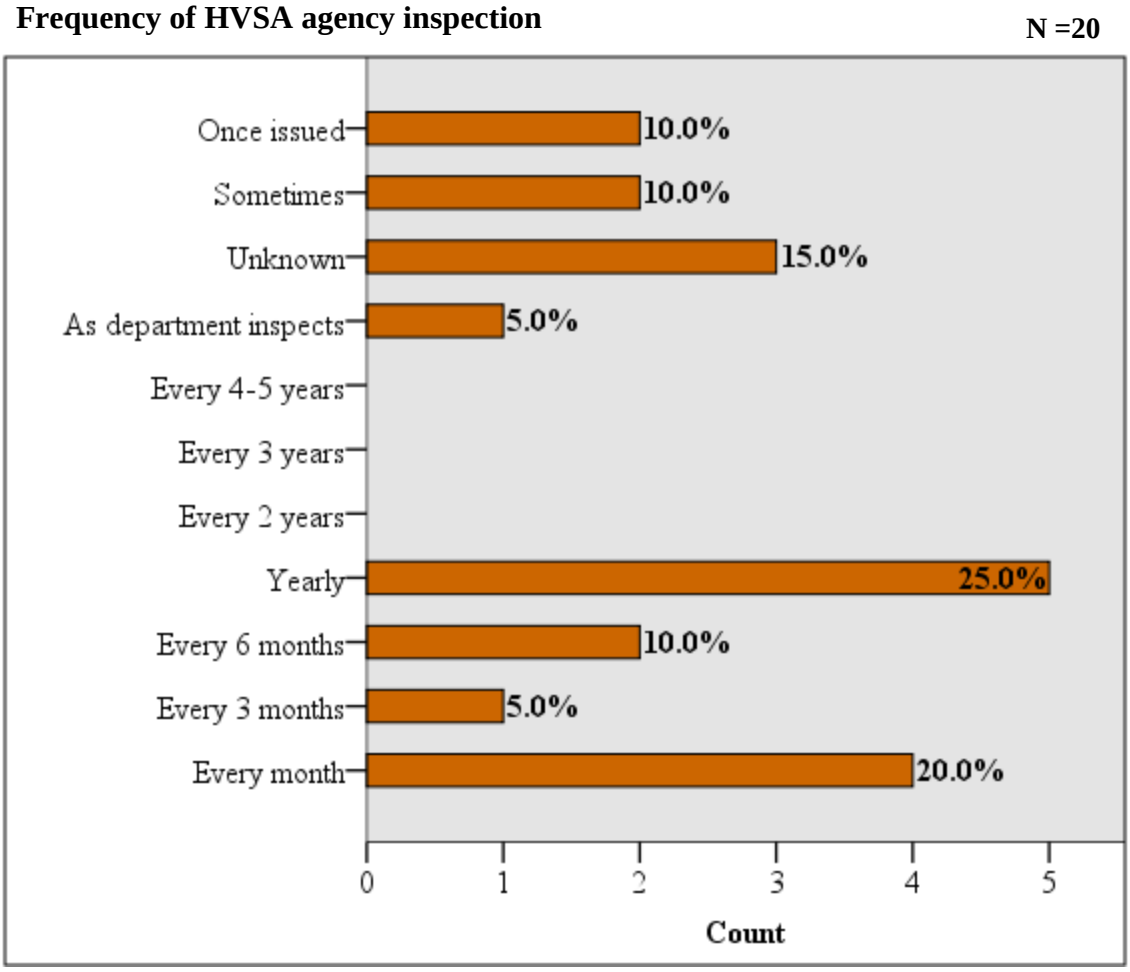



**Figure 17** Frequency of law enforcement agency inspection of HVSA.

It indicates that law enforcement officers wear HVSA more frequently than required by the boundary of regulation that they perceive. Considering patrol officers' day-to-day patrol tasks, 1.75 (median) to 2.42 (mean) wearing hours seems to be, apparently, too short. Their perceived boundary of regulation requires even shorter wearing hours. This implies that either there may be no such regulation that they must follow, or there is a regulation but no enforcement followed.

**Table 6**
Required and actual HVSA wearing hours per month comparison (hours)

| | N | Min. | Max. | Mean | Median | Std. Deviation |
|---|---|---|---|---|---|---|
| *Required* HVSA wearing hours per month | 72 | 0 | 20 | 1.947 | 1.000 | 3.1794 |
| *Actual* HVSA wearing hours per month | 94 | 0 | 10 | 2.422 | 1.750 | 2.3542 |

Safety training helps to reduce incidents, to stay in compliance and to change safety culture. Training, however, does not solve all of problems. Sometimes the problem may be caused by a work procedure or a system; equipment related; or lack of employee motivation. Training may need to be done due to employee's lack of knowledge in a work process, safety, or any aspects of behavior needing to be changed. Question 27 and 28 were constructed to consider HVSA safety training. The number of participants, 24.7% (N=97, n=24), indicated that they had HVSA safety training previously and 75.3% (N=97, *n*=73) indicated that they had no previous training on HVSA. Among those participants with previous HVSA safety training experience, the use of HVSA, the duties required to wear the HVSA, and the use of other visibility equipment were selected most often as

areas having been trained previously as shown in Table 7. Total hours of HVSA training given in past 3 years is 0.43 hours in average (N=90, *SD*=1.36).

**Table 7**
HVSA safety training given: multiple response frequencies

| HVSA safety training given | Responses | | Percent of Cases |
|---|---|---|---|
| | N | Percent | |
| Use of HVSA and duties required to wear. | 15 | 32.6% | 62.5% |
| Use of other visibility equipment such as traffic corn. | 15 | 32.6% | 62.5% |
| Federal regulation and agency rule related to HVSA. | 11 | 23.9% | 45.8% |
| Other info related to HVSA. | 3 | 6.5% | 12.5% |
| Care, maintenance and replacement of HVSA. | 2 | 4.3% | 8.3% |
| Total | 46 | 100.0% | 191.7% |

The finding suggests that safety training subject to care, maintenance, and replacement of HVSA was the least trained area and should be enhanced to improve agency's practice and implementation of safety regulation in the law enforcement community.

### 4.4 Causes influencing HVSA wearing decision

Accidents may occur not only because they don't have a HVSA, but also because they don't use it in many cases. In this section, the factors or causes that influence an officer's HVSA wearing decision were studied. The participants' anticipated percentage in estimated deaths due to being struck by a vehicle is found in question 15. It was constructed to measure the amount of perceived risk toward traffic-related fatalities and discussed further in the next section. The number of participants, 25.5% (N=98, *n*=25), experienced traffic accidents of other officers or co-workers struck by a vehicle during patrol duty. Seventy-two percent (N=25, *n*=18) of those law enforcement officers

indicated that the incidents did not influence their attitude on traffic safety and wearing HVSA.

Uniformed law enforcement officers have general law enforcement duties, such as maintaining regular patrols, directing traffic at the scene of an accident, and responding to calls for service, etc. Most physical assaults or murders of law enforcement officers during their patrol duties were committed at a distance, where the identity of law enforcement officer was more likely known. Law enforcement officers were asked to indicate all of the factors (multiple responses) that influenced them not to wear the HVSA, as noted in question 20 (summarized in Table 8), and the factor that made them the least inclined to wear the HVSA, as noted in question 21 (graphed in Figure 18). These two questions complemented to each other and were constructed under the same criteria, and the built-in redundancy verified the validation of the result found in the two questions.

The finding of both questions similarly revealed that the most critical factor was that law enforcement officers perceived HVSA as making them an easier target if a situation turned out to be violent (Q21, N=72, n=18, 25%). The subsequent factor was the time and effort required to wear the HVSA (Q21, N=72, n=16, 22.2%), and other causes (Q21, N=72, n=16, 22.2%) such as forgetting to put it on, fitting issues, not being able to find it in patrol vehicle, or marked as other causes but falling into one of the multiple factors listed. The following factors were professional appearance (Q21, N=72, n=5, 6.9%) and the physical comfort (Q21, N=72, n=5, 6.9%).

**Table 8**
Factors causing officers not to wear HVSA: Multiple response frequencies

| Factors causing law enforcement officers inclined not to wear HVSA. | Responses N | Responses Percent | Percent of Cases |
|---|---|---|---|
| HVSA makes officer an easier target. | 32 | 22.4% | 41.6% |
| Time and effort required to wear. | 25 | 17.5% | 32.5% |
| Other. | 24 | 16.8% | 31.2% |
| Professional appearance. | 13 | 9.1% | 16.9% |
| Physical discomfort. | 12 | 8.4% | 15.6% |
| Uncertainty of my risk of traffic accident. | 9 | 6.3% | 11.7% |
| Weather or hot temperature. | 8 | 5.6% | 10.4% |
| Decrease of mobility. | 7 | 4.9% | 9.1% |
| Uncertainty of efficiency of HVSA. | 7 | 4.9% | 9.1% |
| Decrease of efficiency. | 6 | 4.2% | 7.8% |
| Total | 143 | 100.0% | 185.7% |

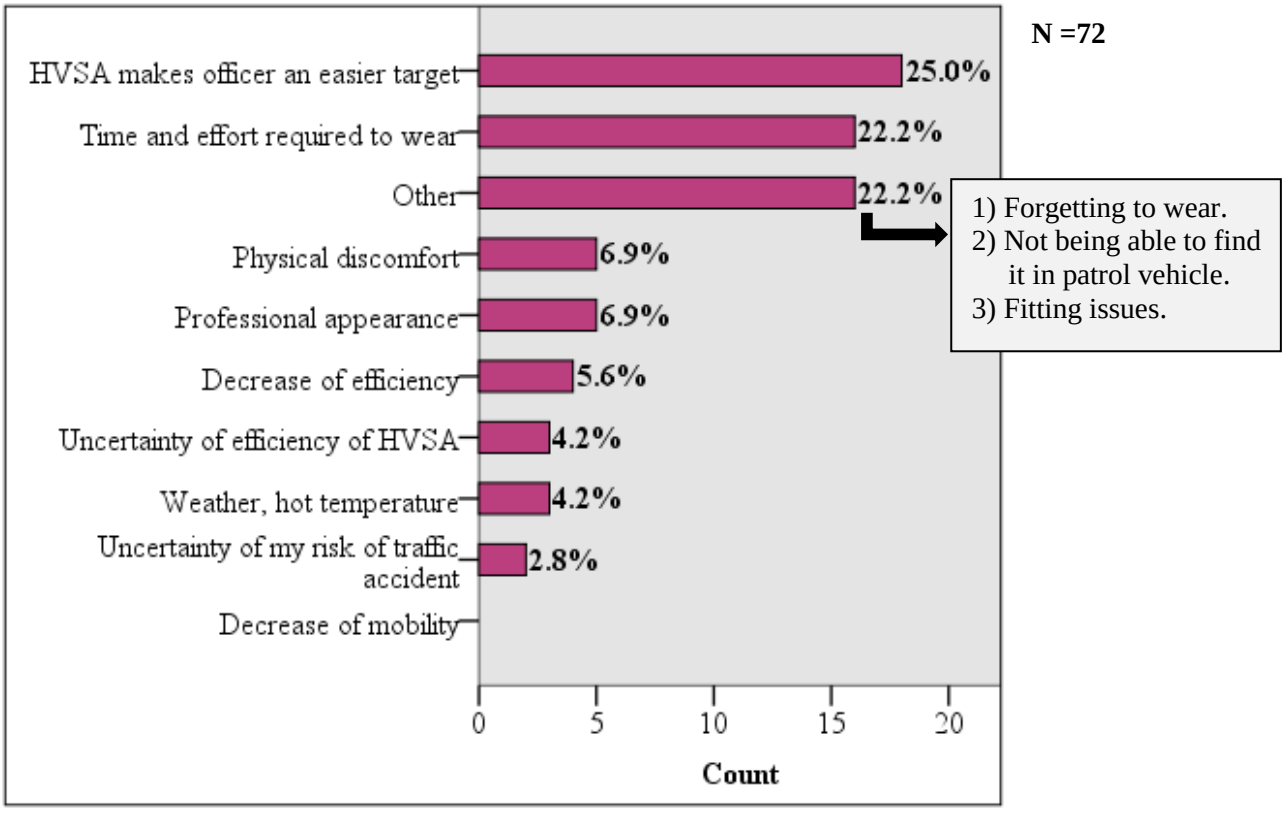



**Figure 18** The factor causing officers the least inclination to wearing a HVSA.

These results illustrated the need for evaluating the statistical significance of the risk of actually becoming a target due to HVSA when law enforcement officers performed routine traffic-related duties on streets, roads and highways.

Question 22 inquired about the greatest cause of injury or of fatality in a local law enforcement agency. It was discarded for analysis because one of the major causes of death, firearm-related injury/fatality, was left out in multiple choices and caused misreporting of statistics toward a bias favorable to the direction of traffic-related fatality.

### 4.5 Person Factor: Attitudes Correlations

This section reviews the strength of correlations among attitude variables in addition to their statistical results in interest, and presents findings for the hypotheses. For the hypothesis that would identify the relationship between variables, Spearman's rank correlation analysis was conducted.

The descriptive statistics for question 23 attitude items are summarized in following Table 9 and the Shapiro-Wilk test results (final set of attitude items) are reported in Table 10. The data sets did not meet the assumption of normality for both matching variables. Non-parametric Spearman's rank correlation was used to measure the strength of association between two ranked variables. Correlation Matrix in Figure 19 is graphed to show magnitude and direction of correlation as well as the level of statistical significance (i.e. $p<0.05$*, $p<0.01$**). One asterisk indicates $p<0.05$ and two asterisks imply $p<0.01$. The analysis of correlation and hypotheses by category follows.

Cohen's conventional criteria for the social science of small($r$=0.10), medium($r$=0.30), or large ($r$=0.50) association was adapted to interpret the effect size magnitude of the correlation coefficient (Cohen J., 1988, 1992).

### 4.5.1 Testing of hypotheses for Person Factor: attitude correlation

This study makes an inference from the sample to the population that the sample is supposed to represent. The relationships identified using Spearman's rank correlation coefficients in this study were interpreted for what they were: associations, not causal relationships (Aldrich, J., 1995).

The result and interpretation of hypotheses is as follows.

**$H_o$ (H1~H6):** There is no correlation between the two variables.

- **H1:** A correlation exists between law enforcement officers' levels of disliking HVSA use and the belief of effectiveness of HVSA preventing traffic accidents (Q23i/Q23v).

  The null hypothesis was rejected. There was a significant negative correlation between the level of disliking wearing HVSA and the belief of effectiveness of HVSA to avoid traffic-related fatalities ($r_s$=-0.335, p=0.001). This suggests that a law enforcement officer who dislikes wearing a HVSA has a tendency not to believe in the effectiveness of a HVSA or to show less certainty of its safety functionality. The effect size of this relationship was medium.

**Table 9**
Descriptive statistics: attitudes toward HVSA and traffic safety

| Question | | N | Mean | Std. Deviation | Min. | Max. | Percentiles | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 25 | 50 (Median) | 75 |
| 23a | HVSA prevents getting struck by vehicle. | 97 | 2.789 | 2.1771 | 0 | 10 | 1.25 | 2.2 | 4.35 |
| 23b | I feel worried about my safety during patrol duty. | 98 | 5.163 | 2.8772 | 0 | 10 | 2.475 | 5.35 | 7.725 |
| 23d | Safety education programs are helpful for awareness of traffic accidents. | 98 | 3.306 | 2.2388 | 0 | 8.5 | 1.575 | 3.2 | 4.825 |
| 23i | I dislike wearing a HVSA. | 98 | 6.523 | 2.8677 | 0 | 10 | 4.575 | 7.5 | 9 |
| 23j | I feel safer when wearing a HVSA. | 98 | 4.274 | 2.6632 | 0 | 10 | 2 | 4.45 | 5.725 |
| 23k | I feel comfortable when my uniform and HVSA vest look professional. | 98 | 2.705 | 2.2799 | 0 | 10 | 0.9 | 2.45 | 3.7 |
| 23n | I feel inclined not to wear a HVSA since it makes me look like a highway worker. | 98 | 7.903 | 2.2497 | 0 | 10 | 7.175 | 8.5 | 9.625 |
| 23o | My HVSA is uncomfortable. | 98 | 7.074 | 2.6807 | 0.3 | 10 | 4.975 | 7.9 | 9.45 |
| 23q | HVSA makes me a target in situations that I do not wish to be seen. | 97 | 5.442 | 3.3027 | 0 | 10 | 2.3 | 5.3 | 8.45 |
| 23r | The decision to wear a HVSA should be at an officer's discretion. | 98 | 5.18 | 3.4029 | 0 | 10 | 1.875 | 5.1 | 8.6 |
| 23s | Wearing a HVSA is too much of a hassle. | 98 | 7.149 | 2.4749 | 0.3 | 10 | 5.2 | 7.9 | 9.2 |
| 23t | I feel safe without a HVSA. | 98 | 5.101 | 2.7107 | 0 | 10 | 2.975 | 5 | 7.425 |
| 23u | I feel that wearing HVSA has a negative impact on my command presence. | 98 | 7.226 | 2.6203 | 0 | 10 | 5.25 | 8.15 | 9.225 |

**Table 9 (continued)**
Descriptive statistics: attitudes toward HVSA and traffic safety

| Question | | N | Mean | Std. Deviation | Min. | Max. | Percentiles | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 25 | 50 (Median) | 75 |
| 23v | HVSA help officers to avoid traffic-related injuries/fatalities. | 98 | 2.907 | 2.3497 | 0 | 9.7 | 0.875 | 2.45 | 4.725 |
| 23x | Overall comfort of the law enforcement uniform is satisfactory. | 98 | 3.944 | 2.4362 | 0 | 10 | 2.175 | 3.85 | 5.425 |
| 23z | I believe a darker color of law enforcement uniform such as black, dark blue, or brown is more authoritative and tactical. | 98 | 2.097 | 2.0222 | 0 | 8.8 | 0.4 | 1.6 | 2.825 |

*Note.*

- Table 9 reflects the final set of variables after reliability test (Cronbach's Alpha) and establishing validity (content validity) of survey instrument for analysis.
- N = sample size.

**Table 10**
Normality test result (Shapiro-Wilk test) for attitude items as on Table 9

| Question | Shapiro-Wilk | | |
|---|---|---|---|
| | Statistic | df | Sig. (p) |
| Q23a | .903 | 95 | .000 |
| Q23b | .952 | 95 | .002 |
| Q23d | .953 | 95 | .002 |
| Q23i | .912 | 95 | .000 |
| Q23j | .955 | 95 | .002 |
| Q23k | .902 | 95 | .000 |
| Q23n | .814 | 95 | .000 |
| Q23o | .895 | 95 | .000 |
| Q23q | .920 | 95 | .000 |
| Q23r | .915 | 95 | .000 |
| Q23s | .907 | 95 | .000 |
| Q23t | .969 | 95 | .025 |
| Q23u | .874 | 95 | .000 |
| Q23v | .924 | 95 | .000 |
| Q23x | .971 | 95 | .032 |
| Q23z | .865 | 95 | .000 |

*Note.*

- Statistical significance is set at $p<0.05$ ($H_o$ : Normal distribution).
- p-value of all above variables are less than 0.50. One can reject the null hypothesis and concludes that the population was not normally distributed. .
- Variables Q23a ~ Q23z: see Table 9 for description.
- Table 9 reflects the final set of variables after reliability test (Cronbach's Alpha) and establishing validity (content validity) of the survey instrument.

| V | 23a | 23b | 23d | 23i | 23j | 23k | 23n | 23o | 23q | 23r | 23s | 23t | 23u | 23v | 23x | 23z |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **23a** | | .248* | .335** | -.228* | .399** | .349** | -.118 | .011 | .002 | -.146 | -.057 | -.239* | -.049 | .539** | .059 | .199 |
| **23b** | | | .173 | -.174 | .395** | .116 | -.034 | .123 | -.085 | -.059 | -.091 | -.197 | .013 | .269** | .116 | .096 |
| **23d** | | | | -.338** | .247* | .336** | -.089 | -.158 | -.063 | -.189 | -.315** | -.225* | -.083 | .404** | .213* | .153 |
| **23i** | | | | | -.362** | -.217* | .435** | .324** | .411** | .550** | .651** | .450** | .302** | -.335** | -.069 | -.101 |
| **23j** | | | | | | .142 | -.172 | .063 | -.210* | -.330** | -.228* | -.447** | -.118 | .510** | .055 | .103 |
| **23k** | | | | | | | -.126 | -.134 | .163 | .025 | -.120 | .069 | -.018 | .315** | .294** | .402** |
| **23n** | | | | | | | | .532** | .325** | .378** | .585** | .246* | .694** | -.282** | -.001 | -.321** |
| **23o** | | | | | | | | | .290** | .172 | .487** | .057 | .346** | -.096 | -.244* | -.279** |
| **23q** | | | | | | | | | | .263** | .317** | .172 | .349** | -.025 | -.109 | -.037 |
| **23r** | | | | | | | | | | | .530** | .568** | .307** | -.410** | -.027 | -.004 |
| **23s** | | | | | | | | | | | | .319** | .389** | -.404** | -.085 | -.200* |
| **23t** | | | | | | | | | | | | | .204* | -.331** | .102 | .101 |
| **23u** | | | | | | | | | | | | | | -.153 | -.012 | -.106 |
| **23v** | | | | | | | | | | | | | | | .064 | .279** |
| **23x** | | | | | | | | | | | | | | | | .340** |
| **23z** | | | | | | | | | | | | | | | | |

** Negative correlation is significant at the 0.01 level (2-tailed)
* Negative correlation is significant at the 0.05 level (2-tailed)
No significant correlation exist
* Positive correlation is significant at the 0.05 level (2-tailed)
** Positive correlation is significant at the 0.01 level (2-tailed)

**Variables:**
**Q23a~Q23z** : see Table 9 for description.

**Figure 19** Non-parametric Spearman rank correlation matrix ($r_s$) for VAS attitude items measured in survey of HVSA in Yavapai County Police Departments sampled in 2012. $p<0.05$*, $p<0.01$**; color-coded by correlation direction and statistical significance levels.

- **H2:** A correlation exists between law enforcement officers' levels of anxiety toward traffic-accident fatality and levels of feeling safe when wearing HVSA (Q23b/Q23j).

  The null hypothesis was rejected. Significant association between anxiety toward traffic-accident fatality and the level of feeling safe when wearing a HVSA was found, indicating that the higher level of anxiety they perceived was significantly the greater level of feeling safe when wearing HVSA. ($r_s$=0.395, $p<0.001$). A positive relationship existed and the effect size of this relationship was medium to large.

- **H3:** A correlation exists between levels of disliking wearing HVSA and the fact that the officer judges the HVSA wearing decision as an officer's discretion (Q23i/Q23r).

  The null hypothesis was rejected. There was a strong positive and significant correlation between the level of disliking wearing the HVSA and the fact that the officer judged the HVSA wearing decision as an officer's discretion ($r_s$=0.550, $p<0.001$). This suggests that a law enforcement officer who does not like wearing a HVSA due to various reasons, is inclined to judge the HVSA wearing decision as an officer's discretion. The effect size of this relationship was large.

- **H4:** A correlation exists between the levels of disliking the wearing of a HVSA and an officers' perception that "the HVSA has a negative impact on my command presence" (Q23i/Q23u).

The null hypothesis was rejected. A moderate positive correlation between the level of disliking of the HVSA use and the officers' perception that HVSA has a negative impact on one's command presence was found. This implies that the higher level of disliking of the HVSA use is significantly the greater magnitude of the perception that HVSA may negatively affect one's authority and command presence ($r_s$=0.302, p=0.003). The effect size of this relationship was medium.

- **H5:** A correlation exists between the levels of feeling inclined not to wear HVSA since it makes the officers look like highway workers and the officers' perceptions that HVSA has a negative impact on their command presence (Q23n/Q23u).

  The null hypothesis was rejected. A strong positive correlation between two variables was found, suggesting that the law enforcement officers who felt inclined not to want to wear the HVSA because of looking like highway workers were more likely to think that the HVSA would negatively impact their authority and command presence ($r_s$=0.694, p<0.001). The effect size of this relationship was large.

- **H6:** A correlation exists between the positive perception of safety education programs being helpful for awareness of traffic-related accidents and the level of disliking in HVSA use (Q23d/Q23i).

  The null hypothesis was rejected. There was a moderate negative and significant relationship between the positive perception of safety education programs being helpful for awareness of traffic-related accidents and the level of

disliking with the HVSA use. The explanation was that law enforcement officers judging safety education programs helpful for awareness of traffic-accidents were inclined to like wearing a HVSA ($r_s$=-0.338, p=0.001). The effect size of this relationship was medium.

### 4.5.2 Other safety attitude correlation on VAS attitude items

The attitude survey was constructed with intentional redundancy built-in and its redundancy aided verifying the result of attitudes correlations and hypotheses (see Figure 19 for $r_s$).

Both attitude items Q23a and Q23v (i.e. belief of effectiveness of HVSA preventing accidents) consistently exhibited a significant positive relationship with Q23b anxiety level toward traffic-accident fatality (Q23a: $r_s$=0.248, p=0.014, Q23v: $r_s$=0.269, p=0.007); Q23d safety education (Q23a: $r_s$=0.335, p=0.001, Q23v: $r_s$=0.404, $p<0.001$); Q23j feeling safe (Q23a: $r_s$=0.399, $p<0.001$, Q23v: $r_s$=0.510, $p<0.001$). A negative relationship with Q23i dislikeness (Q23a: $r_s$=-0.228, p=0.025, Q23v: $r_s$=-0.335, p=0.001) as hypothesis test; Q23t feeling safe without HVSA (Q23a: $r_s$=-0.239, p=0.018, Q23v: $r_s$=-0.331, p=0.001). This indicates that officers with positive attitudes toward a HVSA tend to have higher anxiety of their safety during their patrol duties; think safety education is helpful to avoid traffic accidents; feel safer when wearing the HVSA; and show lower levels of dislikeness of HVSA use.

Question 23d (i.e. positive attitude toward safety education being helpful for awareness of traffic accidents) exhibited a uniformed positive relationship with levels of

feeling safe (Q23j, $r_s$=0.247, p=0.014); and a negative relationship with the inconvenience of wearing HVSA (Q23s, $r_s$=-0.315, p=0.002). The result revealed that law enforcement officers with positive attitudes in safety education were inclined to feel safer when wearing a HVSA, and showed lower levels of inconvenience of wearing HVSA.

Attitude item Q23i level of disliking wearing a HVSA, showed a significant positive relationship reliably with negative safety attitudes, such as feeling inclined not to wear a HVSA, due to looking like highway workers (Q23n, $r_s$=0.435, p<0.001); the perception of a HVSA making officers targets in situations not to be seen (Q23q, $r_s$=0.411, p<0.001); the inconvenience of wearing HVSA (Q23s, $r_s$=0.651, p<0.001). All these negative attitudes shared the matching positive relationship mutually which verified the relationship presented in attitude correlation hypotheses.

Feeling safe when wearing a HVSA (Q23j) exhibited a negative significant association consistently with negative safety attitudes such as Q23q (i.e. HVSA making a target in situations not to be seen, $r_s$=-0.210, p=0.039); Q23r (i.e. decision to wear HVSA to be at the officer's discretion, $r_s$=-0.330, p=0.001); and Q23t (i.e. feeling safe without a HVSA, $r_s$=-0.447, p<0.001). It also showed a significant negative relationship with the inconvenience of wearing a HVSA (Q23s, $r_s$=-0.228, p=0.024), indicating that law enforcement officers who thought wearing a HVSA was too much of a hassle were less likely to feel safe when wearing a HVSA. The effect size of this relationship was small to medium.

Feeling comfort could arise from psychological, social-psychological satisfaction and/or physical comfort, and it could be interpreted in several different directions. Question 23o (i.e. HVSA is uncomfortable.) was constructed to find out how participants' comfort or discomfort perception was translated into bivariate correlation. An attitude item of Q23o consistently displayed a significant positive relationship with a negative attitude such as Q23q (i.e. HVSA makes me a target in situations that I do not wish to be seen, $r_s$=0.290, p=0.004); Q23s (i.e. wearing HVSA is too much of a hassle, $r_s$=0.487, $p < 0.001$); Q23u (i.e. wearing HVSA has a negative impact on command presence, $r_s$=0.346, $p < 0.001$). The results indicated that there was a statistically significant association between feeling uncomfortable in wearing a HVSA and negative attitudes toward HVSA.

Feelings of satisfaction on the overall comfort of law enforcement uniforms (Q23x) exhibited significant positive correlation with question 23z (i.e. law enforcement officers' belief that a darker color of uniform is more authoritative and tactical.). This indicates that the higher their satisfaction of comfort with their uniform the higher the level of officers' belief that a darker color of uniform is more authoritative and tactical ($r_s$ =0.340, p=0.001). The effect size of this relationship was medium.

### 4.6 Experience, risk perception and behavior factor

The risk perception and attitudes toward safety/HVSA are associated with the safety behavior decision making, such that negative or passive attitudes tend to indicate a negative safety behavior. The lack of knowledge in PPC and adverse health outcomes

from hazardous environments tend to elicit a more negative safety behavior. Based on the speculation of the study, the following hypotheses (H7~H10) were tested. For hypotheses 7 and 8, a Spearman's rank correlation was conducted to find out whether there is an association between variables among experience, risk perception, and HVSA wearing behavior. For hypotheses 9 and 10, a non-dichotomous ordinal scale of question11c was transformed to dichotomous variable in two groups (a group with basic knowledge in HVSA and the other without it) to test statistical difference (Mann-Whitney U-tests) depending on whether having knowledge in HVSA would affect attitude and/or wearing behavior of a HVSA.

The result and interpretation of hypotheses is as follows.

**$H_o$ (H7~H8):** There is no correlation between the two variables.

- **H7:** A correlation exists between the level of job experience (or exposure to traffic-hazardous environment) and the amount of risk a law enforcement officer judges toward traffic-accident fatality (Q1/Q15).

  A Spearman's rank correlation was conducted. The null hypothesis was not rejected and concluded that the null is plausible. There was no significant relationship between the extents of experience and the level of risk they perceive toward traffic-accident fatalities (see Table 11; $r_s$=0.05, p=0.672). The median of job experience was 9.5 years as shown on Table 12. This suggests that the population for correlation is well experienced with adequate levels of exposure to traffic hazardous environment.

- **H8:** A correlation exists between the amount of risk a law enforcement officer judges toward traffic-accident fatality and HVSA wearing behavior (Q15/Q18).

  A Spearman's rank correlation was conducted and the null hypothesis was rejected. There was a positive and significant correlation between the level of risk perceived and the HVSA wearing behavior ($r_s$=0.274, p=0.019). This suggests that a law enforcement officer who perceives higher risk toward traffic accident is inclined to wear a HVSA more frequently than the ones who perceives less risk. The effect size of this relationship was small to medium.

  **$H_o$ (H9~H10):** There is no difference between two independent groups.

- **H9.** There is a difference of attitude of feeling safe when wearing a HVSA between law enforcement officers with basic knowledge of their HVSA and officers without it (Q11c transformed/Q23j).

  Mann-Whitney U-test was performed and results indicated that there was a significant difference of attitude of feeling safe when wearing HVSA between officers who knew about Performance Class of their HVSA and officers who do not (Table 13, U=148.5, z=-2.933, p=0.003). The population of a variable was not normally distributed (Shapiro-Wilk test, Yes: p=0.154, No: p=0.01). Homogeneous and equal variances was assumed (Levene Statistic=2.857, p=0.095) based on median. The two independent samples, however, were not equal in size as shown on Table 13.

  It could be further concluded that law enforcement officers who obtained basic technical knowledge on their HVSA (i.e. knowing what Performance Class

they wore) drew statistically significant positive attitudes (lower scores) of feeling safe when wearing a HVSA, than the group of officers who did not obtain the basic knowledge on their HVSA. This suggests that knowledge affects to elicit positive attitudes toward the HVSA use as illustrated on boxplot of Figure 20.

- **H10.** There is a difference of HVSA wearing behavior between law enforcement officers with basic knowledge of their HVSA and officers without it (Q11c transformed/Q18).

  Mann-Whitney U-test was conducted and results indicated that there was no significant difference of HVSA wearing behavior whether law enforcement officers had basic knowledge on HVSA or not (Table 14, U=320.5, z=-0.49, p=0.624). This indicates that knowledge do not considerably influence a law enforcement officer's HVSA wearing decision. The Shapiro-Wilk normality test revealed the abnormality in distribution of the data (Yes: p=0.001, No: p<.000). Homogeneous and equal variances were assumed (Levene Statistic=0.01, p=0.922). The two independent samples, however, were not equal in size (see Table 14).

**Table 11**
Spearman rank correlation matrix ($r_s$) and normality test results
Experience, risk perception, and HVSA wearing behavior (H7~H8)

| Spearman's rank correlation | | Q1. Job Experience (years) | Q15. Estimated % death struck by automobile | Q18. HVSA wearing hours per month |
|---|---|---|---|---|
| Q1. Job Experience (years) | Correlation Coefficient | | 0.05 | 0.069 |
| | Sig. (2-tailed) | | 0.672 | 0.511 |
| Q15. Estimated % death struck by automobile | Correlation Coefficient | | | .274* |
| | Sig. (2-tailed) | | | 0.019 |
| Normality test | | Q1 | Q15 | Q18 |
| Shapiro-Wilk | Statistic | 0.917 | 0.881 | 0.796 |
| | df | 73 | 73 | 73 |
| | Sig. (p) | .000 | .000 | .000 |

*Note.*

- Values of statistical significance level for Spearman rank correlation $p<0.05$*.
- Shapiro-Wilk: p-value<0.001, the population is not normally distributed.

**Table 12**
Descriptive statistics
Experience, risk perception, and HVSA wearing behavior (H7~H8)

| Question | | N | Mean | Std. Deviation | Min. | Max. | Percentiles | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 25 | 50 (Median) | 75 |
| Q1 | Job Experience (years) | 98 | 10.744 | 7.3516 | 0.4 | 38 | 6 | 9.5 | 15 |
| Q15 | Estimated % death struck by vehicle | 75 | 25.148 | 22.3263 | 0 | 80 | 10 | 20 | 40 |
| Q18 | Actual HVSA wearing hours per month | 94 | 2.422 | 2.3542 | 0 | 10 | 1 | 1.75 | 3 |

*Note.* N = sample size

**Table 13**
Mann-Whitney U test statistics and normality test result
Attitude of feeling safe and knowledge (H9)

| Variables | | Test Statistics | | | |
|---|---|---|---|---|---|
| Q23j | I feel safer when wearing a HVSA. | Mann-Whitney U | Z | Asymp. Sig. (two-tailed) | |
| | | 148.5 | -2.933 | 0.003 | |
| | | Knowledge in HVSA (Performance Class: Q11c) | N | Mean Rank | Sum of Ranks |
| | | Yes | 9 | 21.5 | 193.5 |
| | | No | 82 | 48.69 | 3992.5 |
| | | Total | 91 | | |
| | | Knowledge in HVSA (Performance Class: Q11c) | Shapiro-Wilk | | |
| | | | Statistic | df | Sig.(p) |
| | | Yes | 0.879 | 9 | 0.154 |
| | | No | 0.959 | 82 | 0.01 |

*Note.*

- Grouping Variable: Officer's knowledge in HVSA(Q11c).
- Mann-Whitney U test: statistical significance is set at $p<0.05$.
- Shapiro-Wilk: p-value<0.05, the population of a variable (Yes: $p=0.01$) is not normally distributed.
- The two independent samples were not equal in size.
- N = sample size

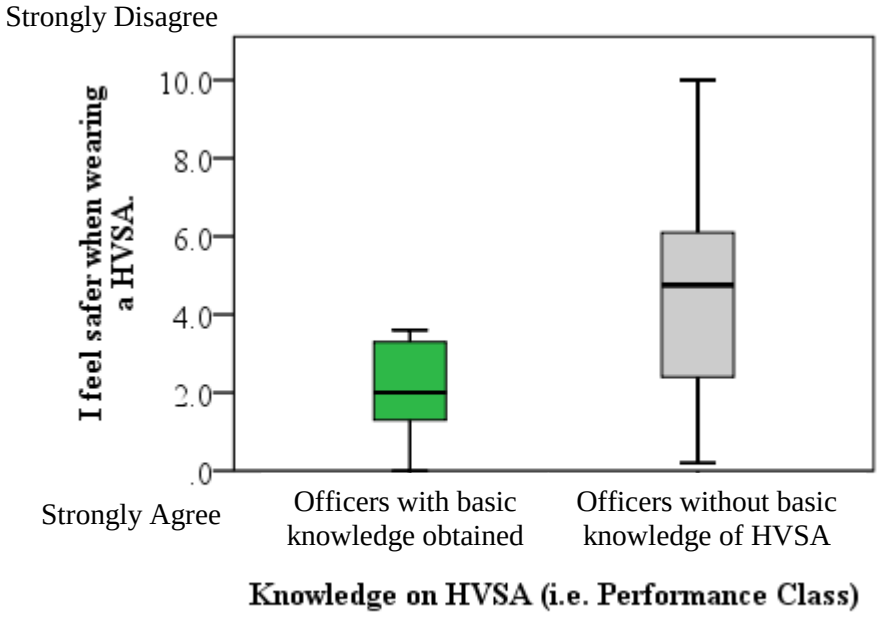



**Figure 20** The magnitude of feeling safe when wearing HVSA based on their basic knowledge of HVSA (H9).

**Table 14**
Mann-Whitney U test statistics and normality test result
Knowledge and HVSA wearing behavior (H10)

| Variables | | Test Statistics | | | |
|---|---|---|---|---|---|
| Q18 | Actual HVSA wearing hours per month. | Mann-Whitney U | Z | Asymp. Sig. (two-tailed) | |
| | | 320.5 | -0.49 | 0.624 | |
| | | Knowledge in HVSA (Performance Class: Q11c) | N | Mean Rank | Sum of Ranks |
| | | Yes | 9 | 48.39 | 435.5 |
| | | No | 79 | 44.06 | 3480.5 |
| | | Total | | | |
| | | Knowledge in HVSA (Performance Class: Q11c) | Shapiro-Wilk | | |
| | | | Statistic | df | Sig.(p) |
| | | Yes | 0.699 | 9 | .001 |
| | | No | 0.83 | 79 | .000 |

*Note.*

- Grouping Variable: Officer's knowledge in HVSA (Q11c).
- Mann-Whitney U test: statistical significance is set at $p<0.05$.
- Shapiro-Wilk: p-value<0.05, the population is not normally distributed.
- The two independent samples were not equal in size.
- N = sample size

### 4.7 Organizational safety behavior and individual's safety attitude

Based on this study's speculation that an organization providing workplace safety culture, regulation, and training is likely to produce the more positive safety attitude of an individual, the hypotheses 11 and 12 were tested. Non-Parametric Mann-Whitney U tests were conducted to test the differences between two independent groups.

The result and interpretation of hypotheses is as follows.

**$H_o$ (H11~H12):** There is no difference between two independent groups.

- **H11.** There is a difference of risk perception between law enforcement officers with and without safety training in HVSA use (Q27a/Q23t).

  Mann-Whitney U-test was conducted to evaluate the difference between two groups (i.e. officers with and without safety training for HVSA use). Results indicated that there was no significant difference of level of risk perception whether officers received HVSA safety training or not (see Table 15, U=805.5, z=-0.590, p=0.555). The Shapiro-Wilk normality test revealed the normality of the data distribution (Yes: p=0.433, No: p=0.094). Homogeneous and equal variances was assumed (Levene Statistic=0.268, p=0.606). The two independent samples were not equal in size as following Table 15.

- **H12.** There is a difference in an individual's attitude toward traffic safety education, based on whether the law enforcement agency inspects HVSA or not (Q30a/Q23d).

Mann-Whitney U was computed. It was concluded that there was a statistically significant difference of law enforcement officers' attitudes on safety education whether their agencies inspected HVSA or not (see Table 16, U=532, z=-2.392, p=0.017). The population of a variable was not normally distributed (Table 16, Shapiro-Wilk test, Yes: p=0.014, No: p=0.032) and the two independent samples were not equal in size. Homogeneous and equal variances was assumed (Levene Statistic=2.091, p=0.152).

It could be further concluded that law enforcement officers whose agency inspected HVSA elicited statistically significant positive attitude (low scores) toward safety education for traffic safety than the group whose agency did not inspect HVSA as following boxplot of Figure 21. These results suggest that an organization's safety behavior such as conducting the safety inspection of a HVSA at a regular basis, affects the positive attitude on safety education.

## 4.8 Summary

This chapter has primarily presented the results of the quantitative analysis. The final chapter will discuss the findings of the quantitative analysis as well as the relationships between them. Theoretical implications, recommendations based on the findings, limitations of the study, and areas for future research will be presented.

**Table 15**
Mann-Whitney U test statistics and normality test result
Risk perception and safety training (H11)

| Variables | | Test Statistics | | | |
|---|---|---|---|---|---|
| Q23t. | I feel safe without a HVSA. | Mann-Whitney U | Z | Asymp. Sig. (two-tailed) | |
| | | 805.5 | -0.59 | 0.555 | |
| | | Previous safety training for HVSA use (Q27a) | N | Mean Rank | Sum of Ranks |
| | | Yes | 24 | 51.94 | 1246.5 |
| | | No | 73 | 48.03 | 3506.5 |
| | | Total | 97 | | |
| | | Previous safety training for HVSA use (Q27a) | Shapiro-Wilk | | |
| | | | Statistic | df | Sig.(p) |
| | | Yes | 0.958 | 23 | 0.433 |
| | | No | 0.97 | 72 | 0.085 |

*Note.*

- Grouping Variable: Previous safety training for HVSA use (Q27a).
- Mann-Whitney U test: statistical significance is set at $p<0.05$.
- Shapiro-Wilk test: p-value > 0.05, the population is normally distributed.
- The two independent samples were not equal in size.
- N = sample size

**Table 16**
Mann-Whitney U test statistics and normality test result
Individual's attitude toward safety education and organizational safety culture (H12)

| Variables | | Test Statistics | | | |
|---|---|---|---|---|---|
| Q23d. | Safety education programs are helpful for awareness of traffic accidents. | Mann-Whitney U | Z | Asymp. Sig. (two-tailed) | |
| | | 532 | -2.392 | 0.017 | |
| | | Does your agency inspect your HVSA? (Q30a) | N | Mean Rank | Sum of Ranks |
| | | Yes | 22 | 35.68 | 785 |
| | | No | 73 | 51.71 | 3775 |
| | | Total | 95 | | |
| | | Does your agency inspect your HVSA? (Q30a) | Shapiro-Wilk | | |
| | | | Statistic | df | Sig.(p) |
| | | Yes | 0.883 | 22 | 0.014 |
| | | No | 0.963 | 72 | 0.032 |

*Note.*

- Grouping Variable: agency's inspection of HVSA (Q30a).
- Mann-Whitney U test: statistical significance is set at $p<0.05$.
- Shapiro-Wilk: p-value<0.05, the population is not normally distributed.
- The two independent samples were not equal in size.
- N= sample size

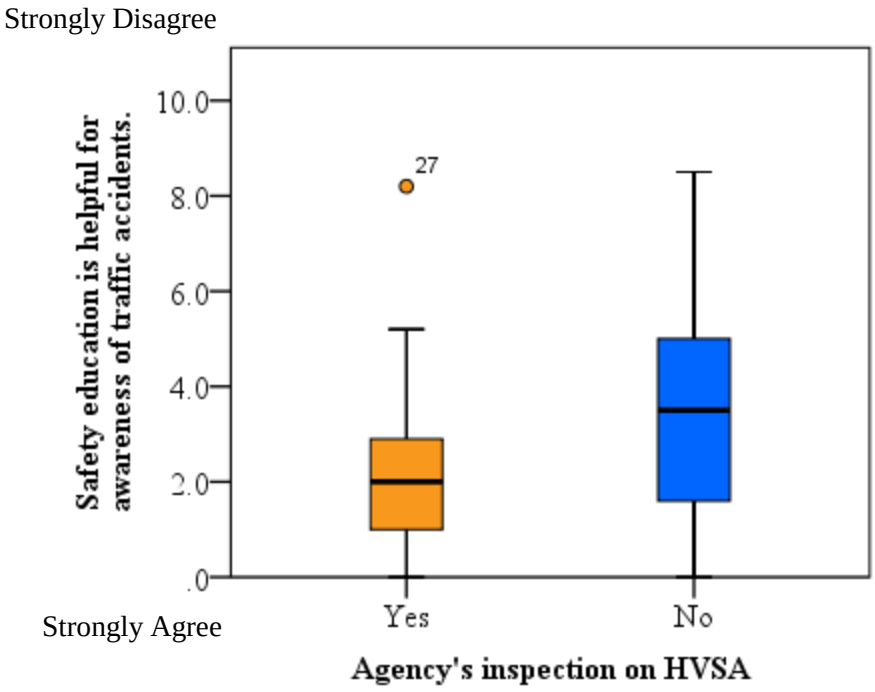



**Figure 21** Law enforcement officers' attitudes on safety education based on agency's safety inspection of HVSA (H12).

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# CHAPTER 5. DISCUSSION

## 5.1 Implication based on findings

Attitude refers to an expression of a person's favorable or unfavorable evaluation toward an object, whereas belief represents the information he or she has about the object. Behavior is an observable overt action of the subject by which a person adjusts to its environment. Changing individual and organizational attitude or belief to safety can influence one's behavior either directly or indirectly. When people change their beliefs, attitudes, or values, certain behaviors change as a result (Fishbein and Ajzen, 1975). Based on these generalized speculations, this study explored how a variety of different personal factors influenced individual and organizational safety attitudes and behaviors by applying Geller's The Safety Triad used as conceptual framework in this study (Geller E.S., et al.1989; Geller E.S., 2000). Behaviors follow attitudes. Attitudes are learned from one's cultural experiences, interpretations and acceptance or rejection of those attitudes.

The finding revealed that law enforcement officers were aware of temporary discomforts of wearing HVSA, but had limited knowledge of the HVSA use. Positive attitudes toward HVSA tended to show higher levels of belief or certainty of safety effectiveness in HVSA use; higher anxiety in their personal safety; and a more positive attitude toward safety education. In contrast, positive attitudes indicated lower level of dislikenss and feelings of inconvenience in HVSA use. Negative attitudes or beliefs had a tendency of not believing in safety effectiveness of HVSA; having negative attitudes about safety education; having higher levels of discomfort; and less feelings of safety in wearing the HVSA; Law enforcement officers with negative attitudes were inclined to

judge the HVSA wearing decision to be an officer's discretion and indicated higher magnitudes of perception that the HVSA undesirably influenced on their authority and command presence.

What was also shown by the relationship between attitudes toward HVSA and traffic safety was that law enforcement officers were aware of and worried about the consequences of not wearing a HVSA. The majority (99%) of officers were aware that they were required to wear a HVSA during traffic-related duties. It suggested that their decisions not to wear it were under their control. They were aware of the traffic-fatality but did not intend to carry out safety procedures.

The lack of knowledge in HVSA and adverse health outcomes from hazardous environment tended to elicit a more negative safety attitude; however, knowledge did not considerably influence a law enforcement officer's HVSA wearing behavior in this study result. Law enforcement officers tended not to wear HVSA if they were uncertain about safety functionality of HVSA.

Perceived risk influenced the HVSA use decisions. The higher perceived risk of traffic accidents by the law enforcement officers drew more frequent use of the HVSA than the ones who perceived less risk. Through literature review on perceived risk, it appears that experiences on the job may lead law enforcement officers to perceive a relatively low level of risk than actual risk toward safety hazards: the level of job experience did not significantly impact a law enforcement officer's HVSA wearing behavior in this study's statistical result. Safety behavior is often determined by perceived rather than real risk. The characteristics of traffic-related hazard in law

enforcement community are that the hazard is very familiar, forgettable, understood, and it affects a majority of sworn officers on a daily basis. This lowers their perceived risk of the hazard. Thus, law enforcement officers are less likely to perceive the risk on the job as high as it should be, and less likely to wear a HVSA than they should. Greater risk perception together with acquiring knowledge in HVSA use can reduce fatalities or injuries. The necessities of developing traffic safety messages targeting law enforcement officers were found to reduce risk associated traffic-accidents.

Similarly, the study findings revealed that the most critical factor of non-use in HVSA was that law enforcement officers perceived the HVSA as making them an easier target if a situation becomes violent. The majority of physical assaults or murders of law enforcement officers during their patrol duties are committed at a distance, where the identity of the law enforcement officer was more likely known. As discussed earlier, the current study results illustrated the need for evaluating the statistical significance of risk of actually becoming a target due to HVSA. It would be genuinely challenging to prove a causal relationship, as to whether the physical attack was decided or caused by perceiving officer's identity due to the HVSA. Nevertheless, with law enforcement officers' vehicles with warning lights to alert motorists, the identity of officers was already known and the theory that HVSA caused the officer to be an easier target, appeared to be a spurious relationship.

Person factors such as attitudes, beliefs, knowledge, and risk perception influenced law enforcement officers' willingness to guard for their own safety. When there is no feasible engineering control or administrative control to eliminate the risk, a HVSA can be the only way of defending against the traffic-related fatalities of being

struck by vehicle. By altering person factors, behavior factors, and organization factor as Geller's Safety Triad (2000) can improve safety culture in an organization and increase appropriate PPE use ultimately.

An organization's safety behavior, such as conducting the safety inspection of a HVSA on regular basis, affected the form of the positive safety attitude of individuals. In contrast, law enforcement agencies or sub-groups within the organization which did not show safety organizational behavior or neglected to enforce the use of HVSA adversely impacted risk perception. Organizational behavior with safety environments having proper procedure and standards apparently affected individuals' risk perceptions and positive attitudes toward HVSA.

### 5.2 Safety culture: education and training

Safety culture requires law enforcement officers to understand principles and how to use them. Education focuses on theory or principles. Training gets into the specifics of how to turn principles into effective safety action. Attitudes, beliefs, and perceptions can be influenced directly through education; whereas behaviors are directly influenced through training. If we do not educate people about the principles behind a safety policy, they might participate only minimally. Thus, long term behavior changes require both, education and training (Geller E.S., 2000).

With the aim of decreasing traffic-related fatalities of being struck by a vehicle in a law enforcement community, a strategic combination of both education and training is desired for modification in both safety attitude and behavior. In other words, safety

educators should use both education to alter safety attitude and training to draw positive safety behavior in HVSA use. They should begin with education, by teaching the basic principles and then they should execute a training process applying these principles to know precisely what to do. However, understanding between attitudes and behaviors, and how to improve these vital human factors should be preceded among safety educators (Geller E.S., 2000). This combined teaching technique would bring about prolonged improvement that law enforcement officers would be more likely to accept and follow procedures.

### 5.3 Regulation, Practice, and Knowledge

Training is a reflection of regulation. Law enforcement officers' unsafe actions arise not only because of inconvenience or discomfort of wearing HVSA, but also because the HVSA is not available or is ineffective when protection is needed. Maintaining protective functionality, replacement, and proper storage of protective gear are crucial for its accessibility and availability. In addition, law enforcement officers in the traffic-related duties shall wear a HVSA while driving, otherwise they do not have time to put it on, or it may not be accessible.

The area of training needed the most was related to the storage, care; maintenance and replacement of a HVSA, as with any PPE. The following is considered to be minimum information: (1) when to use, (2) limitations of use, (3) how to check for wear and tear, (4) how to clean or decontaminate the apparel correctly (with complete washing and/or dry cleaning instructions), (5) how to store and maintain the apparel correctly, (6) fitting instructions, including how to put on and take off the apparel (CSA, 2009).

The most important influence regarding law enforcement officers' attitudes toward the HVSA use was prioritized in regulation, higher authorities, and practice as a nature of occupation. The penalty of failure in complying with HVSA policy was a minor reprimand or no reprimand. This implies that there is no clear set of regulations or authorities to enforce HVSA use. Varying law enforcement agencies' policies, officers' discretion to wear the HVSA, no training or education provided for HVSA use, the granted exemption to law enforcement officers from Federal regulations, attributed to the final outcome of the frequency usage of the HVSA in day-to-day patrol tasks. These regulations, organizational attitudes, and practices remained critical for changes in an individual's attitude and behavior toward HVSA use.

## 5.4 Recommendation for HVSA Regulation and Design Development

Through literature review on conspicuity and survey of HVSA among law enforcement officers, this current study recommends as following: (1) consider to upgrade the standard Performance Class for patrol officers to Performance Class 3 in order to maximize their safety, especially working nearby vehicles in significantly higher speeds in excess of 50mph (unless there is an environmental extreme, such as extreme high temperature not being able to wear the HVSA for long periods of patrol duties); (2) the decision of choosing Performance Class 2 or 3 shall not be an agency's or individual's discretion but determined by State wise control; (3) fitting and appropriate garment size for each individual shall be checked when distributing new HVSAs to law enforcement personnel, because an individual's body size and the physical shape tend to

change over the course of life along with one's age and weight gain, The effective usage of HVSA shall be achieved by correctly sized and fitted HVSA; (4) provide more sizing choices accommodating smaller (x-small and small) and bigger sizes (x-large). Due to the amount of background material required by the garment design guidelines in ANSI/ISEA 107-2010 standard, it can be difficult for a compliant garment to fit small-framed personnel such as female officers (typically smaller in size) than their male counterparts. In this case, the selection of Performance Class 3 such as half-sleeve or full-sleeve garment shall be considered to accommodate the common fitting problems (ISEA, 2013). There is also a reduction in Public Safety Vest background material compared to Performance Class 2, which permits smaller size user to wear shortened vests for unrestricted access to utility belts (ANSI/ISEA 207-2011); (5) new design development of HVSAs visually signaling the presence of law enforcement officers which would enhance their authority, or could help to reduce the resistance in wearing HVSAs, and to shift the negative attitude among law enforcement officers, to a more positive attitudes.

## 5.5 Limitation of Current Study

The greatest challenge in the study was constructing the most appropriate survey instrument to measure law enforcement officers' attitudes and behaviors toward HVSA use, and finding the most appropriate statistical procedures to test the hypotheses. The limitation in this current study was the lack of measuring target behaviors (i.e. use or non-use of HVSA) because participants' overt action would occur randomly and individually outside of police offices. Other direct or indirect behavioral observation methods were not applicable in this specific occupational field. In reality, video recording

individual's behavior feedbacks or having someone else to record it within law enforcement organizations was not easy to conduct. This made it even harder to document its occurrence.

The self-reported wearing behavior surrounding the use of HVSA has limited reliability on responses. Respondents may have answered survey questions according to how they believe they should behave rather than how they actually behave. Noticeably, it is necessary to use alternative methods in order to measure safety performance and find out whether attitude, belief, knowledge, and risk perception actually cause the non-use of HVSA. This would allow accurate measurement of the outcome, HVSA wearing behavior influenced from attitudes.

Results are limited to the specific groups. The sample of 98 law enforcement officers in the same environment (i.e. small sized urban area) may not represent the population in different surroundings. Broader and larger samples from various environmental settings are necessary for more precise conclusions to be drawn. In addition, despite the anonymity of the survey, respondents may have felt guilty or fear for reporting their agency's safety policy or HVSA procedure.

# APPENDIX A

Cover Letter to City Police Department Chief Officer

EMBRY-RIDDLE
Aeronautical University
PRESCOTT, ARIZONA

September 14, 2012

Dear Chief Officer or Safety manager:

I am a graduate student in the Department of Safety Science, working towards fulfilling my requirements for a Master in Safety Science Degree under the direction of Dr. Maxwell Fogleman at Embry-Riddle Aeronautical University. The study is to attempt to examine police officer's attitude, protective behavior and social-psychological dimension toward Personal Protective Clothing (PPC) specifically high-visibility safety apparel (retroreflective vest), intending to bring a clearer understanding of protective clothing wearing behavior and assessing the need for a potential safety training tactics emphasis on human, organizational and culture factors toward high-visibility safety apparel use.

I would appreciate your assistance for survey participation of patrol officers in this study which will help to find better safety training tactics to reduce traffic-related fatality and occupational safety risk. Getting knowledge through traditional way of training may not be enough to change safety behavior. In order to assess the need for a systematic training tactics, it necessitates your help.

There are no known risks if officers decide to participate in this research study. There are no costs to officers for participating in the study. The questionnaire will take approximately 20 minutes to complete. This survey is anonymous. Should the data be published, no individual information will be disclosed. The conclusions of the study will serve as an aid to help reduce the number of workplace fatality in law enforcement community, and its summary and presentation can be provided upon your request.

Questionnaire is enclosed for your review. The targeted survey enrollment is two hundreds of respondents, and survey is to be completed and returned by October 26th, 2012. If you have any questions concerning the research study, please contact me at (917) 478-8043 or e-mail songs3@my.erau.edu. If you have any questions about your rights as a research subject, please contact Embry-Riddle Aeronautical University's Institutional Review Board (IRB), through Prescott campus IRB committee member, Dr. Gary Northam, at (928) 777-3964 or e-mail Gary.Northam@erau.edu. Your assistance in this research effort is appreciated.

Sincerely,

*So Young Song*

So Young Song,
Graduate Student
Department of Safety Science
Embry-Riddle Aeronautical University

Maxwell Fogleman
Associate Professor
Department of Safety Science
Embry-Riddle Aeronautical University

Enclosures

3700 Willow Creek Road
Prescott, AZ 86301-3720

# APPENDIX B

Questionnaire

September 14, 2012

Code No. _____
Use only to verify return

HIGH VISIBILITY SAFETY APPAREL (REFLECTIVE VEST)
IN YAVAPAI COUNTY POLICE DEPARTMENTS

You are being invited to participate in a research study to examine police officer's attitude, protective behavior and social-psychological dimension toward Personal Protective Clothing (PPC) specifically high-visibility safety apparel (retroreflective vest), intending to bring a clearer understanding of protective clothing wearing behavior and assessing the need for a potential safety training tactics emphasis on human, organizational and culture factors toward high-visibility safety apparel use. This study is conducted by So Young Song, a graduate student in the Department of Safety Science, working towards fulfilling thesis requirements for a Master in Safety Science Degree under the direction of Dr. Maxwell Fogleman at Embry-Riddle Aeronautical University.

There are no known risks if you decide to participate in this research study. There are no costs to you for participating in the study. The information you provide will help find better safety training tactics toward traffic-related fatality and occupational safety risk, especially struck by vehicle associated with use of high-visibility safety apparel. The questionnaire will take about 20 minutes to complete. The information collected may not benefit you directly, but the information learned in this study should provide general benefits.

This survey is anonymous. Do not write your name on the survey. No one will be able to identify you or your answers, and no one will know whether or not you participated in the study. Should the data be published, no individual information will be disclosed.

Your participation in this research is voluntary. By completing the questionnaire, you're voluntarily agreeing to participate. You are free to withdraw your participation at any time without penalty if you do not wish to continue for any reason.

If you have any questions concerning the research study, please contact me at (917) 478-8043 or songs3@my.erau.edu. If you have any questions about your rights as a research subject, please contact Embry-Riddle Aeronautical University's Institutional Review Board (IRB), through Prescott campus IRB committee member, Dr. Gary Northam, at (928) 777-3964 or Gary.Northam@erau.edu. Thank you for your time and cooperation.

***Date of IRB Approval:*** 09/14/2012
***IRB Number:*** IRB 13-113
***Project Expiration Date:*** 12/30/2013

**Survey of High Visibility Safety Apparel (Reflective Vest)**
**in Yavapai County Police Departments**

**This questionnaire will take approximately 20 minutes of your time to complete. Your response is anonymous. Do not write your name on the survey. Place an X mark in the box next to your response for the following.**

**1. How long have you been a Law enforcement officer?**

**_____years**

**2. What is your current rank?**

☐ Officer/Deputy/Trooper (state highway patrol)
☐ Corporal
☐ Sergeant
☐ Lieutenant
☐ Captain or above
☐ Other (please describe): ☐

**3. Sex:** ☐ Male ☐ Female

**4. Marital status:**

☐ Married ☐ Single ☐ Divorced ☐ Separated ☐ Widowed

**5. Age:_____years**

**6. What is your race?**

☐ White / Caucasian
☐ Black / African American
☐ Hispanic
☐ Asian / Pacific Islander
☐ Arabic / Middle Eastern
☐ Native American Indian
☐ Other (please specify): ☐

**7. Please mark your highest level of education you have completed:**

☐ High school graduate
☐ Some college or Associate degree
☐ Bachelor's degree
☐ Some graduate work
☐ Graduate Degree
☐ Other (please specify): ☐

**8. Please mark your *current* assignment that best describes your duties:**

☐ General patrol/Traffic & Safety
☐ Administration/ Office/desk duty
☐ Training
☐ Detective/Criminal Investigations
☐ Special assignment (e.g. bomb squad, narcotics, gang enforcement, etc.)
☐ Other (please describe): _____

**9. What other Police/Sheriff departments or *previous* assignment have you served?**

☐ General patrol/Traffic & Safety
☐ Administration/ Office/desk duty
☐ Training
☐ Detective/Criminal Investigations
☐ Special assignment (e.g. bomb squad, narcotics, gang enforcement, etc.)
☐ Other (please describe): _____

**10. Please mark the type of environment setting you work:**

☐ Large sized urban area
☐ Medium to small sized urban area
☐ Suburban area
☐ Rural area
☐ Other (please specify): _____

**11. Do you have high-visibility vest? : a.** ☐ Yes ☐ No

**If yes, please answer the following questions.**

→ **b. How old is current high-visibility safety vest? : _____ ____years**

→ **c. What Performance Class is your high-visibility safety vest?**
☐ Class I ☐ Class II ☐ Class III ☐ Don't know

→ **d. How many do you own the high-visibility safety apparel or vest?**
☐ None ☐ 1 ☐ 2 ☐ 3 ☐ More than 3 (please specify: _____ )

→ **e. How often do you replace your high-visibility safety apparel or vest?**

**every_____months, or _____ ___**

→ **f. Do you wash or clean the high-visibility safety apparel?**
☐ Yes ☐ No
↓

→ **g. If yes, describe how you wash or clean your high-visibility vest:**

_____

_____

**12. Describe how you store your high-visibility vest when you're not wearing it:**

_____

**13. Are you required to wear high-visibility safety vest during certain duties?**

**a.** ☐ Yes ☐ No

**b. If yes, briefly describe those duties:** _____

_____

_____

**14. Identify <u>the most important</u> influence on your attitude toward high-visibility safety vest (mark only one).**

☐ Co-workers
☐ Supervisor or higher authorities
☐ Practice in police community
☐ Other officer's traffic accidents
☐ Safety training
☐ Spouse or family members
☐ Safety representative
☐ Regulation & department rule
☐ Previous Experience

**15. What percentage of deaths do you estimate (or know) are due to being struck by an automobile during the law enforcement duties? (Describe from 0% to 100%)**

_____ **%**

**16. Have you had other officers or co-workers struck by vehicle accidently during patrol duty?**

**a.** ☐ Yes ☐ No

**If yes, please answer the following two questions.**

→ **Did other officers' traffic accidents influence your attitude on traffic safety and wearing high-visibility safety apparel?**

**b.** ☐ Yes ☐ No

↓

**If yes, explain briefly how it affects your attitude or behavior:**

_____

_____

**17. Who provides your high-visibility safety vest?**

☐ Agency purchases high-visibility vest for each individual officer.
☐ Agency purchases high-visibility vest, but the vests are assigned to a squad or a police vehicle.
☐ Officers are *<u>required</u>* to purchase their own high-visibility safety vest.
☐ Officers are **<u>not</u>** *required* to purchase their own high-visibility safety vest, but purchase their own vests if desired.
☐ My agency do **<u>not</u>** utilize high-visibility safety vests.
☐ Other (please specify): _____

**18. How many <u>hours</u> of <u>each month</u> that you *<u>actually wear</u>* high-visibility vest?**

**_____ _ _____hours**

**19. According to your duties assigned and relevant rules, how many <u>hours</u> of <u>each month</u> that you are *<u>required to wear</u>* your high-visibility safety vest?**

**_____ _ _____hours**

**20. Place [X] marks in the box of <u>ALL</u> of factors which you think that make you inclined <u>not to wear</u> your high-visibility safety vest.**

☐ High-visibility vest does not enhance officer's professional appearance.
☐ Physical discomfort of high visibility safety vest
☐ Weather, especially hot temperature.
☐ Time and effort to get the vest and wear it every time of patrol duty.
☐ Decrease of mobility.
☐ Decrease of efficiency in performing duties.
☐ Uncertainty of efficiency of high-visibility vest if actually help reducing traffic-related accident. It seems to do nothing.
☐ Uncertainty of your risk of traffic accident.
☐ High-visibility vest makes officers an easier target if a situation turns violent, and to avoid the risk of getting shot.
☐ Other (please describe): [ ]

**21. What factor causes you to be <u>least</u> inclined to wear your high-visibility safety Vest ? (mark only one)**

☐ High-visibility vest does *not* enhance officer's professional appearance.
☐ Physical discomfort of high visibility safety vest
☐ Weather, especially hot temperature.
☐ Time and effort to get the vest and wear it every time of patrol duty.
☐ Decrease of mobility.
☐ Decrease of efficiency in performing duties.
☐ Uncertainty of efficiency of high-visibility vest if actually help reducing traffic-related accident. It seems to do nothing.
☐ Uncertainty of your risk of traffic accident.
☐ High-visibility vest makes officers an easier target if a situation turns violent, and to avoid the risk of getting shot.
☐ Other (please describe): [ ]

**22. What is the greatest cause of injury or fatality to your patrolmen in your agency?**

☐ Injury due to environment (falls, slips, heat stroke, etc.)
☐ Automobile accident
☐ Physical attack during arrest of suspects
☐ Other (please describe): [ ]

**23. Please mark the appropriate point on the line with a cross, which describes best how you feel at each of the following value statement. At the very left side of the line is the most positive value, at the very right the most negative. Please use only marks, do not write text.**

This is an example for an answer of the value statement "I feel always comfortable to communicate with my partner or co-worker." as shown:

Strongly Agree ⊢—X—⊣ Strongly Disagree

**23a.** High-visibility vest prevents officers getting struck by vehicle accidently.

Strongly Agree ⊢———⊣ Strongly Disagree

**23b.** I feel worried about my safety during patrol duty.

Strongly Agree ⊢———⊣ Strongly Disagree

**23c.** Officers wearing high-visibility vest are less likely to get injured.

Strongly Agree ⊢———⊣ Strongly Disagree

**23d.** Safety education programs are helpful for awareness of traffic-related accidents.

Strongly Agree ⊢———⊣ Strongly Disagree

**23e.** Safety education programs induce officers to wear *high-visibility vests* more frequently.

Strongly Agree ⊢———⊣ Strongly Disagree

**23f.** Environmental conditions have impact on wearing high-visibility vests. (e.g. hot temperature).

Strongly Agree ⊢———⊣ Strongly Disagree

**23g.** High-visibility vests provide better conspicuity at night than at day.

Strongly Agree ⊢———⊣ Strongly Disagree

**23h.** High-visibility vests do not help improve conspicuity during the day.

Strongly Agree ⊢———⊣ Strongly Disagree

**23i.** I dislike wearing a high-visibility safety vest.

Strongly Agree ⊢———⊣ Strongly Disagree

**23j**. I feel safer when wearing a high-visibility safety vest.

Strongly Agree ⊢———⊣ Strongly Disagree

**23k.** I feel comfortable when my uniform and vest look professional.

Strongly Agree ⊢——————————————————————————⊣ Strongly Disagree

**23l.** High-visibility safety vests help to enhance officer's professional look and authority.

Strongly Agree ⊢——————————————————————————⊣ Strongly Disagree

**23m.** Being safe is more important than being comfortable.

Strongly Agree ⊢——————————————————————————⊣ Strongly Disagree

**23n.** I feel inclined *not* to wear a high-visibility vest since it makes me look like a highway worker.

Strongly Agree ⊢——————————————————————————⊣ Strongly Disagree

**23o.** My high-visibility safety vest is uncomfortable.

Strongly Agree ⊢——————————————————————————⊣ Strongly Disagree

**23p.** High-visibility safety vests do not hinder access to weapons or the utility belt.

Strongly Agree ⊢——————————————————————————⊣ Strongly Disagree

**23q.** High-visibility vest makes me a target in situations that I do not wish to be seen.

Strongly Agree ⊢——————————————————————————⊣ Strongly Disagree

**23r.** The decision to wear a vest should be at an officer's discretion.

Strongly Agree ⊢——————————————————————————⊣ Strongly Disagree

**23s.** Wearing a reflective vest is too much of a hassle.

Strongly Agree ⊢——————————————————————————⊣ Strongly Disagree

**23t.** I feel safe *without* a high-visibility safety vest.

Strongly Agree ⊢——————————————————————————⊣ Strongly Disagree

**23u.** I feel that wearing high-visibility vest has a negative impact on my command presence.

Strongly Agree ⊢——————————————————————————⊣ Strongly Disagree

**23v.** High visibility vests help officers to avoid traffic-related injuries/fatalities.

Strongly Agree ⊢——————————————————————————⊣ Strongly Disagree

**23w.** Overall comfort of high-visibility safety vests is satisfactory.

Strongly Agree ⊢——————————————————————————⊣ Strongly Disagree

Overall comfort of law enforcement uniform is satisfactory.

**23x.** Strongly Agree ⊢——————————————————————⊣ Strongly Disagree

**23y.** General law enforcement uniform enhances the officer's professional look and authority.

Strongly Agree ⊢——————————————————————⊣ Strongly Disagree

**23z.** I believe a darker color of law enforcement uniform such as black, dark blue, or brown is more authoritative and more tactical.

Strongly Agree ⊢——————————————————————⊣ Strongly Disagree

**24. Are there certain activities affected when you're wearing your high-visibility vest, and makes you inclined *not* to wear it ?**

**a.** ☐ Yes ☐ No

**b. If yes, specify those activities:**_____

_____

_____

**25. Do you have any other experiences that affected your attitude of wearing high-visibility vest?**

**a.** ☐ Yes ☐ No

**b. If yes, briefly explain the experience:**_____

_____

_____

_____

**26. Describe your most uncomfortable experience of wearing high-visibility vest physically, psychologically, or in any reason.**

_____

_____

_____

**27. Have you had any safety training for the use of high-visibility safety apparel?**

**a.** ☐ Yes ☐ No

**If yes, please answer the following question.**

→ **b. Place [X] marks in the box of <u>ALL</u> of training for high-visibility safety vest.**

☐ Use of high-visibility vest (Explanation of duties required to wear it)
☐ Federal Regulation and agency rule.
☐ Care and maintenance of vest, instruction of replacement of the vest, storage.
☐ Use of other visibility equipment (e.g. traffic cones, director lights, flares)
☐ Other (please describe):

_____

_____

**28. How many *<u>total</u>* hours of training have you received regarding use of high-visibility safety apparel *<u>in past 3 years</u>*?**

**_____hours**

**29. Does your agency maintain a written policy for the use of high-visibility safety apparel?**

**a.** ☐ Yes ☐ No ☐ Don't know

**If yes, please answer the following two questions.**

→ **b. How often do you comply with agency policy for those situations that high-visibility vest is required to be worn?**
☐ Always ☐ Often ☐ Sometimes ☐ Seldom ☐ Never

→ **c. What are the consequences of failing to comply with agency policy in wearing high-visibility safety vest?**

☐ No reprimand or no specified outcome.
☐ Minor reprimand (e.g. verbal or written reprimand, etc.)
☐ Major reprimand (e.g. suspension with or without pay, etc.)
☐ Other (please specify): [ ]

**30. Does you agency inspect the high-visibility vests after purchased or issued?**

**a.** ☐ Yes ☐ No

**b. If yes, how often the vests are inspected?**

**every_____months or _____**

**31. Please list any suggestions or general comments for the improvement on any issues regarding high-visibility safety apparel *including but not limited to design, material, regulation, agency rule, safety training, etc.***

# APPENDIX C

Human Subject Research Approval Letter

# Embry-Riddle Aeronautical University

## Application for IRB Approval

## Cover Sheet

**13-113**

Principle Investigator: Max Fogleman, Advisor
Other Investigators: So Young Song, Graduate Student

Project Title: ***Personal Protective Clothing: Law enforcement officers' Attitudes and Human Behavior Assessment Toward High-Visibility Safety Apparel***

Submission Date: August 31, 2012

Determination Date: September 14, 2012

Review Board Use Only

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Initial Reviewer: Teri Vigneau/Bert Boquet

Exempt: X Yes __ No

Approved: X Yes ___ No

Comments: This survey project will examine Law enforcement officer's attitudes toward Personal Protective Clothing to assess the need for safety training tactics. Since this is an anonymous survey, there will be no risks to participants and so this may be determined to be **exempt.** [Teri Vigneau 9-6-12]

This protocol is **exempt**. [Bert Boquet 9-6012]

# APPENDIX D

Police Department Agency's Written Policy related to HVSA

| COTTONWOOD POLICE DEPARTMENT GENERAL ORDERS<br>*Serving with Integrity and Dedication* | Section<br>**700 TRAFFIC ENFORCEMENT** | |
|---|---|---|
| | General Order<br>**705 Traffic Control** | Effective<br>**07/19/05** |

**PURPOSE** The purpose of this order is to create general guidelines for officers to follow when directing traffic so as to best accommodate the safe and efficient flow of traffic.

**A. POLICY** Cottonwood officers are encouraged to become proficient with standardized methods of directing traffic so as to reduce the level of possible confusion facing motorists approaching a location where an officer is directing traffic. The safe and expedient flow of traffic through an area where an officer is directing traffic is our primary goal.

**B. MANUAL OPERATION OF TRAFFIC CONTROL DEVICES**

1. Manual operation of traffic control devices may be accomplished by use of the stop time switch, use of the flasher, or manual phasing. Personnel should not turn off any power switch in the hopes of correcting any signal problem.

2. Use of the stop time switch—When the signal is green for heavy traffic flow direction, activate the switch to stop the internal time counter and keep the light from phasing properly. When sufficient traffic has cleared, de-activate the switch to allow the light to return to normal phasing.

3. Manual phasing—Activate the switch to immediately phase the light on the operator's command. When finished, return the switch to the normal operation position.

4. Flasher—During a safe break in the flow of traffic, activate the flasher switch to deactivate the normal phasing and turn on only the red/red (or red/yellow at some intersections) flashers. When finished, return the switch to the normal operation position.

**C. HAND SIGNAL TRAFFIC DIRECTION**

1. Orders of direction to a motorist or pedestrian should generally be made by hand signals and not by voice only. Simple hand signals, which are clearly visible and readily understandable, emphasized by the use of a whistle, should conform to the following standards:

a. The officer should stand facing one line of stopped traffic with his side toward moving traffic.

b. The “stop” signal should be given while standing sideways to the flow of traffic. One long blast from the whistle may be used in conjunction with the hand signal. Arms should be extended from the sides at nearly a horizontal angle and hands should be held vertically with the palm turned over toward the traffic to be stopped.
c. After stopping the moving traffic, the officer should turn so that he faces the traffic that is stopped, look at the lane of traffic to be started, use two short blasts of the whistle, and give a hand/arm motion signal for that lane to start moving.
d. If emergency vehicles approach the area and the officer is unclear as to where it is coming from, traffic should be stopped in all directions until the officer can determine how best to expedite the emergency vehicle’s passage through the area.
e. When directing traffic at an intersection, stand in the position that is most visible to the majority of traffic—this is usually in the center of the intersection.

## D. ENFORCEMENT WHILE DIRECTING TRAFFIC

1. If an officer directing traffic observes a violation he should base his response on the type and seriousness of the violation.

a. If it is a minor or non-hazardous violation, it should be overlooked.
b. If it is a serious or hazardous violation, the officer directing traffic should request assistance from another officer if possible. If not possible, depending on the individual situation, enforcement action may be taken. Officers should give due consideration to the fact that the safe flow of traffic through the area he has been assigned to control is a primary concern.

## E. EQUIPMENT FOR DIRECTING TRAFFIC

1. Any employee in the roadway shall wear a department issued traffic vest at all times while directing traffic. During times of inclement weather an officer may wear a rain coat with ANSI Class 3 reflective striping in lieu of the traffic vest.

2. Officers directing traffic should have a whistle available for use.

3. The use of flares, cones, flashlights, or other lighting devices is recommended as appropriate for the specific situation.

4. The employee may wear an approved hat while directing traffic.

■■■

**Prescott Valley Police Department**

Agency Policy/General information provided related to Traffic Safety/High Visibility Vest

Dated on Feb.13th, 2013

**630. HIGH VISIBLITY VESTS**

630.10 HIGH VISIBILITY VEST WHEN REQUIRED. The high visibility vest shall be worn by each uniformed officer at traffic collision scenes, traffic collision investigation scenes, during traffic direction or special traffic enforcement. In addition, such high visibility equipment shall be worn at other times as directed by the Police Chief, division commanding officer or supervisor in charge of an operation.

**630.20 HIGH VISIBILITY VEST SUPPORT SERVICES DIVISION COMMANDING OFFICER RESPONSIBIITY.** The Commanding Officer, Support Services division shall:

* Ensure an adequate supply of high visibility vests are maintained in a safe and accessible place.
* Issue the vests to officers who may be required to wear such equipment.
* Maintain records of vests issued, returned, damaged, lost or unserviceable.
* Upon discovery of vests lost or damaged through negligence or carelessness, initiate appropriate action.

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