Review of the Skills Perishability of Police "Use of Force" Skills

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This work represents the opinions of the authors. The Canadian Police Sector Council (PSC) may not necessarily agree with the opinions expressed in this review. The principles for psychomotor skill acquisition expressed in this review have been arrived at through years of research. Each reader must filter these recommendations through their own unique situation. The factors affecting skill retention reported in this paper have also been arrived at through years of research. Although there have been conflicting results as to the impact of the skill retention factors, the preponderance of evidence is used to justify recommendations within this report. This report also includes the opinions of use of force instructors interviewed during the course of the study. These opinions may not reflect the position of the respective training institution or police force. While every effort was made to check the validity of facts obtained by the interviewees, it was not possible within the scope of the budget. This paper is intended to assist officials in determining best practices for skill retention at both the initial training academies and when police officers are employed. Finally recommendations for research represent the opinions of the authors and subject matter experts**.**

Executive Summary

Background This study was conducted for the Police Sector Council to help inform an impartial evidence-based recertification strategy for "use of force" training in Canada. The ultimate goal of the Police Sector Council is to establish national standards for skills training/maintenance that meet operational policing needs.

The primary objectives of this study were to conduct a literature review and to conduct an interview-based survey noting the state of use of force training in Canada. The goals of the literature review were to identify factors that influence police skill perishability, identify empirical based evidence that supports the timing of police use of force skills refresher training and recertification and to identify teaching principles and techniques that will promote long term skill retention. The goals of the survey were to identify basic approaches used by training academies for use of force skill acquisition, identify refresher training approaches and finally identify empirical based evidence that supports the timing of police use of force skills refresher training and recertification.

Method The literature review began with a systematic search of the relevant literature related to skills perishability, culminating in a preliminary review. This draft review was then distributed to a range of experts in a 2-day workshop conducted in May 2011. This workshop provided academics specializing in motor skills as well as use of force experts to discuss the preliminary review in order to further shape it, and to help identify a way ahead to address the police skills perishability problem. The interview survey began with attendance at a use of force expert workshop. Use of force skill perishability issues and lines of further investigation were identified. The interview process began with the development of an interview script and the identification of open and closed questions. The PSC provided contact information to a number of use of force trainers across Canada. Attempts were made to interview instructors that train their officers at each of the training academies. Telephone and physical interviews were conducted with training academy instructors and in-service training instructors.

Key Results It is impossible to separate issues of skill retention from skill acquisition. There are a number of models relevant to skill acquisition, as well as a range of factors impact on skill acquisition. Several evidence-based best practices relevant to training skills and skill acquisition emerged from the literature and workshop discussions, including using a random rather than blocked practice approach when training, providing explicit knowledge of results to trainees early in training but decreasing as skills become automatic, and using high realism training.

In general, the psychomotor skill retention literature is underdeveloped in the area of long term skill retention. Skills examined in many controlled studies are artificial in nature and do not reflect the complexity of the police use of force context. However, there is good agreement that characteristics of the individual (e.g., level of initial learning), the nature of the task (procedural skills fade faster than psychomotor skills, and mental tasks are better retained than psychomotor tasks; tasks with more steps are more subject to perishability), and the nature of training (e.g.,

regular refresher training, active participation, realistic training, and good quality feedback) are all critical factors that influence retention. Although there are few models that enable prediction of skills fading, the User Decision-Aid (UDA) model shows considerable promise.

Literature relevant to transfer of training (i.e., the extent to which skills acquired during training are expressed in novel contexts) was also explored. This research also showed controlled but artificial studies that may not reflect the complexity of the police use of force context. However, some training principles were noted, including the importance of exposing trainees to as many different situations as possible to promote knowledge and skills transfer, and providing diverse cases or examples during training that are supported by trainer instruction and using simulation.

Although existing research and literature provides some evidence of best practices in training psychomotor skills, when thinking about the application of use of force skills, it seems critical to understand not just the psychomotor aspects that influence skilled performance, but the larger context within which skills are expressed. Only this will yield an optimal understanding of use of force skills acquisition and retention.

Conclusion In general, the policing skill retention literature is underdeveloped. Either due to a lack of funding, lack of academic access or due to the sensitivity of the subject itself, substantive research has not been undertaken. The state of Canadian police use of force skills perishability is currently unknown. Only isolated anecdotal information is available on the degree of refresher training across police agencies beyond their statutory requalification requirements. Empirical evidence justifying skill retention timings was not found.

It is believed that the OODA Loop model is a more appropriate model for explaining the recognition and action components involved in psychomotor skills in the policing use of force context. The use of force experts workshop supported the view in many of the policing use of force publications that perception and decision making issues need to be addressed. Prior to any application of use of force techniques, the police officer needs to assess the situation and then make the decision to use the proper use of force technique. This suggests that the perishability of use of force skills will need to be addressed within a broader tactical decision-making context.

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1 Introduction

This literature review describes the background, purpose, and results of the work carried out under Work Order Number - PSC/CSP 29 dated January 2010 (Reference A: Statement of Work for Skills Perishability).

1.1 Background

Police forces have a large and on-going requirement to train. Conducting the correct amount of training is critical as insufficient training can lead to death, injury, financial losses, loss of capability, and policing failure. Excessive training can conversely deny time and resources to other policing activities, which can result in the same undesirable results. A scientific basis for scheduling refresher or maintenance level training is required. Furthermore, as policing operations involve increasing levels of high stress, its impact on the retention of psychophysical and cognitive tasks is important. A scientific basis for conceptualizing and predicting the effect of stress on the retention of physical and cognitive skills is required.

Policing agencies have established frameworks and schedules for the recertification of some of the use of force policing tools and techniques. However, time frames for skill recertification are based on historical practice (tradition) rather than evidence. Recertification periodicity needs to be defendable, evidence-based and sufficient to maintain an acceptable skill level. Acquisition and maintenance of skills should be underpinned by impartial evidence and research and should respond to an evidence-based recertification strategy and national standards for skills training / maintenance. Training a large array of skills creates a problem for professional organization such as the Canadian police forces. Because forgetting can occur over any time period without practice (e.g., Goldberg & O'Rourke, 1989; Hagman & Rose, 1983; Schendel & Hagman, 1982), the skills of those trained will gradually degrade, eventually to the point at which skills do not meet required levels of proficiency. This is true for any training organization and many others have considered the issues surrounding it (e.g., Wisher, Sabol, & Ellis, 1999):

- How quickly does forgetting occur for different kinds of skills?
- Are some individuals more likely to forget than others?
- What instructional strategies are effective in reducing forgetting?
- How difficult will it be to reacquire forgotten skills?

Many organizations from around the world have recognized the importance of quantifying skill perishability and understanding the impact of stress on skill retention. Several decades of research on skill perishability has been conducted in non-policing environments. Research has focused on the assessment of artificial tasks such as learning an obscure foreign language, over a relatively short time. In additional to short term academic based-studies where bias factors have been controlled, longer term, complex, real-world studies have been undertaken. Due to the complex nature of the use of force policing issues and the difficulty involved in collecting the relevant information, only limited data has been collected to date. The purpose of this contract is

to bring together the published and unpublished data and theory from the policing Research and Development (R&D) community pertaining to the impact of stress and other relevant factors on the retention of physical and cognitive skills. Given that the bulk of the skill retention research conducted to date has been outside the policing domain, the contributions from the general scientific, motor skills and military literature will be relevant.

1.2 Objectives

The original goals of this project were:

- to conduct literature review
- scan and report on the current state of "use of force" skills training

The ultimate goal, beyond the scope of this call-up, is to develop an evidence-based recertification strategy and training standards for mandatory operational skills (e.g. use of force).

1.3 Scope

A literature review examining use of force skill perishability must consider a variety of skills in the police use of force technique continuum. Techniques that promote good retention for one type of skill may not be suitable for another type of skill. Consequently, it is important to identify factors that impact skill retention across the use of force spectrum. As well it is equally important to develop a framework for interpreting the literature in a way meaningful for the Police Sector Council. Although the original scope of the literature review was focused just on skill retention factors, the degree of learning or skill acquisition and transfer affect has a direct relationship with skill perishability. Thus we will systematically examine factors affecting psychomotor training, transfer and skill retention with respect to the different kinds of use of force skills relevant to the Canadian police forces. This literature review is not intended to be a comprehensive survey of the research surrounding each of the factors associated with skill acquisition, transfer and retention. These areas are very broad and subject to several volumes of texts on their own. Rather, we will seek to address several core issues of relevance to police skill retention. Although the focus of the review is on police use of force psychomotor skill retention, we will first review concepts and models surrounding motor skill acquisition. Second, we will review in depth the factors that have been shown to address skill retention. Knowledge of these factors is crucial to understanding approaches that either improve skill acquisition at the training academies, or reduce skill loss once the recruit is deployed. We will discuss literature pertaining to retention of all kinds of skills but emphasize research directly applicable to actual policing skills and tasks. The review will not focus on theoretical models of skill retention except as they apply to providing direction for changing skill acquisition and retention processes. The reader is referred to Bryant and Angel (2000) for a review of quantitative and qualitative models of skill perishability. Third we introduce the concept of skill transfer as it applies to skill perishability. Fourth we will specifically examine skills perishability from the policing use of force context. Use of force tasks involve motor and perceptual skills but a large number are highly cognitive, requiring complex decision making and reasoning. Finally, based on the literature review we will propose research to address knowledge gaps to attain the PSC goal.

The original scope of the use of force literature review was as follows:

- Identify literature pertaining to use of force skill acquisition and perishability.
- Identify teaching principles and techniques that will promote long term use of force skill retention.
- Identify empirical based evidence that supports the timing of police use of force skills refresher training and recertification.

During the course of this project additional direction was provided expanding the scope of the literature review to include the following goals:

- Identify factors that influence skill perishability
- Identify skill acquisition models
- Identify training transfer issues

The second objective of this project was to conduct a scan of the current state of "use of force" skills training". The word scan has different meanings; it can either be taken to be examine closely or to look over quickly ( ). Given the number of police training academies and police forces in Canada, scan was interpreted as being a quick over view of the use of force skills training in Canada. A number of approaches were available to evaluate the current state of the "use of force skills training including surveys, interviews and focus group sessions. Given that police training academies were simultaneously replying to a larger survey sponsored by the PSC/CSP, the approach chosen for this effort was focus group and interview based. In an effort to understand the scope of the use of force skill retention problem, a focus group session was held with a number of use of force experts attending a working group session. The focus group session helped identify the scope of the issues surrounding use of force skills and provided guidance for further research. Next we will introduce use of force skills training approaches used by a number of Canadian academies. The scan will identify gross training blocks and specific use of force training hours where possible. Thirdly, we will review use of force skills refresher training undertaken by representative police forces across Canada. The refresher training and recertification cycles will be introduced as well as feedback on how the skills are refreshed will be detailed. Finally based on the scan we will propose research to address knowledge gaps to attain the PSC goal.

The scope of work to achieve the survey of the state of use of force training was to:

- Identify basic approaches used by training academies for use of force skill acquisition
- Identify refresher training approaches.
- Identify empirical based evidence that supports the timing of police use of force skills refresher training and recertification.
- Identify the research required to provide an impartial evidence-based recertification strategy with the ultimate goal of establishing national standards for skills training/maintenance that meet operational policing needs.

1.4 Approach

Despite the broad skill-base of the Canadian police forces, the focus of the literature review and scan must be on the skills and training factors that pertain strongly to the perishability of use of force skills. Research on skill retention in other domains, such as the military, medical, sports, business and education, can be relevant but must be interpreted with respect to the skill requirements of the Canadian police forces. Thus, we will review the literature with a regard to the application of the knowledge to the target audience.

We will adopt a practical focus in our review and interpretation of the scientific literature and police interviews. The ultimate goal is to identify empirical based evidence that supports the timing of police use of force skills refresher training and recertification. We will survey the applied science literature to identify recommendations validated with empirical results.

We will also adopt a focus on psychomotor skill retention. The goal of the review is to identify ways for determining optimal training and refresher training programs for police use of force skills.

1.5 Acronyms

Table 1: Acronyms

Acronym	Meaning
AACP	Alberta Association of Chiefs of Police
AFOQT	Air Force Officer Qualifying Test
ARI	Army Research Institute
ASVAB	Armed Services Vocational Aptitude Battery
CACP	Canadian Association of Chiefs of Police
CED/CEW	Conductive Energy Device/ Conductive Energy Weapon
CF	Canadian Forces
CISTI	Canadian Institute for Scientific and Technical Information
CPR	Cardio Pulmonary Resuscitation
CPRC	Canadian Police Research Centre
DCIEM	Defence and Civil Institute of Environmental Medicine
DRDC	Defence Research and Development Canada
ENPQ	Ecole Nationale de Police du Quebec
FLETC	Federal Law Enforcement Training Centre
GMP	generalized motor pattern

Acronym	Meaning
LEO	Law Enforcement Officer
LVNR	Lateral Vascular Neck Restraint
NTIS	National Technical Information Service
OACP	Ontario association of Chiefs of Police
OC	Oleoresin capsicum
OODA	Observe, Orient, Decide and Act
PDT	Personal Defence Tactics
PPSIC	Public and Police Safety Instructors Course
PSC/CSP	Police Sector Council
R & D	Research and Development
RCMP/GRC	Royal Canadian Mounted Police
SA	Scientific Authority
SBOR	Subject Behavior Officer Response
SME	Subject Matter Experts
TRU	Tactical Response Unit
UK	United Kingdom
UDA	User's Decision Aid

1.6 Report Organization

Given the two objectives of this project and different foci of the literature review the report is organized as follows:

Section 1 - Introduction

Section 2 – Skills Perishability Literature Review

Section 3 - Skills Perishability within the Use of Force Context Literature Review

Section 4 –State of Use of Force Skills Training Survey

Section 5 – Discussion/Recommendations

Section 2: Skills Perishability Literature Review

2. Skills Perishability Literature Review

2.1 Goals

The primary goals of the literature review were to:

- Identify generic factors that influence skill perishability.
- Identify teaching principles and techniques that will promote long term skill retention.
- Identify empirical based evidence that supports the timing of refresher training and recertification.
- Identify the research required to provide an impartial evidence-based recertification strategy with the ultimate goal of establishing national standards for skills training/maintenance that meet operational policing needs.

This literature review focused on generic factors affecting skill perishability and the identification of factors that promote long term skill retention.

2.2 Literature Review Method

A literature review is a systematic study and organization of a large body of relevant scientific research. The key to success, then was to develop a framework for interpreting the literature and generating clear and useful insights, lessons learned, and recommendations for future research and practice. We followed a number of steps to complete the literature review. For this project, we used what can be described as a "funneling" approach in that we will identify many concepts which may be appropriate to police skills perishability or recommendations for future investigation. As such, the project began by conducting a broad exploration of trends, issues and factors that have shown to impact skill retention and police use of force skill retention in particular.

2.2.1 Develop Systematization Framework

The first step of the literature review was to develop a framework for organizing and interpreting empirical results and theories of skill retention. The framework applied herein will be based upon the framework used in previous reviews of the skill fading literature (Bryant & Angel, 2000).

The previous reviews of the skill fading literature (Bryant & Angel, 2000), Development of Theories of Collective and Cognitive Skill Retention (Adams, Webb, Angel & Bryant, 2002), Accelerated Learning and Retention Literature Review (Adams, Karthaus & Rehak, 2011), Military Individual Readiness (Adams, Hall, & Thomson, 2009) served as a preliminary guide to identifying relevant literature related to both skill retention and the impact of stress on skilled performance. We used the set of keywords developed in these projects as the starting point for developing a set of keywords used to conduct a further search of the literature (see Table 2). Based on the feedback from the Use of Force Experts Workshop (2 March 2011), the keywords were expanded to include the relevant OODA model components and stress in decision making.

Table 2: Preliminary Keyword Set

Category	Keyword	Related Keywords
General	Skill	Ability, Expertise
	Training	Train, Re-train, Refresher
	Practice	Rehearsal, Sustainment, Maintenance
	Task	Job, Work
Performance	Retention	Memory, Remember, Recall, Recognize, Long-term, Short-term, Durable, Execution
	Fading	Loss, Degradation, Decline, Interference, Decay, Perishability
	Performance	Proficiency, Skilled, Capability
	Criterion	Standard
Domain	Military	Army, Navy, Air Force, Marine, Soldier, Combat, Tactical decision making
	Policing	Law enforcement, police,
	Weapon	Pistol, handgun, shotgun, taser, baton, choke hold, carotid hold, force intervention
	Equipment	Vehicle, Maintenance, Assemble, Clean, Repair, Troubleshoot, Identify
Model	Model	Theory, Quantitative
	Predict	Prediction, Hypothesis
	Empirical Result	Empirical Support, Validated
Factors	Type of Training	Performance, Mastery, Tutor, Instruction, Self-taught, Simulation, Team, Individual, Feedback, Part-task, Whole-task, Acquisition, Learning
	Maintenance	Schedule, Time, Retention-interval, Disuse
	Fact	Knowledge, Information, Data
	Type of Task	Cognitive, Procedural, Perceptual-motor, Continuous, Discrete, Complexity, Sequential
	Type of Skill	Steps, Cognitive, Mental, Procedural, Motor, Perceptual, Control, Automatic,
	Individual Factors	Original learning, Aptitude, Motivation, Education
	Job Aid	Memory Aid, Guide, Instructions, Manual,
	Stress	Time Pressure, Fatigue

2.2.2 Search Literature

The first step in this task was to identify relevant databases of scientific research. Again, the earlier literature searches conducted by HIS® provided a starting set of databases. We surveyed databases for psychology, sports, human factors, military, professional/business, and other related domains to compile a set of databases to search – see Table 3. The next step in

conducting a search of the literature was to identify relevant areas of concern for the Canadian police forces. To this end, all literature was categorized by the following use-of-force skill sets:

- Perceptual skills
- Orientation skills
- Decision making skills
- Psychomotor skills
- Verbal skills

The second step was to identify and categorize databases of scientific research. We surveyed databases for policing, psychology, human factors, military, and other related domains to compile a set of databases to search.

Table 3: Databases Used For Search

Database	Description
PsycINFO	The PsycINFO database is a collection of electronically stored bibliographic references, often with abstracts or summaries, to psychological literature from the 1800s to the present. The available literature includes material published in 50 countries, but is all presented in English. Books and chapters published worldwide are also covered in the database, as well as technical reports and dissertations from the last several decades.
NTIS	NTIS is an agency for the U.S. Department of Commerce's Technology Administration. It is the official source for government sponsored U.S. and worldwide scientific, technical, engineering and business related information. The 400,000 article database can be searched for free at the www.ntis.gov. Articles can be purchased from NTIS at costs depending on the length of the article.
CISTI	CISTI stands for the Canada Institute for Scientific and Technical Information. It is the library for the National Research Council of Canada and a world source for information in science, technology, engineering and medicine. The database is searchable on-line at cat.cisti.nrc.ca. Articles can be ordered from CISTI for a fee of approximately $12.
STINET	STINET is a publicly-available database (stinet.dtic.mil) which provides access to citations of documents such as: unclassified unlimited documents that have been entered into the Defence Technology Technical Reports Collection (e.g., dissertations from the Naval Postgraduate School), the Air University Library Index to Military Periodicals, Staff College Automated Military Periodical Index, Department of Defence Index to Specifications and Standards, and Research and Development Descriptive Summaries. The full-text electronic versions of many of these articles are also available from this database.
Google Scholar	The World Wide Web was searched using the Google Scholar search engines (scholar.google.com).
DRDC Research Reports	DRDC Defence Research Reports is a database of scientific and technical research produced over the past 6- years by and for the Defence Research & Development Canada. It is available online at pubs.drdc-rddc.gc.ca/pubdocs/pcow1_e.html.
National Research Council	National Research Council Canada is a database of scientific and technical research. It is available online at http://www.nrc-cnrc.gc.ca/eng/search/index.html

2.2.3 Review Selected Articles

Once we had selected the key articles and categorized them by retention factor technical application, we conducted a thorough review of each article. The review:

- Identified factors and issues relevant to skill acquisition and transfer
- Identified factors and issues relevant to use-of-force skill retention
- Identified empirical data supporting skill perishability theories and models of skill retention

2.2.4 Preliminary Survey of the Literature

Based on the review of key articles, we generated a preliminary literature review that focused on use of force skills perishability issues for use in workshop discussions with the PSC. The review allowed us to identify skill retention theories and factors based on scientific validity and applicability to the Canadian police forces. Our literature survey:

- Developed a comprehensive list of factors promoting skill acquisition and skill retention in the police use-of-force categories.
- Developed a comprehensive list of tools and techniques that can be used to promote skill retention.
- Classified factors, theories, and techniques based on the OODA loop and use-of-force framework.

The results of the preliminary literature review were presented to a series of Subject Matter Experts (SME) over the course of two days (10-11 May 2011). The workshop provided academics specializing in motor skill as well as use of force experts a forum to highlight search deficits with the literature review. While no new skill retention factors were introduced during the workshop, participants identified the desire for more background information on:

- Skills acquisition theories
- Skills transfer

The workshop also provided a forum to identify a way ahead to address the police skills perishability problem.

2.2.5 Finalize Survey of Literature and Generate Lessons Learned

Based on the review of key articles and recommendations from the SME workshop we generated an account of the major factors relevant to police use of force skill perishability. Our literature survey:

- Developed a comprehensive list of factors promoting skill acquisition and skill retention in the police use-of-force categories
- Developed a comprehensive list of tools and techniques that can be used to promote skill retention
- Discussed skill retention factors within the use-of-force framework

The literature survey provided a detailed account of the scientific literature. This survey was focused on the issues relevant to the goals of the Canadian police forces (as developed through the review with SMEs).

The final step of the literature survey was to generate where possible a set of training recommendations for police refresher training. Recommendations included advanced practices and techniques that could improve the quality and efficiency of training efforts by Canadian police forces.

2.3 Skills Perishability Literature Review Results

This first results section introduces a general overview of skills perishability while the next section reviews specific skills perishability research within the policing domain. In the general overview particular emphasis was given to examination of the factors that have been examined in skill acquisition and perishability studies. During the SME review of the preliminary literature results, concerns were expressed by some on the lack of discussion on motor learning theories and the lack of discussion on skills transfer. The literature review was expanded to introduce these areas.

The literature review results are organized as follows:

- Nature of skills and skills acquisition models
- Skill retention and perishability
- Transfer of training

Throughout the literature review every effort was made to identify evidence justifying police use of force refresher training. Except for Cardio Pulmonary Resuscitation (CPR) training (see paragraph 3.2.2.1) no empirically based evidence justifying police use of force recertification or refresher training was identified.

2.3.1 Nature of Skills and Skills Acquisition Models

It is first necessary to understand the specific nature of skills and motor skills prior to examining police skills perishability and discussing the issues of motor skills in policing. This chapter introduces the concept of human performance, skills and skill models with the emphasis on psychomotor skills.

2.3.1.1 Skills

Skill can be defined in two ways. First, it is the achievement of some criterion level of performance at a task. Thus, a police officer who scores 181 out of 240 on a handgun course of fire is said to possess some level of skill and a police officer who scores 235 out of 240 is said to possess expertise, or an extremely high level of skill. In relation to skills perishability, skill is any kind of learned procedure, problem solving technique, or sequence of steps.

Skills are goal-directed and organized in complex sets of skills that are used together in a work domain e.g. Kraiger, Ford & Salas, (1993); (Schmidt & Lee, 2011). Rasmussen (1987) classified human performance according to three behaviours, skill based, rule-based and knowledge-based –see Figure 1.

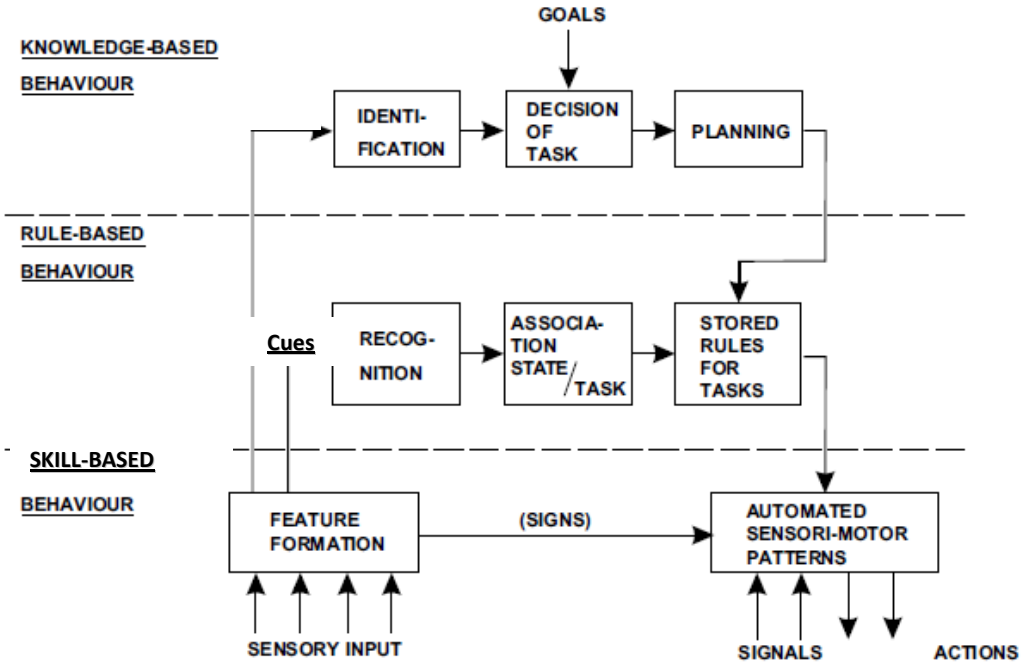

Figure 1: Levels of performance of skilled human operators. Modified from Rasmussen (1993)

Skill-based behaviour happens without conscious control and the body acts as a seamless control system coordinating force, movement, and speed. Rule-based behaviour may be viewed as the proper sequence of actions and is learned during in and through experience. In unfamiliar situations the police officer may not have the know how to handle the situation and thus is forced to analyse the situation and come to a decision using their existing knowledge set.

2.3.1.2 Psychomotor Skills

Psychomotor skills include both an action and a recognition component and it is now recognized that expert and ordinary performance also involves perceptual and cognitive skills (Williams, 2002; Schmidt & Lee, 2011). The recognition component is used to identify the task conditions that trigger a motor action response. In open sports or activities, the process is typically a series of adaptive actions that involve dynamic adaptations to changing conditions. For the Law Enforcement Officer (LEO), application of a restraint hold on a non-compliant offender varies from situation to situation. The officer must react to the size and strength of the offender, how the offender moves, resists, etc. In sports expertise, training researchers have been typically concerned with decision-making skills in open sports rather than motor skills. Conversely in closed sports the focus has been on the production of motor skills. While the goal in open skills is to react to an opponent by adjusting motor sequences, the goal in closed skills focuses on reproducing motor sequences accurately and consistently. For the law enforcement officer handgun shooting at a static range is an example of a closed psychomotor skill. Both recognition and action activities are combined in a seamless manner to the observer. Sports science research has shown that expert performers typically outperform less abled performers in the area of recognition skills rather than in action skills (Williams & Ward, 2003).

The visible demonstration of psychomotor skill occurs through gross and fine motor movements of the LEO. Gross motor skills involve the large muscles of the body that enable such functions as walking, punching, sitting upright, lifting, and raising firearm to eye height. Gross motor skills are important for major body movement such as walking, maintaining balance in an altercation, coordination of breathing and movement, lunging, reaching and shooting. Fine motor skills are the coordination of small muscle movements which occur e.g., in the fingers and hands, usually in coordination with the eyes. Precise eye–hand coordination is involved in weapon shooting, writing, handcuff operation, etc.

Psychomotor ability can be differentiated from physical ability. O*NET (2011), a database of occupational information used to distinguish occupations by the mix of knowledge, skills and abilities required in performing a variety of tasks and activities includes psychomotor and physical abilities in its taxonomy . O*NET identifies psychomotor abilities as those abilities that influence the capacity to manipulate and control objects and physical abilities as the abilities that influence strength, flexibility, balance and coordination – see Table 4.

Table 4: Components of Psychomotor and Physical Abilities from O*NET (2011)

Psychomotor Abilities	Physical Abilities
Arm-Hand Steadiness — The ability to keep your hand and arm steady while moving your arm or while holding your arm and hand in one position.	Dynamic Flexibility — The ability to quickly and repeatedly bend, stretch, twist, or reach out with your body, arms, and/or legs.
Control Precision — The ability to quickly and repeatedly adjust the controls of a machine or a vehicle to exact positions.	Dynamic Strength — The ability to exert muscle force repeatedly or continuously over time. This involves muscular endurance and resistance to muscle fatigue.
Finger Dexterity — The ability to make precisely coordinated movements of the fingers of one or both hands to grasp, manipulate, or assemble very small objects.	Explosive Strength — The ability to use short bursts of muscle force to propel oneself (as in jumping or sprinting), or to throw an object.
Manual Dexterity — The ability to quickly move your hand, your hand together with your arm, or your two hands to grasp, manipulate, or assemble objects.	Extent Flexibility — The ability to bend, stretch, twist, or reach with your body, arms, and/or legs.
Multilimb Coordination — The ability to coordinate two or more limbs (for example, two arms, two legs, or one leg and one arm) while sitting, standing, or lying down. It does not involve performing the activities while the whole body is in motion.	Gross Body Coordination — The ability to coordinate the movement of your arms, legs, and torso together when the whole body is in motion.
Rate Control — The ability to time your movements or the movement of a piece of equipment in anticipation of changes in the speed and/or direction of a moving object or scene.	Gross Body Equilibrium — The ability to keep or regain your body balance or stay upright when in an unstable position.

Psychomotor Abilities	Physical Abilities
Reaction Time — The ability to quickly respond (with the hand, finger, or foot) to a signal (sound, light, picture) when it appears.	Stamina — The ability to exert yourself physically over long periods of time without getting winded or out of breath.
Response Orientation — The ability to choose quickly between two or more movements in response to two or more different signals (lights, sounds, pictures). It includes the speed with which the correct response is started with the hand, foot, or other body part.	Static Strength — The ability to exert maximum muscle force to lift, push, pull, or carry objects.
Speed of Limb Movement — The ability to quickly move the arms and legs.	Trunk Strength — The ability to use your abdominal and lower back muscles to support part of the body repeatedly or continuously over time without 'giving out' or fatiguing.
Wrist-Finger Speed — The ability to make fast, simple, repeated movements of the fingers, hands, and wrists.	

Although psychomotor abilities are different from physical abilities, police psychomotor skills do involve physical abilities (i.e. arm strength to hold a firearm steady during the shooting process, gross body equilibrium during unarmed grappling, etc.) While the loss of physical abilities is not the focus of this literature review, a large body of motor skill research has been undertaken to identify evidence-based best practices for acquiring, re-acquiring and maintaining physical abilities (see Schmidt & Lee, 2011).

2.3.1.3 Psychomotor Skill Learning Theories

During the SME review of the preliminary literature results, concerns were expressed by some on the limited review of motor learning theories. The theories are introduced below and potential lessons for skill acquisition and retention are noted.

There have been numerous theories on motor learning that have been developed over time. In the literature some of the most cited theories include the Adams Closed Loop Theory, the motor schema theory, the Gentile's model, and Fitts' Law. Adams (1971) noted that the availability of information about performance (feedback) was essential for the learning response. This information about performance could either be extrinsic (knowledge of the result), intrinsic (proprioceptive, visual, or auditory), or central (monitoring the efferent outflow from an order response (Olaogun, 1986). The concept of knowledge of the results to enhance performance led to the development of the Adams' closed-loop theory where an action is taken that produces some feedback and this feedback is used for learning the action. Adams' theory suggests that knowledge of results (KR) is very important for learning at the early verbal and cognitive phases but KR play no significant role at the advanced stage when movement become almost automatic (Olaogun, 1986). After criticism of this theory, the theory changed based on physiological data (Olaogun, 1986). In 1977, Adams determined that the positioning and the timing of a limb

movement were accounted for by slowly adapting joint receptors. The position of the limb was determined by which joint receptors were firing and the rate of the firing of these joint receptors determined the state and the dynamic nature of the limb. It was found that the relationship between the firing function at the level of the joint receptor and its cortical input were linear (Olaogun, 1986). The receptor firing function from the joint receptors, along with their timing are stored in what is known as the perceptual trace (i.e. reference input) (Olaogun, 1986). Adams' theory suggests that KR for timing and KR for position should produce separate learnings (Olaogun, 1986). Adams also determined that long inter-response intervals with or without KR weakens subsequent performance as the process of forgetting sets in. Therefore, the strength of the perceptual trace is a direct function of practice and rehearsal (Olaogun, 1986). Adams' closed-loop theory explained performance control in slow response but does not accurately explain what happens in fast responses where KR is not always available (Olaogun, 1986).

Provide explicit knowledge of results to trainees.

As previously mentioned, sensory information, or response-produced feedback, is too slow to account for control in quick actions; therefore, schema theory was intended to account for discrete actions and not continuous actions (Schmidt, 2003). The schema theory suggests that a Generalized Motor Pattern (GMP) for all actions is stored centrally and this GMP can be scaled linearly in time and in amplitude to produce many variations of the same task (Schmidt, 2003). The learner would need to acquire the GMP and would need to learn the schemata that allowed the action to be scaled to the environment (Schmidt, 2003). A schema was defined as a rule developed by practice and experience across a lifetime that describe a relationship between outcomes on past attempts at running a specific GMP and the parameters chosen on those attempts (Schmidt, 2003). A recognition schema was the relationship between past sensory feedback generated by running a GMP and the outcomes (Schmidt, 2003). The process of motor learning was conceptualized as the development of these schemas with practice and experience (Schmidt, 2003). There has been some debate on whether certain actions can be pre-programmed and stored or whether actions are the results of a dynamically changing motor system (dynamical theorist perspective). Evidence that supports the schema theory includes a study by Wadman, Denier van der Gon, Geuze, & Mol in 1979 where participants made rapid elbow extensions with a free limb and a blocked limb. Even when the limb was blocked EMG muscle activity from the agonist and antagonist muscles produced similar patterns. From a dynamical theorist perspective, blocking the limb changes the dynamics and would alter the movement EMG but the EMG activity appeared in time and amplitude just as if the limb was not blocked (Schmidt, 2003). The previous study supports the notion of a pre-programmed GMP that controls quick actions. A study by Dounskaia, Swinnen, Walter, Spaepen, and Verschueren (1998) found that a single GMP does control the whole action and that there are separate GMPs for actions that involve the wrist and the elbow. A study by Wulf and Lee (1993) showed that a powerful variable to determine learning of a GMP was randomize, and not blocked, practice. Also, the reduction in the relative frequency of feedback facilitated GMP learning (Schmidt, 2003). The original schema theory predicted that withholding KR on a given trial resulted in no schema update as the movement outcome and the parameter used for the trial must be paired together to update the schema (Schmidt, 2003). Therefore, the notion of GMP learning from reduced feedback seemed contradictory to the schema theory. However, further research learned that

reduction in KR frequency acted on degrading the parameterization of the task and not the act of learning the task itself (Schmidt, 2003). Schema theory also incorporates learning if the action is incorrect. Incorrect actions increase variability in experiences that leads to increased movement generalization to new environmental conditions (Schmidt, 2003).

> Learning a *generalized motor pattern is more effective when using a random practice approach vice a blocked practice approach.*
>
> *Provide explicit knowledge of results to trainees early in training but decrease as skills become automatic.*

The addition of environmental factors into the learning process has been hypothesized to have an effect on both the performance outcomes and the movements used during skill acquisition. Gentile (1972 and 2000) proposed that the environmental context is a combination of the regulatory conditions (stationary vs. in-motion) and the absence or presence of inter-trial variability. If the environmental context changes as the skill is being performed, and this change influences the movements used to perform the skill than the regulatory condition is considered 'in-motion' and the skill is open (i.e. shooting at a moving target) (Gentile, 2000). When the environmental context is stable and does not change when the movement is being performed then the movement is classified as 'stationary' and the skill is closed (i.e. shooting at a stable target on a wall) (Gentile, 2000). If the regulatory conditions remain the same after each trial and no other skill characteristics are changed then there is no inter-trial variability. Gentile, Higgins, Miller, and Rosen (1975) developed a skill taxonomy representing how motor skills could be categorized into one of four categories based on the regulatory conditions under which the skill was performed and the absence or presence of inter-trial variability. As skills move from stationary to in-motion regulatory conditions and from absence of inter-trial variability to presence of inter-trial variability skills become more complex and more difficult to perform. In terms of motor learning, complexity is defined as the number of component parts of a skill, and not the difficulty of the skill (Magill, 2000). The absence or presence of inter-trial variability affects; the demands placed on the attentional processes, how the movements are organized, and how the skill is represented in memory (Gentile, 2000). No inter-trial variability minimizes the amount of information processing needed to prepare for the movement and observation of the environment may provide enough information for the learner to become successful. Once this movement is learned, the performer refines the movement until a successful movement pattern is performed consistently, which has been referred to as 'fixation' (Gentile, 1972). Once the movement pattern is learned, limited effort is given to change the movement organization but instead the performer refines the movement until a successful movement pattern is performed consistently (Gentile, 1972). When inter-trial variability is introduced demands on the attentional processes are increased, the movements must be organized to adapt to an unpredictable environmental context and the memory must be flexible enough to adapt to a changing environment (Gentile, 1972). In these situations the learner continuously monitors the environment to detect the regulatory conditions affecting skill performance which allows the learner to perform the skill in a variety of situations (Gentile, 1972). The learner must then adapt their own movements to match the changing environmental context. The adaptability of this movement pattern has been referred to as 'diversification' (Gentile, 1972).

Introduce an environmental context into training.

Introduce inter-trial variability to challenge the trainee's attention processes.

One concept of motor learning that may be of interest to police training is the degrees of freedom problem. During initial learning their might be difficulty in simultaneously controlling multiple, independently moving body parts (Schmidt & Lee, 1999). Initial learners are typically more spastic and rigid, and fix the number of joints or limbs involved in initially performing a skill which reduces the degrees of freedom. As later stages of learning are approached 'unfreezing' of the joints typically occur proximally to distally (Schmidt & Lee, 1999). During the progression of skill learning, the degrees of freedom are released gradually, giving more control to the learner as their skill level increases (Schmidt & Lee, 1999). However, the proximal to distal rule does not always apply. A study by Broderick and Newell (1999) found that sharpshooters lock their wrist to assure control while increasing the variability at the shoulder.

Given that new learners may preferentially reduce their degrees of freedom when learning a new motor skill, develop training schemes that support this concept (e.g. part task training that isolates limb movement during firearms skill acquisition).

One of the most cited theories of motor learning is the Fitts & Posner's (1967) three-stage model. They describe the model as having three phases (cognitive, associative, and autonomous) where the learner continuously transfers from one phase to the next without a clear transition between them. The cognitive phase is the initial phase where the learner begins to understand how the task is performed. The learner must focus attention on all the relevant tasks associated with the skill. During this phase a large amount of errors are performed and the errors tend to be more gross errors than fine motor errors, similar to the degrees of freedom problem where learners are more rigid and spastic. During this phase, learners also perform the task with much variability and knowledge of the results is important so that the learners can understand what they are doing incorrectly and so that they can improve on their performance. As many of the basic fundamentals or mechanics of the skill is learned the learners progress to the associative phase. This phase is marked by less variable results and fewer and less gross errors. The knowledge of results is less important during this stage as the learners have developed the ability to detect their own errors and attempt to refine their skill. After much experience the learner moves into the final phase which is labeled the autonomous phase. In this phase the skill becomes automatic and habitual and the learner does not have to attribute much attention to performing the skill. Instead, learners are able to transfer that attention to optimize the skill in a variety on instances.

Assess trainees to determine if they have reached the autonomous stage. Explore the training approach that utilize skill "expertise" as a go/no go graduation measure versus passing a single performance test, e.g. tailored assessment.

The three stage model of motor skill learning has been supported by evidence in a variety of animal and human studies - (for review see Doyon and Ungerleider 2002; Karni et al. 1998; Korman et al. 2003). The studies showed that different cortical and subcortical brain regions are preferentially involved at different phases of learning.

Evidence suggests that the three-stage model may adequately reflect the stages of learning.

Experts have more comprehensive and better organized domain knowledge than novices (Lesgold, Rubinson, Feltovich, Glaser, Klopfer & Wang, 1988; Sternberg, 1996; Wiley, 1998). This is almost a tautology but it indicates two important processes of expertise acquisition, namely a) the identification of crucial concepts, cues, and procedures in the domain, and b) the organization of knowledge to facilitate rapid and accurate access to those concepts, cues, and procedures. Thus, as a person develops expertise, memory becomes specialized to recognize and retrieve appropriate responses to problems in that domain.

Maximize the use of training scenarios during initial training. Utilize cognitive and behavioural task analysis to explicitly identify the important concepts, cues and proper procedures to use in each scenario

In addition to proceduralization, a process of schematization also occurs as one develops expertise. The expert creates mental frameworks that describe the kinds of problems encountered in the domain, the kinds of cues that indicate problems, and the kinds of solutions that can be applied. Anderson (1995) distinguishes between tactical and strategic learning. Tactical learning deals with the acquisition of skills and procedures, following the three stages of Anderson's model. Strategic learning refers to learning how to organize one's problem solving. Creating mental schemata to organize domain knowledge allows one to determine the best means to solve problems and quickly judge the applicability of solutions.

Examine the efficacy of schema-based learning techniques for elements of use of force skill training.

Anderson's theory implies that training should focus more on procedures than information. Because expertise involves acquiring sets of specific procedures, training can be enhanced by analyzing what those procedures are. Thus, a prerequisite to training is a thorough task analysis. The results of this analysis will be specific tasks and procedures that can be explicitly taught to novices. Such training will be especially effective if tasks are broken into components, each of which can be mastered more easily than the whole task in its entirety.

Utilize part task training so that task components are mastered individually, e.g. perceptual components, decision making components, and action components.

2.3.1.4 Skills and Skill Acquisition Literature Review Summary

This section focused on skill and skill acquisition with specific emphasis on psychomotor skills. Our review of this literature and our workshop discussion with experts within the area of motor learning showed that there are a number of models relevant to skill acquisition, as well as a range of elements that impact on skill acquisition.

Psychomotor skill learning theories and related research show a number of principles relevant to training skills and skill acquisition, as follows:

Provide explicit knowledge of results to trainees early in training but decrease as skills become automatic.

Learning a generalized motor pattern can benefit from using a random practice approach vice a blocked practice approach.

Introduce an environmental context into training.

Introduce inter-trial variability to challenge the trainee's attentional processes.

Given that new learners may preferentially reduce their degrees of freedom when learning a new motor skill, develop training schemes that support this concept are promising (e.g. part task training that isolates limb movement during firearms skill acquisition).

Assess trainees to determine if they have reached the autonomous stage. Explore the training approach that utilize skill "expertise" as a go/no go graduation measure versus passing a single performance test, e.g. tailored assessment.

Evidence suggests that the three-stage model may adequately reflect the stages of learning.

Maximize the use of training scenarios during initial training. Utilize cognitive and behavioural task analysis to explicitly identify the important concepts, cues and proper procedures to use in each scenario.

Examine the efficacy of schema-based learning techniques for elements of use of force skill training.

Utilize part task training so that task components are mastered individually, e.g. perceptual components, decision making components, and action components.

Although existing research and literature provides some evidence of best practices in training psychomotor skills, when thinking about the application of use of force skills, it seems critical to understand not just the psychomotor aspects that influence skilled performance, but the larger context within which skills are expressed. The following sections of this report explore this issue in more detail.

2.3.2 Skill Retention

2.3.2.1 Overview of Skill Retention

Before examining skill fading or perishability, we must clarify the concepts of skill retention and loss or perishability. In one sense, skill retention can be defined as the maintenance or sustainment of learned behaviours without practice (Schendel & Hagman, 1991; cited in Rowatt & Shlechter, 1993) or as "the degree of competence to which an acquired skill [or knowledge] is retained through the passage of time" (Ginzburg & Dar-El, 2000, p. 327).

Researchers typically refer to skill retention when referring to situations when learned skills are applied in the work setting anticipated during training. Skill transfer is taken to refer to situations where skills are applied to tasks and situations not explicitly anticipated during training. Please refer to Section 5 for an in-depth examination of skill transfer issues.

2.3.2.2 Skill Perishability

As detailed in Hurlock and Montague (1982), Hagman and Rose (1983), Adams (1987), Farr (1987), Goldberg and O'Rourke (1989), Elliot and Wisher (1993), Arthur, Bennett, Stanush and M^{C}Neilly (1998), Bryant and Angel (2000), Kratzig (2011) and Leonard (2007), researchers have spent considerable time identifying the relevant factors that affect skill retention. Literature reviews of skill perishability or retention have been undertaken in nearly every decade for the past 50 years. Much of the researcher has focused on examining the qualitative effects of the skill retention factors (Bryant and Angel), i.e. whether the factor promoted skill retention or skill perishability. Research that empirically quantified the effect of these factors on skill perishability is sparse.

Skill retention factors have been divided into a number of basic categories (see Bryant and Angel, 2000).

- Retention interval factors, which pertain to the events and manipulations occurring between training and performance; e.g. length, opportunity to practice
- Personal characteristics (learner factors), which pertain to the individual differences and factors that affect learning (skill acquisition) and retention; e.g. aptitude, experience, motivation
- Training factors, which pertain the training manipulations employed during initial learning; e.g. practice, performance criterion, training schedule
- Task factors, which pertain to the nature of the task or skill to be acquired; e.g. task complexity
- Job factors, which pertain to the physical and psychological conditions present during skill retrieval; e.g. presence of aids, environmental and psychological stressors

The job environment for police officers in an operational setting includes a critical element which has a significant impact on performance – the factor of stress. Recent studies have documented the impact of stress on performance.[1]

Skill perishability research has traditionally focused on the isolated manipulation of individual factors in a controlled setting. Studies to quantify the relative strength of more than one skill perishability factor are sparse. As well, the bulk of the skill perishability research has examined skill loss over a relatively short time frame (less than two months on average) and used artificial tasks (memorization of simple tracking movements, memorization of foreign words, etc.). Thus in the policing context the relative importance of the skill perishability factors for predicting real world skill loss is limited.

Skill perishability research has identified many different interactions amongst skill perishability factors (e.g. skill loss covaries with retention period and degree of initial learning).

> *The majority of the evidence quantifying skill retention utilizes short retention periods and the clinical isolation of retention factors which may not be applicable to the policing skills domain.*

[1] The Federal Law Enforcement Training Centre (FLETC) Survival Scores Research Study (2004)

The literature review identified a number of interactions amongst the skill perishability factors (retention interval, personal, task and job) and caution is advised when assessing the impact of individual factors in isolation.

Retention Interval

A number of retention interval factors have been investigated in skill perishability research, these include:

- Time
- Opportunity to practice
- Inter-study intervals
- Refresher training

These skill perishability factors will be briefly introduced below.

Length of the Retention Interval

In general, there is a tendency for skills to perish over time (Ginzburg & Dar-El, 2000) with the most rapid loss of ability occurring relatively quickly after learning, followed by a more moderate loss of skill after that, as can be seen in Figure 2 (Adams, Webb, Angel, & Bryant, 2003).

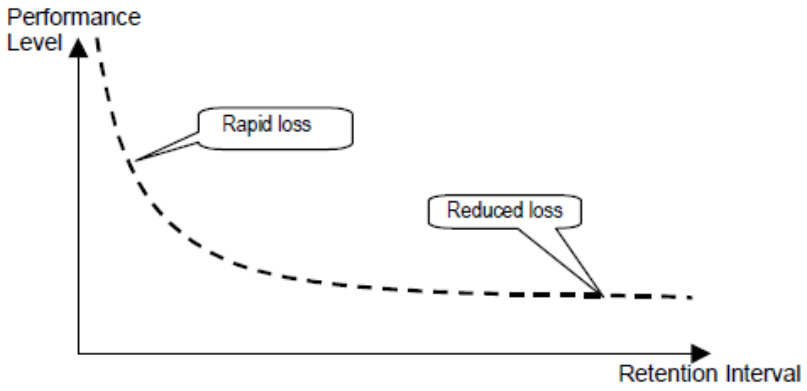

Figure 2: Relationship between retention performance and retention interval (Adams et al., 2003)

The level of skill retained over time is a function of a variety of factors, including the duration between task performances (e.g., Lance et al., 1998). The interval between learning or last performance and a subsequent performance is called the non-utilization period, *retention interval* or Skill Retention Interval (SRI).

One study with empirical skill retention data was identified in the medical training domain. McKenna et al (1985) empirically examined the effect of retention interval on CPR skills. A sample of 124 subjects was trained to criterion level and then participants were re-assessed at 3, 6, 12, 24 and 36 month intervals. The results tabled below (Table 5), indicate a dramatic degree of skill loss after initial learning.

Table 5: Percentage of Subjects Scoring 75% or Greater on CPR Skills (from McKenna et al (1985)

	Percentage of subjects scoring 75% or greater on test				
Measure	3 months	6 months	12 months	24 months	36 months
Technique	70%	40%	35%	30%	10%
Performance	55%	28%	29%	18%	2%
Total Score	40%	18%	12%	5%	1%
Diagnosis	30%	18%	10%	4%	1%

The use of sub-scores for recognition (diagnosis), technique and performance may have utility when assessing psychomotor skill loss in the policing domain.

The study supports the contention that psychomotor skills rapidly degrade within six months.

Retention interval is likely to co-vary with other skill perishability factors that do have a causal relationship with skill loss (Bryant and Angel, 2000). As well, the rate of skill loss varies between psycho-motor skills (technique) and cognitive skills (diagnosis). Retention intervals are however easy to measure and thus have become a convenient variable to consider in predicting skill retention.

There is a direct relationship between the SRI and the amount of skill loss (when the interval is spent without practice). In general, the longer an officer does not perform or practice a skill the more they will lose their ability to perform the skill to criterion level.

Retention intervals co-vary with other skill perishability factors.

Retention intervals are easy to measure and are predictive of skill perishability. CPSC should utilize retention intervals as a major factor for predicting police officer skill perishability.

Opportunity to Practice

Although skills fade over time, the right kind of retraining or practice can return skill performance to original levels (Ginzberg & Dar-El, 2000). Refresher training is the most common method for ensuring that skills are not lost. Importantly, the length of time needed for refresher training is half that of the original training session or less (Rowatt & Shlecher, 1993). However, the longer the period between the initial training and the retraining, the longer it will take to relearn the skills. For instance, military personnel operating complex electronic systems had their skills fully

restored if they had retraining after 2 months, but not after 3 months (Ginzburg & Dar-El, 2000). After 3 months, the personnel required more training to restore their skills.

> *Providing periodic refresher training or practice will allow police officers to retain perishable skills.*

Ford, Quinones, Sego and Sorra (1992) identified several factors that affect a worker's opportunity to perform or practice trained tasks on the job:

- Organizational goals and values
- Work context, supervisory attitudes, support network, pace of work
- Individual ability, motivation and self-efficacy

Organizations and supervisors may promote skill practice by encouraging trainees to utilize taught skills while on the job or during post-training practice sessions. Structured on the job training (OJT) programs utilize task and skill checklists to indicate if trainees have successfully performed a task or demonstrated a skill on the job. This approach has been utilized to review the trainee's progress and the development and or maintenance of a skill. Self-efficacy or an individual's expectation or confidence that tasks can be successfully performed affected how often individuals attempted to utilize skills -Ford et al. (1992).

> *Organizational, supervisory and individual factors impact how often police officers apply learned or practice use of force skills.*

Based on a series of telephone interviews there may be some reluctance among officers to practice use of force skills outside of mandatory training or on their own time. Officers expressed concerns about getting injured while taking part in off-duty practice sessions and not being able to obtain proper insurance coverage.

> *Efforts should be made to identify officer concerns with workman compensation issues surrounding off-duty training. Organizations need to see if they need to revise off-duty training policies or communication strategies.*

Refresher training

Refresher or sustainment training has been found to promote long-term retention (no specific length mentioned) by reinstating the student's level of task proficiency to the levels obtained during the period of original learning (Wells & Hagman, 1989; Ammons, Farr, Bloch, Neumann, Dey, Marion, & Ammons, 1958)

Studies have shown that the length of time required for refresher training is less than 50% of the time required for the initial training (Mengelkoch, Adams & Gainer, 1971) Rowatt & Shlechter, 1993). However, long intervals between initial training and retraining mean that relearning will require more time. Oermann, Kardong-Edgren & Odom-Maryon (2011) assessed the impact of providing CPR refresher training on 600 student nurses. Providing just 6 minutes of refresher training a month allowed the student nurses to maintain their CPR skills at criterion levels. O'Hara (1990) found that just 30 minutes of refresher training (after six months of disuse) mitigated the decline in merchant marine cadet watch keeping performance. In Farr (1986) for motor skills, the time saved in relearning to the original mastery criterion is generally more than 50%.

Mengelkoch et al (1971) report that the length of refresher training varies according to:

- The amount of time between initial and refresher training
- The frequency of prior refresher training sessions
- Trainee ability level
- The nature of the task to be retrained (procedural tasks take longer to retrain than continuous tasks)

The amount of periodic refresher training or practice is significantly less than that required in initial acquisition.

Several other methods are available to boost retention between training periods. Wooley (2011) notes that simply reviewing course materials, practicing on a manikin, conducting drills, viewing short videos of the skills, and posting skill procedure guidelines can skill boost retention. Wooley notes that posters are only effective if they are changed periodically to boost attention.

Once optimal retention intervals for particular use of force skills are determined, more effective schedules of refresher training can be implemented.

Other approaches are available to support skill retention.

Personal Characteristics

A number of personal characteristic factors have been investigated in skill perishability research, these include:

- Individual aptitude
- Motivation
- Previous experience
- Expertise
- Age and Gender

These factors are introduced in greater detail below.

Individual Aptitude

Although many personal characteristics could potentially affect skill retention, researchers have focused on a few fundamental ones, of which the most notable is general ability or aptitude. A common hypothesis has been that learners of lower ability forget skills more rapidly than higher ability learners (Lance et al., 1998). Indeed, a number of studies have found that, when training time is fixed, higher ability personnel learn more than lower ability personnel and that this translates into better retention (see Hurlock & Montague, 1982). High ability trainees reach greater proficiency levels sooner, significantly affecting their retention rates by overlearning and/or their better understanding of the material. They will also relearn more quickly. Other studies, however, have yielded more mixed results as aptitude moderated retention for some but not other tasks (Lance et al., 1998). Trained individuals exhibit equivalent rates of forgetting, regardless of difference in their levels of ability.

Police forces should preferentially recruit higher aptitude recruit candidates.

Even when ability is found to affect skill retention, however, it is often unclear whether that factor is truly causal. Hurlock and Montague (1982) report that when high and low ability groups are trained to the same level of proficiency on a task (which will take different amounts of training), no differences in retention were observed. A great deal of research indicates that individuals of different ability levels do not differ in their rates of skill loss (see Schendel & Hagman, 1991).

All individuals will lose skills.

Another issue concerns the precise nature of ability, which can be defined in a number of ways. One view is that ability corresponds to general cognitive ability (referred to as g) (Spearman, 1927). Ree, Carretta, and Teachout (1995) reviewed a number of studies that documented the effectiveness of "g "as a predictor of job performance and suggested that g could predict on-the-job performance of US Air Force pilots after their 53-week training course. They collected pilots' scores on the verbal and quantitative subtests of the Air Force Officer Qualifying Test (AFOQT) to serve as measures of g. Job performance was assessed by flying work samples and academic grades. Composing a measurement model, Ree et al. (1995) determined that g had only an indirect effect on job performance; g positively affected prior job knowledge and job knowledge acquired through training, which in turn affected job performance.

Recruit selection scores should be analyzed preferentially recruit higher aptitude recruit candidates.

Another approach to defining ability is to assess multiple specific abilities to determine how each affects performance. In one study, Earles and Ree (1992) examined the validity of the 10 aptitude tests of the Armed Services Vocational Aptitude Battery (ASVAB) as predictors of training performance. They found variability in the effectiveness of the various subtests, with Arithmetic Reasoning and Mathematics Knowledge being the best individual predictors. Composite scales created by combining sets of subtests could be even more effective predictors of performance. Similar multi-scale aptitude tests have been developed for other domains, such as air traffic control, and have sometimes been found to have limited predictiveness of training performance (Ackerman & Kanfer, 1996).

Investigate correlation between police recruiting aptitude tests and skills perishability.

Mental aptitude appears to be a weak predictor of skills perishability.

Motivation

Motivation is another commonly investigated individual factor that seems to have an effect on training performance, although its effect on retention has been less well established (Hurlock & Montague, 1982). Motivation may increase learning during training, which leads to better performance over time. Lack of motivation after training, however, does not seem to increase the rate of skill loss. Related personality factors, including self-efficacy and mastery beliefs may, however, affect the expression of learned skills over time (Zazanis & Lappin, 1998). Self-efficacy is the internal sense of competence pertaining to a given skill. Low self-efficacy has been found to impair performance. Consequently, factors that reduce a person's sense of competence over the span of a retention interval may depress performance further. In addition, emotional states such as self-belief, self-doubting, trainer belief and doubting in the trainee have been linked with

performance and could also affect retention. Trainees should be selected for their motivation for the role they will be carrying out and the trainers should not communicate any belief that the trainee is not capable of acquiring the skill. Motivation may play a role in how much practice people engage in, and thereby how well skills are retained. However, Summers et al. (cited in Leonard & Martin 2007) report that motivation does "not substantively affect skill retention rates". Wetzel, Konoske, Montague (1983) found that in many instances, students find it difficult to practice procedures learned previously, even when they are highly motivated to do so, because of the lack of specific equipment, classified information, or other specific requirements.

> *Recruit selection scores should be analyzed preferentially recruit motivated candidates.*
>
> *Emotional states such as self-belief, self-doubting, trainer belief and doubting in the trainee have been linked with performance and could also affect retention. Trainers should not communicate any belief that the trainee is not capable.*
>
> *Organizations should provide all police officers the opportunity to practice and refresh their use of force skills.*

Based on a series of telephone interviews, general duty constables may lack the motivation to practice or refresh their skills (i.e. firearms training) on their own time for a variety of reasons. The lack of motivation may stem from the fact officers in special units (i.e. tactical response units, or SERT) are provided this refresher training more often and at no additional cost to them while general duty constable may have to do this at their own time and expense. In some police agencies if an officer wants to practice pistol shooting they have to purchase their own ammunition if they fire more rounds than what is required during their requalification.

> *Efforts should be made to identify officer concerns with refresher training to see if organizations need to revise policies.*

Previous Experience

There are two schools of thought regarding previous experience effects on skill retention. The positive school of thought believes that prior knowledge or experience provides a mental model upon which new knowledge can be built. Existing skills or knowledge may already be automatic allowing the trainee to concentrate on learning the aspects of the task which are new. The negative school of thought believes that prior knowledge held by the subjects may be in conflict with the new tasks being learnt and therefore has to be unlearnt while the new knowledge was being learnt.

Goodwin (2006) reported that having more background information about a topic (i.e., the skill being learned) helps one to develop a more organized and coherent structure, which allows the information to be better retained over time.

> *Evaluate the differences in use of force skill retention of experienced hires and new recruits.*

Expertise

Expertise has been argued to increase the retention of newly formed skills (Andrews & Fitzgerald, 2010). Expertise has been argued (Hoffman, 1996; cited in Andrews and Fitzgerald, 2010) to have 3 key dimensions. First, the development of expertise is the result of deliberate and persistent practice in relevant and diverse tasks, rather than being the result of simple maturation. This means that only people who are sufficiently practiced can hope to have expertise. Within the available literature (e.g., Hoffman et al., 2009), some researchers estimate that true expertise takes about 10 years to develop. Second, expertise is commonly understood as requiring a distinct set of knowledge structures. These structures are highly abstract and reflect deep understanding of complex relationships among the various elements. These elements are organized in ways that are meaningful to the expert. Lastly, because of these rich knowledge structures, experts are also able to anticipate potential problems more effectively and to solve problems that emerge more adeptly as well. Their rich knowledge allows them to attend more efficiently to critical information and to filter out extraneous information better than novices, and they are able to perform well under levels of high stress and workload (Hoffman et al., 2009).

Identify research to see if there are ways to quickly develop knowledge structures amongst trainees

Age

Only limited research that dealt with age and skill retention was identified in the literature review. Most of the skill retention studies were cross-sectional studies. Rodrigue, Kennedy and Raz (2005 pg. 1) determined that "long-term retention of acquired skills declines with age, older adults still retain the ability to learn the skill. Moreover, those who maintained a processing speed comparable with that of the younger participants evidenced no age-related performance decrements on the… task".

Given the working ages of police officers, it is believed that age is not a relevant skill perishability factor for police.

Initial Training Factors

How well a skill is learned during training has been found to be an excellent predictor of retention performance (Rowatt & Shlechter, 1993). Rowatt and Shlechter (1993, p. 2) state that the initial level of learning is "the single best determinant of skill retention with the relationship between original learning and retention remaining highly positive and stable for an indefinite period of time." A number of psychomotor training principles that impact skill acquisition and thus retention have been developed from theories of sports coaching and motor skill learning. The principles relate to the amount of practice, overlearning, scheduling of practice, feedback to the trainee, use of simulation, feedback, and hard first.

Practice Effects

Motor skill learning is the process by which motor skills become effortlessly performed through practice. Two levels of learning most often studied are proficiency training (i.e., training until the task can be completed without error at least once) and mastery training or overlearning (i.e. training some number of additional trials beyond proficiency, (Wisher, Sabol, Ellis, & Ellis, 1999). In some research reports, where level of original learning varies on a continuous scale (i.e., it is

simply measured after training), the degree of original learning predicts a high level of variability in performance at recall (Goodwin, 2006). Schendel, Shields & Katz (1978) reported motor tasks show persistent effects of learning for at least two years.

A host of researchers: Adams (1964), Annett (1969), Fitts (1964), Fleishman& Parker (1962), Hurlock & Montague (1982), Magill (2001), Schmidt & Lee (1999) determined that the most important factor in skill retention was the level of proficiency achieved during initial learning. Ericsson and Tesch-Romer (1993) proposed that the highest levels of mastery only occur after thousands of hours and years of practice. Fortunately once a skill is well learned, it can be retained for months and even years (Hikosaka et al. 2002; Shadmehr and Brashers-Krug 1997). Evidence also indicates that intellectual and perceptual-motor skills are acquired in fundamentally similar ways (Rosenbaum, Carlson & Gilmore, 2001). Practicing observation and decision making skills improves performance.

The progress of perceptual-motor skills and intellectual skill acquisition is similar (Rosenbaum, Carlson & Gilmore, 2001). The time to complete a task diminishes with practice at a lower and lower rate as practice continues (see Figure 3) has been demonstrated in many studies –see Crossman (1959) for his classic cigar rolling study. Whether this curve represents a power function or other is still subject to debate - see (Heathcote et al 2000). As noted by (Rosenbaum, Carlson & Gilmore, 2001, p. 453) “the feature of practice-related speeding of performance that is of greatest importance for present purposes is that the way performance speeds with practice is the same in perceptual-motor domains and in intellectual domains”. Research has confirmed that practicing until mastery improved individual exam scores, group success rates, and in some cases long-term retention.

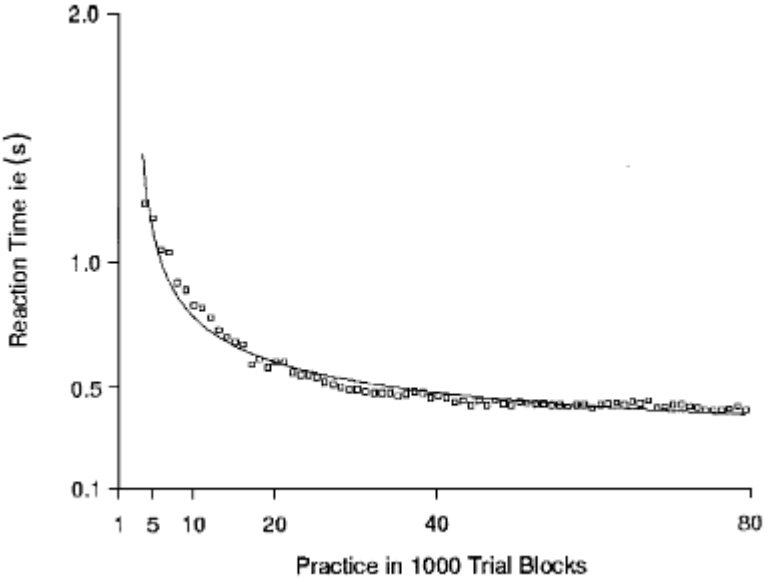

Figure 3: Learning curve from Ritter & Schooler (2002)

Psychomotor skills are improved with practice.

Perception and decision making skills can be improved with practice.

Research has shown that practice improves cognitive and psychomotor skill retention.

Impact of Overlearning

The term overlearning has been referred to as the" deliberate overtraining of a task past a set criterion" (Driskell, Copper, & Willis, 1992 pg 615; Kratzig, 2011). The impact of overlearning on long term skill retention has been examined by a large number of researchers over the years – see Driskell, Willis & Cooper (1992); Rohrer, Taylor, Pashler, Wixted, & Cepeda (2005) and Kratzig (2011) for illustrative reviews. Overlearning also refers to a strategy and not the ultimate degree of mastery (Rohrer & Taylor, 2006). The amount of overlearning can be determined by the amount of trials completed after the set criterion has been met or the duration of time after the set criterion has met (Rohrer, Taylor, Pashler, Wixted, & Cepeda, 2005; Kratzig, 2011). In a typical overlearning academic study, a task criterion may be set at one errorless trial where subjects in the control condition practice until the task performance reaches that criterion while the overlearning group will continue to practice past that level (Driskell et al., 1992; Kratzig, 2011). Kreuger (1930) had subjects perform a maze tracing to 100% learning, 50% overlearning, 100% overlearning, or 200% overlearning. Results of this study showed that the greater amount of overlearning resulted in the greater amount of retention. Similarly, a study by Schendel and Hagman (1982) found that 100% overlearning of assembly and disassembly of a M60 machine gun resulted in 65% fewer errors than a control group when retested after 8 weeks (Kratzig, 2011). This previous study suggests that overlearning for tasks that have dire consequences is appropriate as the likelihood of committing an error is reduced (Rohrer,et al., 2005). Within the policing context, trainees learn to draw their firearm from their holster hundreds of time during the course of their stay at the academy. Trainers invoke the need to build "muscle memory" within their recruits. Overlearning in the policing context appears to be significantly different than that utilized in academic studies. Overlearning has been compared to mastery and the definitions of mastery appear to be far less demanding than that of expertise. Expertise as noted by Ericsson, Krampe and Tesch-Romer (1993 pg 366) – "is acquired slowly over a very long time as a result of practice and that the highest levels of performance and achievement appear to require at least around 10 years of intense prior preparation".

Research is required to identify proficiency and mastery levels (criterion) of the various use of force skills.

In general, as the time between acquisition and retrieval increases there is a greater likelihood of forgetting. The strongest effect of overlearning was obtained with the shortest interval period (Driskell, Copper, & Willis, 1992; Kratzig, 2011). After approximately 38 days, the enhanced retention due to overlearning had dissipated to zero (Driskell, et al.; Kratzig, 2011). A similar result was obtained by Rohrer et al. (2005) where over learners where able to boost their chances of recalling a set of words after one week when compared to normal learners, but no such benefit remained after an interval of 4-weeks. Over learners also forgot what they had learned at a greater proportional rate than normal learners.

Overlearning improves short term skill retention

Most of the literature suggests that overlearning results in greater retention (Driskell et al. 1992; Kratzig, 2011). In a meta-analysis of studies on overlearning, Driskell, et al) found that 50% overlearning produced a small overall effect on retention, 100% overlearning produced a moderate effect and 150% overlearning produced a large overall effect. Therefore, for practical applications, a minimum of manipulation of 50% overlearning should be required (Driskell, et al. While 50% overlearning may be achievable in academic studies, increasing police recruit use of force training by 50% may not be practical. While overlearning has been shown to improve retention, most studies measured skill retention on relatively short re-testing intervals (Adams, 1957; Day et al. 2001; Krueger, 1930; Mackay et al. 2002). Given the current 6, 12 or 24 month recertification programs used by some police forces, it is uncertain whether overtraining can mitigate skill loss if these skills are not practiced in the interim.

> *Further investigation into the efficacy of overlearning with longer retention intervals is required.*

The over learning meta-analysis conducted by Driskell et al. 1992; Kratzig, 2011) found differences on the effect of overlearning on retention depending on the type of task performed. For physical tasks, as the time interval between the overlearning practice sessions and subsequent performance increased, retention was enhanced. However, for cognitive tasks, the longer retention intervals weakened the effects of overlearning. The authors attributed this difference to participants of the physical tasks were able to practice their skill (i.e. cheat in the academic experiment context) between sessions which resulted in enhanced performance. Conversely, research has also shown that physical skills decay more rapidly than cognitive skills (Arthur et al. 1998; Farr, 1987; and Driskell et al. 1992; Kratzig, 2011). The reported rate of skill loss between overlearned cognitive and physical skills varied in the literature reviewed. Within the police use of force context, it is uncertain whether after a period of disuse that physical skills degrade to unacceptable levels before cognitive skills. Skill retraining efforts should focus on those skills that are below criterion levels.

> *The impact of overlearning on the unique use of force skills should be investigated.*

One area in question is the difference between practice type and overlearning. Research has indicated the subsequent retention of information is often greater if practice is distributed rather than massed (Baddeley and Longman, 1978). At brief RIs, spaced practice is typically no better or even worse than massed practice (Bloom & Shuell, 1981). A study by Rohrer and Taylor (2006) found that distributed learners had higher scores after a 4-week RI than massed learners but found no difference at the 4-week RI when comparing the overlearning group to the control group. This study concluded that the long term retention (i.e. 4-weeks) of mathematics is aided by distributed practice and not by an overlearning strategy. Due to the moderate length of RI used in this study may explain the absence of any observed benefit of overlearning (Rohrer & Taylor, 2006). The study authors noted that the minimal effect of overlearning on retention can be interpreted as an instance of diminishing returns. That is, with each additional amount of practice of a task, there is an even smaller increase in test performance (Rohrer & Taylor, 2006).

An area of concern to police training is whether or not the initial ability of the trainees affects their ability to retain information after overlearning. Vineberg (1975) found that differences in the

ability level of the trainees affected the level of skill acquisition but had little effect on the rate of retention. Therefore, training everyone to certain level of proficiency and then providing overtraining may ensure all users acquire skill mastery and retain this information for an optimal period of time. One of the drawbacks of overlearning is the cost associated with providing the appropriate level of training. Schendel and Hagman (1982) found that after an 8-week RI, overtrained subjects required 22% fewer trials to retrain to the criterion level than did the controls. Therefore, the increased initial costs associated with overlearning may be partially offset by lowered costs for subsequent retraining or refresher training (Driskell, Copper, & Willis, 1992).

Overlearning may offset the costs of subsequent training.

Practice Scheduling

Practice scheduling refers to the approach to, timing and spacing of skill practice sessions. As summarized in Fadde (2011) key psychomotor practice design factors affecting skill retention include:

- Blocked or variable practice
- Concentrated or spaced
- Part or whole task
- Chaining steps or shaping
- Hard first

Fixed or Variable practice. Variable practice is based on the theory of contextual interference (Battig, 1966; Shea & Morgan, 1979) where learning benefits when the items to be learned are randomly intermixed across training sessions rather than repeated in concentrated sessions or blocks. One training website (Brainmac, 2011) suggests that open skills (skills that executed in constantly changing environments requiring trainee adaptation) are best practiced using a variable practice approach while closed skills (skills that are predictable and executed in stable, e.g. the trainee knows exactly what to do) should be practiced in a fixed schedule. While fixed or blocked practice sessions improves initial skill acquisition (Lee & Magill (1983), variable practice has been shown to improve long term skill retention (Lee & Simon, 2004), While variable practice has been shown to improve long term retention in the laboratory, Magill & Hall (1990), Barreiros, Figueirdo & Godhinho (2007) and Brady (2008) reported that contextual interference effect evidence (variable practice effect) was less evident for studies involving adults in complex tasks and when studies were conducted in applied settings.

Confirm the efficacy of variable practice on complex use of force skills.

Utilize blocked practice for faster initial learning; variable practice for better retention and transfer. As mastery improves move to random practice.

It should be noted that training academies do utilize fixed and variable practice schedules.

Inter-study Intervals

Studies by Cepeda et al. (2006) demonstrated that interspaced learning improved skill retention (i.e. teach a subject over a longer period of time broken by other skill training). Subjects were

brought back for abbreviated training and tests at a variety of inter study intervals to test for skill retention. Cepeda et al identified that for a 6 month retention interval, the optimum Inter-Study-Interval (ISI) was 28 days. Cepeda et al. recommended that trainers structure interstudy periods at a minimum spacing of 10% of the time of the RI.

> *Monthly spacing of abbreviated study (or testing) improves skill retention. Training academies should space use of force instruction over the entire curriculum.*

The blocked training approach (initial 13 week academy session, followed by field portion and then a final academy session) used in many police training academies may be viewed as a method of injecting periods between studies. When trainees return from the practical field portion they are retested on previous skills learnt and these skills are honed to a higher degree.

> *Blocked instructional programs that sandwich a practical field element between academic instruction blocks may promote more skill retention over continuous study programs.*

Schendel, Shields, & Katz (1978) indicated that the number of practice trials, not their distribution, is a key issue, especially when training time is limited. As well, when time is limited, training should be massed to optimize original learning.

It should be noted that training academies do utilize inter-study intervals.

Part or whole task

Part task training (PTT) focuses on dividing complex tasks into a series of components. These component tasks are then learned individually and once mastered the whole task is practiced. Research has shown that part task training can be as effective as whole task training providing that components of the task critical to the criterion are trained in the part task training program (Goettl & Shute (1996), Fadde (2011)). Part task instruction is beneficial when tasks are dangerous and complex.

Considerable research has been devoted to the development of part-task trainers. A wide variety of part task simulators have been developed –see Bennell (2005) for a detailed review. Part task simulators range from marksmanship simulators and driving simulators to decision making simulators, etc. The PRISim (2011) judgement training simulator is a video based interactive training system that forces police officers to respond with appropriate use of force techniques and tactics.

> *Utilize part task simulators and trainers where appropriate.*

Ideally, a use of force skill should be taught as a whole so the trainee can appreciate the complete movement and execution of a skill. Newer theories of sports coaching advocate using contextualized *decision practice* that moves away from part-task drills and toward whole-task practice (Fadde, 2011). Vickers (2007) reported that although whole-task practice leads to slower immediate learning it leads to better retention and transfer of learning to performance.

Part task and whole task practice are not suitable for all tasks. Simple skills benefit from whole task instruction, while more difficult tasks benefit from part task instruction. Use of force skills training typically is a mixed approach with whole and part task practice.

Utilize whole and part task training methods where appropriate.

Chaining Steps or Shaping

Forward chaining involves the mastery of individual component skills through blocked practice and sequenced approach, i.e. in firearms training recruits are taught how to rapidly draw their side arm prior to moving to the holding and aiming step. Each step proceeds in a relatively fixed order until the chain is completed and the last response is reinforced. Chaining is only suitable for complex actions with sequential elements. Backward chaining is he reverse and has been shown to be an effective way of teaching complex sequences of behavior. Feedback is reduced from the instructor as each step is mastered.

In the shaping approach a whole movement is learned first – i.e. draw aim and fire a side arm as a complete sequence. This process begins with a simple context but progresses to more challenging scenarios, i.e. tactical shooting versus target practice. Shaping is suitable for complex tasks with simultaneous elements.

Empirical research on the effects of chaining or shaping on skill perishability was not identified and thus its effects are assumed to be of lesser importance.

Utilize chaining and shaping methods where appropriate.

Hard versus easy first instruction

Hard-First Instruction requires the technical and tactical concepts of the skill to be taught early in training rather than later, as is often the case in traditional training (Vickers, 2003). Doane, Alderton, Sohn, and Pelligrino (1996) showed that participants who received "easy first" visual discrimination training (where they learn to discriminate "easy" visual information before complex information) performed at a lower level than those who experienced "hard-first" training from the outset. Doane et al as reported in Vickers (2003, p. 5) reported that easy first instruction led to *"a less precise comparison strategy which can be modified if completely new difficult discrimination stimuli are viewed; however this modification takes many sessions and is still inferior to that of participants who start with initial difficult training, even when they have less experience with the transfer stimuli. This is very important: We are showing that training in one environment can actually be a hindrance to transfer performance for an extended period."* During hard-first training, trainees are taught how to see complex skills and formations right from the start using video models, field demonstrations, live models, simulations, scenarios, etc. Hard-first instruction is more conceptual in nature than physical when lower skilled trainees are involved. Hard first instruction must be balanced with the need to student confidence and motivation.

Empirical research on the effects of hard-first or easy-first training on skill perishability was not identified and thus its effects are assumed to be of lesser importance.

Utilize hard first instruction in the training of complex, tactically-oriented tasks.

Generation effect

Active participation (trainees generate answers rather than instructors) has been shown to promote better levels of retention and performance (see Meier, 2010). Healy et al. (1990, as cited in Adams et al., 2011) found that participants who were active players in generating responses had a much higher retention rate weeks and months later. Used in most instructional institutions, the use of force instructor acts primarily as a facilitator who uses open questions to allow the trainees to critically reflect on the situation, i.e. what use of force option, what tactics, etc. The process allows trainees to review their own reasoning and provides questions for further discussion.

Utilize the Socratic method of instruction in use of force discussions.

Methods of testing for original learning and retention

Different retention measures yield different estimates of skill retention (Farr, 1986). For knowledge skills recall tests are different than recognition tests. A trainee's memory will allow them to recognize an event more than the individual can recall.

Recall tests are recommended for skill retention testing.

Conditions of Retrieval

Skill retention is increased if the retention test is conducted in a similar manner and environment as that of the original learning (Arthur, et al., 1998). Healy, Fendrich, Crutcher, Wittman, Gesi, Ericsson, and Bourne (1992) review a number of studies demonstrating cases of both remarkably good skill retention and very poor retention.

Similarity of the retention environment to the original learning environment promotes retention (Arthur et al., 1998). This finding derives from the Encoding Specificity Principle of memory, which states that cues to retrieval will be effective if and only if encoded at the time of learning (Tulving, 1983). In the context of skill retention, this implies that perceptual and cognitive cues are needed to retrieve and perform learned skills. If the job environment does not present these cues, performance will suffer.

Assess skill retention in the same manner as which performance was originally assessed.

Healy, Fendrich, Crutcher, Wittman, Gesi, Ericsson, and Bourne (1992) reviewed a number of studies demonstrating cases of both remarkably good skill retention and very poor retention. On this basis, they advanced the Procedural Reinstatement Proposal that the retention of a learned skill depends on the extent to which learning procedures are reinstated at the time of retention. In this case, the cues to retrieval are the very procedures originally learned. The implication of this proposal is that to retain skills over long intervals, one must ensure that procedures used when learning the skill are reinstated later. For example, if training employed a job aid or checklist to aid learners in sequencing steps, that aid will be an important cue needed to reinstate the skill at a later time.

A study by Marmie and Healy (1995) illustrates this effect. They examined learning and retention of tank gunner skills, which were trained using the TopGun simulator used by the U.S. Army. Other theoretical perspectives predict poor retention of these skills due to the complexity and

cognitive nature of the task (Adams, 1987, cited in Marmie & Healy, 1995; Driskell et al., 1992, cited in Marmie & Healy, 1995). The procedural reinstatement proposal, in contrast, predicts extremely good retention because the task is largely procedural and the procedures are reinstated during actual performance. In two experiments, trainees showed very little forgetting over retention intervals up to 22 months, verifying predictions of the procedural reinstatement proposal. These results also rule out a simple monotonic relationship between task complexity and retention.

Different measures of performance can indicate different levels of retention (Arthur et al., 1998). Two common tests, for example, are recall and recognition. Recall requires the learner to generate learned material or skills, often in response to only a few cues. Recognition requires the learner to simply assess the familiarity of material and verify its accuracy. As a result, recognition performance tends to be better than recall performance across a wide range of tasks (Arthur et al., 1998). Research has shown, however, that recall and recognition are largely independent measures of memory (see Tulving, 1983). These two tests can assess different aspects of memory and, hence, reveal differences in retention of selected components of a skill.

Simulators have been used for retention tests (Bennell, 2005). Leonard (2007 pg 7, also cite Grinsley), arguing that "physical fidelity of the training device may be less important than the functional fidelity. If the training does not accurately represent the process of the task to be used in the real world, the visual cues are useless"

> *Retention tests should be conducted in a similar manner and environment of the original learning.*
> *Simulators can be used for retention tests.*

Feedback

Students who are provided with feedback during training have been found to retain their skills better than students who only receive presentation training (Bryant & Angel, 2000; Goodwin, 2006). As summarized in Fadde (2011) feedback factors affecting skill retention include:

- Knowledge-of-performance versus knowledge of results
- Artificial versus natural feedback
- Scheduling of feedback

Trainees generally need feedback, or "knowledge of results," to correct errors, observe and use cues associated with task performance, and generate effective procedures (Hurlock & Montague, 1982). This effect can extend to long-term retention. In one review, Schmidt (1997) examined the benefits of informational feedback and observed that feedback has two opposing effects on retention. Feedback aids learning, leading to better initial learning and longer retention, but also builds reliance on the feedback. In the latter case, the learner suffers performance decrement when the feedback is no longer present, which impairs retrieval of skills on the job. The goal of training should be to make use of the informational content of feedback but to avoid presenting feedback so frequently or in such a regular sequence that the learner incorporates feedback in their mental representation of the task.

Castaneda and Gray (2007) suggested that externally focused knowledge of results is a more appropriate mode of feedback for skilled learners and internally focused knowledge of performance feedback is more appropriate for less skilled performers.

Arthur, et al. (1998) and Leonard (2007) report that feedback on elements of a trainee's performance on the whole task has been found to be more effective than segmented feedback. Augmented feedback has been found to increase skill acquisition where task inherent cues are either scarce or difficult to interpret. Augmented feedback should decrease towards the end of training.

> *Provide feedback on performance early in skill development; knowledge-of-results feedback later; provide feedback on whole task; fade feedback as skills develop.*

Use of force skill training includes the practice or simulation of performance during scenarios. Artificial feedback involves feedback from a simulation system or instructor, while natural simulation feedback is performance oriented, i.e. did the assailant stop in the simulated shoot out (Fadde, 2011). Artificial feedback allows instructors to isolate skill components for in depth review, i.e. the Noptel(2011) firearms training system allows reviewers to analyze shooting performance in separate handling, aiming, trigger manipulation and follow through components.

> *Provide artificial simulation feedback early in training and natural feedback later.*
>
> *Utilize training systems to analyze components of skills.*

Research has also reported that feedback with a slight delay interval is more effective than immediate feedback (Leonard, 2007). The slight delay allows the trainee to critique their own performance, if it allows the trainee to acquire error-detection capabilities. Video recordings of scenarios allows after action reviews of trainee performance in use of force scenarios (FLETC 2004). Videos have proven invaluable to trainees and instructors as it allows the trainee to compare their recollections to what actually occurred. Videos facilitate introspection and retrospection.

> *Provide artificial feedback early in training and delayed artificial feedback later during scenario-based training.*

Task factors

Differences have been found in retention rates across types of skills. For instance, Ginzburg and Dar-El (2000) found that procedural skills decline faster than psychomotor skills, and that controlled skills decayed faster than automatic skills for Israel Defence Force personnel. Complex procedural skills are particularly susceptible to rapid decay (Schendel & Hagman, 1991). Forgetting of such skills, however, is moderated by the organization of the steps making up the procedure (Schendel & Hagman, 1991). One advantage of well-organized tasks may be that procedural steps act as natural cues for each other, making them easier to remember. Shields, Goldberg, and Dressel (1979, cited in Hagman & Rose, 1983) found that soldiers generally forgot steps of common soldier tasks that were not cued by equipment or previous steps (e.g., safety steps). Other studies have confirmed that un-cued steps, steps judged to be difficult, steps addressing safety, and steps at the beginning and end of the task tend to be the most difficult to remember (Osborn et al., 1979, cited in Hagman & Rose, 1983). The greater the number of steps

involved to successfully perform a skill, the greater the load on memory and the less likely skill performance is to be retained (Rose eta l., 1985, as cited in Adams et al. 2003). Rose, Czarnolewski, Gragg, Austin & Ford (1985) as cited in Goodwin (2006 pg 20) reported that "Certain characteristics of the task being trained predict the rate at which the task is likely to decay." The classical task distinctions include (Arthur et al., 1998):

- Physical vs. cognitive tasks
- Continuous vs. discrete tasks
- Natural vs. artificial tasks
- Speed vs. accuracy tasks

In their review of the literature, Arthur et al. (1998) found that skills associated with physical tasks, natural tasks, and speed-based tasks tend to be better retained than skills associated with cognitive tasks, artificial tasks, and accuracy-based tasks.

Physical vs. Cognitive Tasks

Skills can be broadly divided into physical and cognitive tasks. Physical tasks require physical aspects such as muscular strength, exertion of forces, endurance, and coordination (Arthur et al., 1998). On the other hand, cognitive tasks a typified by cognitive aspects such as perception, mental operations, problem solving, and decision making (Arthur et al., 1998). Please note that tactical decision making is introduced in greater detail in Section 3. Mental rehearsal is an effective means of reducing skill decay in both physical and cognitive tasks, with greater effects in cognitive tasks (Driskell, Copper, & Moran, 1994; Farr, 1987). Goodwin (2006) found that mental tasks seem to be retained better than "hands-on" or psychomotor tasks. However in the absence of mental practice, physical skills are better retained than cognitive skills (Arthur et al., 1998).

> *Use mental practice to reduce skill decay of both physical and cognitive skills; Supplement the mental rehearsal of physical skills with physical practice.*

Continuous vs. Discrete Tasks

Discrete, or closed-loop, tasks involve discrete responses with a definite start and finish, whereas continuous, or open-loop, tasks involve continuous responses without definite beginning or end (Arthur et al., 1998). In their review of literature, Arthur et al. (1998) found that empirical studies demonstrate fairly conclusive evidence that continuous tasks are better retained than discrete tasks. The reasons offered for these findings were varied. The continuous nature of open-loop tasks may better allow for overlearning, and thereby better retention (Arthur et al., 1998). Furthermore the coherence of continuous tasks may aid their retention (Arthur et al., 1998). Finally, measures of skill decay are thought to be more sensitive for closed-loop motor tasks, and thereby capable of showing slight performance deviations (Arthur et al., 1998). Although the results of a meta-analysis showed an opposing effect, this finding is explained as contaminated due to an interaction effect with physical/cognitive task types (Arthur et al., 1998).

Hurlock and Montague (1982) also report better retention of continuous tasks. Some research indicates that continuous skills show little or no forgetting over retention intervals of months or even years (Schendel & Hagman, 1991). Hurlock and Montague (1982) speculate that discrete, procedural tasks are more poorly retained because of the large number of discrete steps to remember and the even more difficult problem of remembering the precise sequence of steps. Consistent with this idea is the finding that tasks that have a meaningful organization or coherence of steps tend to be better retained (Hurlock & Montague, 1982).

> *Continuous tasks are better retained than discrete tasks; Provide more opportunities for refresher training of discrete task skills. Procedural task suffer greater skill decay.*

Natural vs. Artificial Tasks

Two major dimensions distinguish natural versus artificial tasks; natural tasks are generally more complex with greater participant motivation (Arthur et al., 1998). Artificial tasks are typically used in skill retention research and by their nature for testing purposes unique (to prevent unintended practice) and have included memorization of foreign language, unique arm movements, etc. The greater complexity of natural tasks leads to more elaborate processing and thereby greater learning and retention (Arthur et al., 1998). The greater motivation of learners with natural tasks also leads to increased skill development and furthermore the amount of practice completed (Arthur et al., 1998). Natural tasks are less susceptible to skill decay than artificial tasks, although the magnitude of this difference is small (Arthur et al., 1998).

> *Artificial tasks are typically found in academic skill perishability experiments and thus the study results may not be applicable within the police use of force skills context.*

Speed vs. Accuracy Tasks

Studies of skill retention often use speed, such as time to complete a task, and accuracy, such as number of errors, as criteria in measuring skill decay (Arthur et al., 1998). Accuracy tasks generally decay more than speed tasks because, while learning and skill acquisition continue even after the participant has achieved perfect accuracy, the rapid asymptote of error rates in many tasks cause false belief of mastery (Arthur et al., 1998). Accuracy performance shows three times more decay than speed performance over all retention intervals (Arthur et al., 1998).

Train accuracy based skills beyond perfection; Practice accuracy tasks more frequently than speed tasks.

Job Conditions

Physiological and psychological stress can also impede performance in real world job conditions. Significant differences between operational conditions and original training conditions will show degraded performance. Optimal retention occurs when the retention test mirrors original test and when the retention test requires the operator to duplicate the same mental operations as were originally employed for skill acquisition. Extreme environmental conditions have been reported as damaging recall. Considerable differences between operational conditions and the original training conditions can cause degraded performance.

Stress and extreme environmental conditions can impact skill retention.

The impact of stress on performance is examined in greater detail in Section 4.

2.3.3 Skills Perishability Models

Bryant and Angel (2000) performed a review of the scientific and technical literature on models of skill fading and tools for determining when refresher training is required. In particular, their literature review investigated models for predicting skill retention relevant to the military domain.

Several classes of models for predicting skill retention were identified. Subjective approaches involve some form of self-assessment of retention and/or need for refresher training on the part of trained individuals. These techniques can yield accurate estimates of retention but are often mistrusted. Qualitative approaches indicate categorically how skills fade over time in relation to certain key factors. These models, as they stand to date, do not solve the practical problems of predicting when proficiency of skills will decline below a criterion or when refresher training will be needed, but they do offer approaches that may be developed into quantitative models in the future.

The most fully developed quantitative model of skill retention found by Bryant and Angel (2000) was the U.S. Army Research Institute's (ARI) Users' Decision Aid (UDA) model. This model was developed specifically to provide quantitative predictions of skill retention for military tasks. The UDA model was based on empirical studies documenting factors that affect skill retention. ARI researchers selected the following task factors because these can be conveniently and economically measured:

- Number of steps
- Whether steps must be performed in a set sequence
- Whether the task contains feedback that indicates the correct performance of steps
- Number of facts or information chunks that must be recalled
- Execution demands
- Whether the skill is cognitive or perceptual/motor
- Whether there are job and/or memory aids for the task
- The time limit of the task (if any)

The UDA model was developed to form the basis of a decision aid tool to be used in predicting skill retention and the need for refresher training in military tasks. The UDA contains ten questions that raters answer based on the task summary and their knowledge of the task. Raters select the appropriate answer and note the scale value associated with the selected answer. When all ten questions have been answered, the raters compute the total of the scale values, which constitutes the task's retention score. Multiple raters review the ratings given to the task and resolve differences to produce an agreed-upon task retention score. Scores are interpreted in two Performance Prediction Tables that are used to convert the total retention score into a prediction of performance for the rated task.

The UDA is one of few approaches for which empirical research has been done to assess its applicability and practicality. The UDA has been demonstrated to be relatively easy to administer, although some training is needed to perform the ratings correctly and reliably. The UDA itself is low-cost and requires no special equipment. The UDA, however, has received empirical validation from just a few studies study that report comparisons between UDA predictions and actual retention data.

Other quantitative approaches involve determining empirical retention curves for tasks or using training, individual, and other task factors to predict retention. These approaches involve longitudinal studies of skill retention and although they may offer empirical data to identify retention scores they are time consuming and costly to execute.

Conduct a cost benefit analysis to confirm the efficacy of conducting longitudinal retention experiments.

Utilize the factors that account for the majority of skill retention variance for long term testing.

Based on their literature review, Bryant and Angel (2000) identified a set of lessons learned and discussed specific recommendations.

- Validate the UDA for applied settings
- Conduct research to determine what factors can be incorporated to increase the accuracy of predictions
- Develop self-assessment tools
- Determine the applicability of the Relapse Prevention Model to supervisory, administrative, and other related tasks
- Conduct studies to derive empirical retention curves for critical tasks

Assess the applicability of the UDA skills retention model for police use of force skills retention.

2.3.4 Skill Retention Literature Review Summary

In general, the psychomotor skill retention literature is underdeveloped in the area of long term skill retention. Skills examined in many controlled studies are artificial in nature and do not reflect the complexity of the police use of force context. Understanding the perishability of

critical police use of force skills will require systematic research that provides for longer time frames and testing of skilled performance over time in realistic settings.

Despite the lack of clarity, however, a number of recommended psychomotor skill acquisition training principles were identified in the literature review (modified from Fadde, 2011). These principles include:

- Blocked practice for faster initial learning; spaced practice for better retention and transfer; decision practice for highly motivated learners
- Explicit instruction for faster initial learning; implicit instruction for better retention and transfer
- Internal focus of attention for initial learning; external focus of attention for more skilled performers
- Knowledge-of-performance feedback early in skill development; knowledge-of-results feedback later; fade feedback as skills develop
- Artificial simulation feedback early in learning; natural simulation feedback later in learning
- Constant, augmented feedback for initial learning, delayed augmented feedback (e.g., video) with more advanced learners
- Questioning by trainer to help advancing learners develop self-coaching
- Train recognition and decision making skills separate from motor skills

Our review of the skill retention literature showed that a range of factors are likely to impact on skill retention. These include:

- The nature of the task. Procedural skills fade faster than psychomotor skills, and mental tasks are better retained than psychomotor tasks. Tasks with more steps are more subject to perishability. The level of original learning is a very good predictor of retention.
- The individual. High cognitive ability, background knowledge, and expertise influence promote better skill retention. Although higher performing individuals y benefit from over learning a skill, as compared to personnel who barely make the passing grade, skill loss in both groups is the same if overlearning is controlled. A police officer who is in good physical and mental condition can withstand more stress and will be better able to physically handle the psychomotor activities involved in use of force skills.
- The nature of training. Regular refresher training, active participation, realistic training, and good quality feedback are key training factors that promote retention. Studies have shown that the length of time required for refresher training is less than 50% of the time required for the initial training (Rowatt & Shlechter, 1993). However, long intervals between initial training and retraining mean that relearning will require more time. Physically or mentally rehearsing or performing a skill will reduce skill loss. For example with only 6 minutes of refresher training a month, participants in one study could maintain required levels of CPR skills over extended periods of time. This was in contrast to dramatic skill loss over time.

Skill loss follows a predictable course. Despite the effects of a large number of factors, skilled performance declines according to a power function of time (Anderson, 1995; Childs & Spears, 1986; Wixted & Ebbesen, 1991). Thus, any given factor influences the rate at which performance

declines and the asymptote level at which performance settles but does not dramatically alter the basic nature of forgetting. In all cases, most skill loss occurs soon after training and the rate of forgetting continually decreases.

Only a few studies, however, have so far attempted to quantify and rank the effects of factors on skill retention (Arthur et al., 1998; Farr, 1987, cited in Arthur et al., 1998) and these studies have been limited by the lack of data. Although there is conflicting evidence in the literature, the factors showing the strongest effects on skill retention include:

- Retention interval (Ginzburg & Dar-El, 2000)
- Degree of overlearning (Hagman & Rose, 1983; Lance et al., 1998; Schendel & Hagman, 1980, cited in Hagman & Rose, 1983)
- Opportunity to practice (Blankmeyer, 1998; Ford et al., 1992; Landry & Campbell, 1997)
- Similarity of training and performance environments (Healy et al., 1992; Marmie & Healy, 1995)
- Individual aptitude (Earles & Ree, 1992; Hurlock & Montague, 1982)

A critical issue that emerges from the research is that most skill retention factors covary with other skill retention factors; for example performance during acquisition does not necessarily predict performance during recall. In fact, factors that impair performance during acquisition may be the same factors that enhance performance during recall. Numerous studies have demonstrated interaction effects between various classes of task, training, and individual factors (see e.g., Arthur et al., 1998; Driskell et al., 1992; Rose et al., 1985b). Isolating the factors that account for the largest variance in police retention skills may be challenging.

Research on overlearning and the spacing of training trials has shown that these two factors can improve skill retention but it is not clear that research in these areas would be particularly fruitful. One reason is that the size of the effect of these factors is variable and another reason is that even if they were found to be beneficial, implementing these practices may not be practical.

The UDA model found has been used to predict retention of military skills. Not only have ARI researchers identified a set of predictive factors, they have determined the empirical relationships of each factor to skill retention to quantify their effect sizes (Rose et al., 1985). These factors have been scaled so that ratings can be used to produce estimates of retention in units of real time. While the UDA is targeted toward procedural tasks, the UDA may provide some utility for evaluating police skill perishability. The model needs to be validated and adapted to the psychomotor police skills.

2.3.5 Transfer of Training

During the SME review of the preliminary literature results, concerns were expressed by some that the concept of transfer of training transfer was not examined in depth. Concerns have been raised in the open literature that the current approach to firearm training does not prepare police officers for the real world (Aveni, 2008), i.e. training for marksmanship on a sterile range does not transfer well to the atypical street scenario. The concept of training transfer of training is presented below and potential lessons for skill acquisition and retention are noted.

2.3.5.1 Definition of transfer of training (near transfer and far transfer)

The most frequently used definition of transfer or training comes from Baldwin and Ford (1988). They define it as "the generalization of knowledge and skills acquired in training to the job and the maintenance and enhancement of that learning over time" (p. 64). This definition has two conditions. Assuming that some form of learning occurred within the training environment, actual transfer requires both the generalization and the maintenance of knowledge and skills. Specifically, transfer is said to occur if this new learning is generalized to a different situation. In some cases, these situations require a different use of the skills or information from the original learning context, emphasizing the ability to use learned material beyond the particular training situation to a novel or dissimilar situation. For example, a police officer learning the principles of negotiation in a training setting, and then being able to use this knowledge in novel contexts on the job is a good example of transfer. This transfer is known as "far" transfer (Barnett and Ceci, 2002). In other situations, transfer is understood as the application of learned material to a similar or related context known as "near" transfer (Barnett and Ceci, 2002). For example, learning how to fire a pistol at the range may be requisite knowledge and skills to fire it on the job. In the sports science world, the application of a motor skill learned in training but used in a real world application is described as transfer of training (Lee, 2011); which this definition appears to according to Barnett and Ceci's description resembles "near" transfer according to Barnett and Ceci. Baldwin and Ford also state that acquired knowledge and skills also have to be maintained over time, though they do not specify how long these need to be maintained. In the sports science world, the application of a motor skill learned in training but used in a real world application is described as transfer of training (Lee, 2011); this definition appears to resemble "near" transfer according to Barnett and Ceci (2002).

2.3.5.2 Transferring open and closed skills

Transfer of training researchers make a distinction between "open" and "closed" skills (Yelon and Ford, 1999). Closed skills are defined as those that require one specific prescribed response, based on adherence to an established set of rules. For example, a police officer learns when it is appropriate to draw and engage his or her weapon when facing an armed felon is based on an established set of training procedures and force escalation continuum. On the other hand, open skills do not have one single correct way to be completed. The performance of these skills can be considerably more variable, and involves more general principles rather than a set of procedures. In this case, learning how to negotiate with the public will vary with the context and will therefore require different approaches, while still maintaining the principles of negotiation. With the appropriation of these skills, Yelon and Ford (1999) graphically depict transfer of training by task adaptability and degree of job supervision (Figure 4).

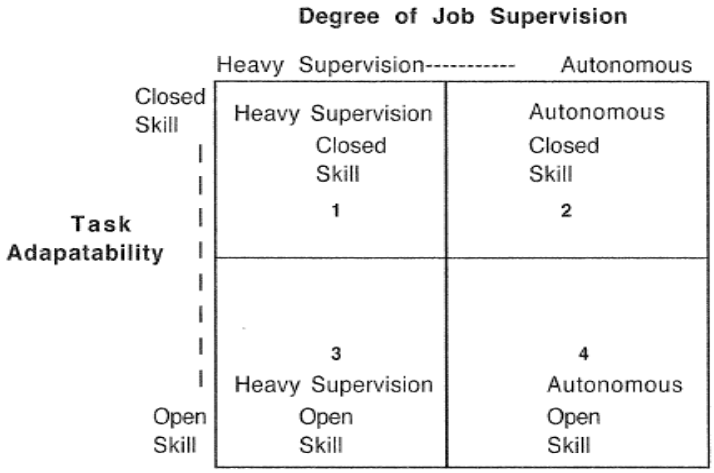

Figure 4: Dimensions likely to influence transfer (Yelon and Ford, 1999, p. 62).

According to Yelon and Ford, the most difficult quadrant is number 4, Autonomous Open Skill, because there are few standards by which to assess job performance and to evaluate job impact after training.

The framework of Yelon and Ford's framework highlights the initial need for supervision and training in order to move individuals to autonomously act on their own skill set whether those are open or closed skills.

2.3.5.3 Transfer of training from a cognitive perspective - analogical transfer

The most prominent research examining transfer focused on the cognitive processes underlying it. These processes include the way information is encoded, stored in memory as a schema, retrieved, and applied in a new situation. This approach was driven by the theory that "learning to solve one problem may enhance the solving of another problem depending on similarities between how the two problems are mentally represented" (Marton, 2006). Simply put, one shows transfer when one can abstract information from a learning situation and transfer this by analogy to a novel situation because they share similar features. The two situations converge in a shared schema.

Gentner and colleagues (2009, p.1343) have defined analogical transfer as "mapping knowledge from a prior stored situation to a current situation."

Figure 5: Analogical transfer

When generating an analogy, an individual can use knowledge from one domain (the source or base) and apply this knowledge to the target in another domain. (Spellman & Holyoak, 1996, Clement & Gentner, 1991, both cited in Blanchette & Dunbar, 2000).

Research demonstrating analogical transfer has been mixed at best. For example, research shows that when people can access the required example from the training situation, they are often very good at mapping the previous solution to a novel problem solution by analogy (e.g., Gentner, Ratterman and Forbus, 1993; Blanchette & Dunbar, 2000). On the other hand, researchers have noted that when attempting to abstract from a single case to a new environment or context, transfer is a challenge (Gentner, Loewenstein, Thompson and Forbus, 2009). For example, two of the most well-known transfer of training researchers, Gick and Holyoak (1980, 1983) showed that in novel situations, people often fail to spontaneously access information they have available to them from their previous experiences. Studies examining analogical reasoning as transfer have shown that people have trouble solving a problem that is analogous to one already (and recently) solved, when the problem is similar but comes from a different context (Thompson, Genter, & Loewenstein, 2000).

> *Expose trainees to as many different situations as possible to promote knowledge and skills transfer.*

2.3.5.4 Surface and structural feature matching of situations

Understanding the research discrepancies in analogical transfer requires some consideration of the role surface and structural features of the source material play in transfer. According to some researchers, constructing an analogy from one situation to another requires two levels of relationships between two domains. The first level is surface similarity or object attributes. Structural similarity, on the other hand, relates to underlying principles or higher-order relationships (e.g., causal relations). Most cognitive researchers assume that the relationships associated with structural similarity reflect the "true" nature of analogy (and hence transfer), presumably because this shows a greater ability to abstract from the source to the target. Greater generalization across situations means greater transfer of source material to novel settings. There is evidence that shows people can invoke surface features (e.g., object attributes) more readily than structural features in novel contexts (Gentner et al., 1993; Chen, Yanowitz, & Daehler, 1995). At the same time, research has shown that when presented with both features, people find structural similarities to be more useful for reasoning, suggesting that "we often fail to recall what is ultimately the most valuable for solving new problems" (Thompson et al., 2000, p. 62).

Examples in training promote transfer

Research shows that recalling structural features is promoted when trainees compare analogous examples during the training exercise (Gick & Holyoak, 1983; Gentner et al., 2003; Kurtz & Loewenstein, 2007). Research has also shown that when asked to produce their own analogous examples, people tend to use structural similarities rather than superficial similarities more frequently (Blanchette & Dunbar, 2000). One of the reasons why comparing examples can be effective is that it can produce a schema that links deep structural relations across a number of varying situations. Examples in training are an important mechanism for knowledge and skill acquisition that will later be utilized on the job. While these findings are promising, research also highlights the limits of making spontaneous comparisons unless they are specifically instructed or otherwise required to do so. This underscores the role of instruction in effectively transferring training.

Promote the use of deep principle-based comparisons rather than surface similarities when training.

2.3.5.5 Simulation training promotes transfer

There is research that shows simulated training is cost effective and beneficial in the acquisition of knowledge and skill for future transfer. For example, Stewart, Dohme, and Nullmeyer (2002) examined the impact of simulation-augmented primary flight training. They found that those pilots trained in a simulator showed transfer for flight maneuvers and required less iterations to to achieve proficiency on flight maneuvers compared to pilots not trained in a simulator. Macchiarella, Arban, and Doherty (2006) also observed a significant degree of transfer in pilots trained in a simulated environment prior to training in an actual airplane. Lane and Tang (2000) compared learning statistics through simulated training or textbook training, and found that those trained by simulation performed better than those trained with a textbook. Research has also shown increased collaboration for decision-making using high-fidelity simulation training (Maxson et. al., 2011). Militaries have also used simulated environments for small arms training. As a means to reduce training costs and offset skill fading, the UK Ministry of Defence invested in interactive 3D equipment simulation solutions as a cost effective means to train soldiers on the theory, maintenance, and repair of SA80 assault rifle for their Weapons Handling Test (EPN Newswire). One advantage of a simulated environment is that it can be deployed to a variety of places, so that personnel can be trained anywhere and at any time. The use of a simulated training platform, therefore, may be an effective way to train and maintain desired police skills (e.g., CED handling) for transfer to real world situations.

Aveni (2008) points out that police active-shooter training can also benefit from the use of simulation for a number of reasons. First, simulation can reflect the real challenges officers face in the line of duty (i.e., being feloniously slain). Moreover, simulation training can counter the focus on speed drawing and speed on-target (known as the "Split-Second Syndrome" coined by NYPD Lt James Fyfe), and move to consider an officer's cognitive capacity to assess and mitigate on the job risks. Simulation training can also increase the requirements for in-service firearms training. According to Aveni, simulation training includes scenario-based training, using RAP4 paintballs, AirSoft, Simunition FX™, etc., to enhance police officer's capacity for decision-making and promote greater situational awareness. This moves officers away from paper and steel targets to live targets that "shoot back," talk back, "lunge at your trainees," interpret and discern furtive movement that suggests an attack is imminent (Aveni). Ultimately, simulation promotes trainee creativity in a way that live-fire does not, given the necessary safety constraints when using live ammunitions (Aveni). Aveni also points out the cost effectiveness and benefits of computer-based training for improving police judgment and decision-making skills. Either option, simulated training is identified as a valuable approach for developing and transferring important police knowledge and skills to the job, thereby countering occupational errors (e.g., "mistake of fact shootings").

Simulation technologies can assist transfer of training in a cost effective manner in varying contexts (e.g., day and night). It can develop police officer's capacity for critical decision-making and assessing and mitigating risk in a more realistic environment that utilizes live "targets."

2.3.5.6 Training design and learning environment

Other research examines the impact of the training design and the learning environment on transfer of training. According to Baldwin and Ford (1988), training design includes incorporating established learning principles, the sequencing of training materials (e.g., receiving part or whole training), and the degree to which the training content is relevant to the job. Some research found that using a diverse case-training approach compared to a specific case-training approach facilitates transfer and generalization across varying contexts (Moran, Bereby-Meyer, & Bazerman, 2008), and that transfer was even better when receiving feedback from instructors during training (Ansburg & Shields, 2003). Goettl and Shute (1996) found that critical part-task training was as effective as whole-task training, and was particularly helpful for people with lower abilities. Other research has shown that whole-task training is often more effective than part-task training at facilitating transfer. This may be because the former promotes rich schema development, which helps people transfer their acquired knowledge and skills more generally (Lim, Reiser, & Olina, 2009). Again, this area of research has a number of inconsistent findings.

Transfer of training research also examined the learning environment. Specifically, what kind of support one receives during the training exercise and whether the trainee has an opportunity to use the newly acquired skills. Work environment factors like organizational climate and a continuous-learning culture as well as social supports show contributions to transfer of training (Tracey, Tannenbaum, & Kavanagh, 1995). The greatest influences are climate and supervisor support. Marks, Zaccaro, and Mathieu (2000) found leader support in a team learning context led to improved team member task knowledge, which encouraged shared mental models (i.e., a mental representation of the world) and had a positive impact on the team's overall performance. The research examining the impact of the learning environment suggests that support during instruction may promote transfer of knowledge and skills.

> *Transfer of training requires context-based scenarios that are facilitated by trainer instruction and support.*

2.3.5.7 Transfer of Training Literature Review Summary

Overall, the research examining transfer of training is not currently adequately developed to help understand the probability that a specific skill learned in a specific situation will be transferred when required within a real world environment. This has led a number of researchers to suggest that transfer of training requires a full conceptual paradigm shift (see Bransford & Schwartz, 1999; Lobato, 2006, 2008; Marton, 2006; Engle, 2006 for the future of transfer of training) in which a broader number of factors are considered. However, these new approaches are in their infancy and, consequently, lack empirical support. For the purposes of this report, research within the area of transfer provides the following insights:

> *Expose trainees to as many different situations as possible to promote knowledge and skills transfer.*
>
> *Providing diverse cases or examples during training that are supported by trainer instruction may be the best way to promote knowledge and skill acquisition and transfer*

Promote the use of deep principle-based comparisons rather than surface similarities when training.

Transfer increases as the fidelity between the training environment and the real-world environment increases. Simulated training environments may be a cost effective way to train police officers and promote transfer of knowledge and skills.

Simulation technologies can assist transfer of training in a cost effective manner in varying contexts (e.g., day and night). It can develop police officer's capacity for critical decision-making and assessing and mitigating risk in a more realistic environment that utilizes live "targets."

Transfer of training requires context-based scenarios that are facilitated by trainer instruction and support.

2.4 Skills Perishability Literature Review Discussion

The goals of this literature review were many; the first concerned the identification of factors that influence skill perishability. A number of these factors are identified in Section 2, but there is more complexity in existing research than can reasonably be accommodated in this literature review. The first step in predicting skill perishability must always be determining the factors that are likely to provide the maximum predictive power in police use of force skill retention. The literature review identified a number of factors that impact skill perishability:

- Retention Interval
- Personal Characteristics
- Initial learning
- Retraining
- Job Conditions
- Task Characteristics

Section 3: Skills Perishability within the Use of Force Context Literature Review

3. Skills Perishability within the Use of Force Context Literature Review

3.1 Goals

The primary goals of this focused literature review were to:

- Identify literature pertaining to use of force skill acquisition and perishability.
- Identify teaching principles and techniques that will promote long term use of force skill retention.
- Identify empirical based evidence that supports the timing of police use of force skills refresher training and recertification.
- Identify the research required to provide an impartial evidence-based recertification strategy with the ultimate goal of establishing national standards for skills training/maintenance that meet operational policing needs.

3.2 Literature Review Method

The method section below will highlight the methods used in the literature review and the examination of the current state of police skills training.

A literature review is a systematic study and organization of a large body of relevant scientific research. The key to success, then was to develop a framework for interpreting the literature and generating clear and useful insights, lessons learned, and recommendations for future research and practice. We followed a number of steps to complete the literature review. For this project, we used what can be described as a "funneling" approach in that we will identify many concepts which may be appropriate to police skills perishability or recommendations for future investigation. As such, the project began by conducting a broad exploration of trends, issues and factors that have shown to impact skill retention and police use of force skill retention in particular.

3.2.1 Develop Systematization Framework

The first step of the literature review was to develop a framework for organizing and interpreting empirical results and theories of skill retention. The framework applied herein will be based upon the Observe, Orient, Decide and Act (OODA) model proposed by Colonel Boyd (1995). Given recent advances in sports research this appears to be a suitable model for understanding the factors involved in the application and thus perishability of use of force skills. The framework will help identify the key elements involved in executing a task and thus provide a framework for identifying points vulnerable to skill perishability. The OODA model will be explored in greater detail in the following sections.

The previous reviews of the skill fading literature (Bryant & Angel, 2000), Development of Theories of Collective and Cognitive Skill Retention (Adams, Webb, Angel & Bryant, 2002),

Accelerated Learning and Retention Literature Review (Adams, Karthaus & Rehak, 2011), Military Individual Readiness (Adams, Hall, & Thomson, 2009) served as a preliminary guide to identifying relevant literature related to both skill retention and the impact of stress on skilled performance. We used the set of keywords developed in these projects as the starting point for developing a set of keywords used to conduct a further search of the literature (see Table 6). Based on the feedback from the Use of Force Experts Workshop (2 March 2011), the keywords were expanded to include the relevant OODA model components and stress in decision making.

Table 6: Preliminary Keyword Set

Category	Keyword	Related Keywords
Domain	Policing	Law enforcement, police,
Model	Model	Theory, Quantitative
	Predict	Prediction, Hypothesis
	Empirical Result	Empirical Support, Validated
Factors	Type of Training	Performance, Mastery, Tutor, Instruction, Self-taught, Simulation, Team, Individual, Feedback, Part-task, Whole-task, Acquisition, Learning, Over Learning
	Maintenance	Schedule, Time, Retention-interval, Disuse
	Fact	Knowledge, Information, Data
	Type of Task	Cognitive, Procedural, Perceptual-motor, Continuous, Discrete, Complexity, Sequential
	Type of Skill	Steps, Cognitive, Mental, Procedural, Motor, Perceptual, Control, Automatic,
	Individual Factors	Original learning, Aptitude, Motivation, Education
	Stress	Time Pressure, Fatigue

3.2.2 Search Literature

The first step in this task was to identify relevant databases of scientific research. Again, the earlier literature searches conducted by HIS® provided a starting set of databases. We surveyed databases for psychology, sports, human factors, military, professional/business, and other related domains to compile a set of databases to search – see Table 3. The next step in conducting a search of the literature was to identify relevant areas of concern for the Canadian police forces. To this end, all literature was categorized by the following use-of-force skill sets:

- Perceptual skills
- Orientation/tactical skills
- Decision making skills
- Psychomotor skills
- Verbal skills
- Defence and Control (weaponless) skills
- Baton skills

- Oleoresin capsicum (OC) skills
- Conductive Energy Device (CED) skills,
- Lethal force skills

The second step was to identify and categorize databases of scientific research. We surveyed databases for policing, psychology, human factors, military, and other related domains to compile a set of databases to search.

Table 7: Databases For Search

Database	Description
PsycINFO	The PsycINFO database is a collection of electronically stored bibliographic references, often with abstracts or summaries, to psychological literature from the 1800s to the present. The available literature includes material published in 50 countries, but is all presented in English. Books and chapters published worldwide are also covered in the database, as well as technical reports and dissertations from the last several decades.
NTIS	NTIS is an agency for the U.S. Department of Commerce's Technology Administration. It is the official source for government sponsored U.S. and worldwide scientific, technical, engineering and business related information. The 400,000 article database can be searched for free at the www.ntis.gov. Articles can be purchased from NTIS at costs depending on the length of the article.
CISTI	CISTI stands for the Canada Institute for Scientific and Technical Information. It is the library for the National Research Council of Canada and a world source for information in science, technology, engineering and medicine. The database is searchable on-line at cat.cisti.nrc.ca. Articles can be ordered from CISTI for a fee of approximately $12.
STINET	STINET is a publicly-available database (stinet.dtic.mil) which provides access to citations of documents such as: unclassified unlimited documents that have been entered into the Defence Technology Technical Reports Collection (e.g., dissertations from the Naval Postgraduate School), the Air University Library Index to Military Periodicals, Staff College Automated Military Periodical Index, Department of Defence Index to Specifications and Standards, and Research and Development Descriptive Summaries. The full-text electronic versions of many of these articles are also available from this database.
Google Scholar	The World Wide Web was searched using the Google Scholar search engines (scholar.google.com).
DRDC Research Reports	DRDC Defence Research Reports is a database of scientific and technical research produced over the past 6- years by and for the Defence Research & Development Canada. It is available online at pubs.drdc-rddc.gc.ca/pubdocs/pcow1_e.html.
National Research Council	National Research Council Canada is a database of scientific and technical research. It is available online at http://www.nrc-cnrc.gc.ca/eng/search/index.html

3.2.3 Review Selected Articles

Once we had selected the key articles and categorized them by retention factor technical application, we conducted a thorough review of each article. The review:

- Identified articles relevant to use of force skill acquisition and transfer
- Identified articles relevant to use-of-force skill retention

3.2.4 Preliminary Survey of the Literature

Based on the review of key articles, we generated a preliminary literature review that focused on use of force skills perishability issues for use in workshop discussions with the PSC. The review allowed us to identify skill retention theories and factors based on scientific validity and applicability to the Canadian police forces. Our literature survey:

- Developed a comprehensive list of factors promoting skill acquisition and skill retention in the police use-of-force categories.
- Developed a comprehensive list of tools and techniques that can be used to promote skill retention.
- Classified factors, theories, and techniques based on the OODA loop and use-of-force framework.

The results of the preliminary literature review were presented to a series of SMEs over the course of two days (10-11 May 2011). The workshop provided academics specializing in motor skill as well as use of force experts a forum to highlight search deficits with the literature review. While no new skill retention factors were introduced during the workshop, participants identified the desire for more background information on:

- Skills acquisition theories
- Skills transfer

The workshop also provided a forum to identify a way ahead to address the police skills perishability problem.

3.2.5 Finalize Survey of Literature and Generate Lessons Learned

Based on the review of key articles and recommendations from the SME workshop we generated an account of the major factors relevant to police use of force skill perishability. Our literature survey:

- Developed a comprehensive list of factors promoting skill acquisition and skill retention in the police use-of-force categories
- Developed a comprehensive list of tools and techniques that can be used to promote skill retention
- Discussed skill retention factors within the use-of-force framework

The literature survey provided a detailed account of the scientific literature. This survey was focused on the issues relevant to the goals of the Canadian police forces (as developed through the review with SMEs).

The final step of the literature survey was to generate where possible a set of training recommendations for police refresher training. Recommendations included advanced practices and techniques that could improve the quality and efficiency of training efforts by Canadian police forces.

3.3 Skills Perishability within the Use of Force Context Literature Review Results

In addition to the generic literature review of skills acquisition and perishability, a focused literature search was conducted on skills perishability within the use of force context. The police use of force skill literature review results are organized as follows:

- Tactical decision making
- Lethal force skill training and retraining
- Conductive energy device, OC, and baton training and retraining
- Hand to hand defence and control skill acquisition and retention

As mentioned previously throughout the literature review every effort was made to identify evidence justifying police use of force refresher training.

3.3.1 Tactical Decision-Making

One of the biggest challenges for police officers in highly charged situations is to respond with an appropriate amount of force warranted by the situation, and in a timely fashion so that their actions are maximally effective (Benge & Williams, 2007). Over the long term, the critical issue is maintaining these skills so that officers are protected while using the appropriate amount of force. In order to better understand the issue of skills perishability, we need to consider all of factors impacting on officers when they engage in use of force. That is, we need to consider the decision making processes officers engage in when choosing the level of force to use. One way in which skills may fade is that officers gradually become less aware of the full range of options available to them when they make the decision to act. This limited awareness of options could be due the result of inadequate acquisition of skills, stress limiting their decision-making abilities, or actual skill fading processes. Indeed, decision-making itself could be a skill that perishes over time if not used. As noted by (Burrows, 2007), officers are rarely put in the position where they have to discharge a weapon. This means that there is often a long gap between training for such scenarios and encountering them. As such, deciding on the appropriate course of action may be difficult for officers because they have not had to think through such scenarios for some time. In this section, we will discuss decision-making and performance, how they are impacted by stress, as well as how they relate to skill perishability. This chapter explores the process of tactical decision-making, and to the extent possible, retention of the ability to display the required skills.

There are two main approaches to the study of decision-making. One approach, known as the rational or analytical approach argues that when making decisions, people should generate an exhaustive list of the pros and cons of each alternative, and weigh the information in order to make the “best” decision. However, this approach has been extensively criticized as representing how people should make decisions while ignoring how they actually do make decisions. Moreover, many of the contexts in which critical decisions are made are not conducive to rational approaches. These approaches are best applied to domains where “the goals are well defined, the environment changes slowly and no other active agents are present” (Grant, 2009, p. 2). This way of making decisions is clearly not a good match for the tactical decision-making environment,

which is often dynamic, with diffuse elements and often inadequate time to consider all the available alternatives.

The second approach, the naturalistic decision-making (NDM) approach, focuses on the process of decision-making rather than on the outcome of decision-making (Azuma, Daily & Furmanski, 2006). This approach assumes that there is not necessarily an ideal or optimal solution to a problem, but that the best course of action will be determined by a number of factors not typically considered in rationalistic approaches. Naturalistic decision-making is often referred to as descriptive because it describes how we normally think, rather than how we should think and acknowledges the dynamic nature of real-world settings, as well as the necessity of moving forward based on incomplete information. It accounts for time pressures, the shifting of goals, and the high-stakes involved.

The recognition-primed decision (RPD) model is a conceptual model of intuitive pattern-recognition-based decision making (Klein, 1997, 2008, as cited in Patterson et al., 2009). As can be seen in Figure 6, the model is composed of three components: a matching component, a diagnose component, and a simulate-course-of action component.

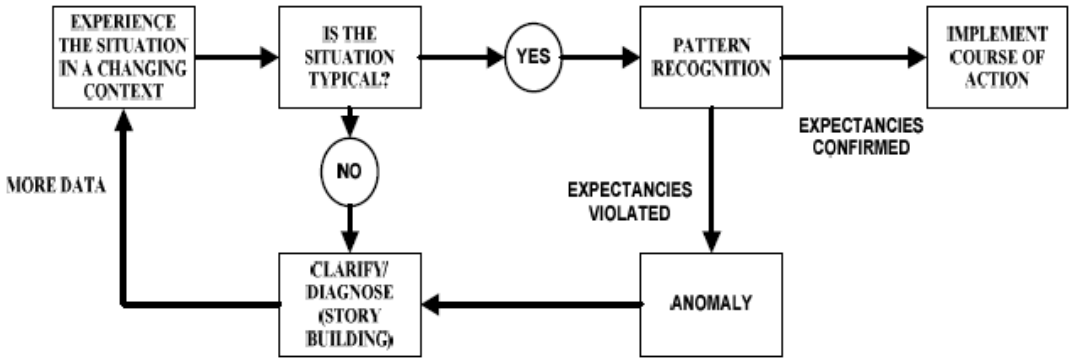

Figure 6: Recognition-Primed Decision Model (Klein, 1997, 2008).

According to this model, a person in a problem situation searches his or her memory for similar situations encountered in the past. If the situation is found in memory and deemed to be familiar or typical, and as expectations become confirmed, he or she decides on an action to initiate. If the situation is deemed to be unfamiliar or if expectations are not confirmed, then the person will diagnose the situation further before acting. The person may also mentally evaluate and simulate a course of action before implementing the action.

Within a tactical environment, NDM would enable officers to make effective decisions without in-depth analysis because of their past training and experience. In practice, when facing a novel situation, experienced officers will tend to rely on a process of pattern recognition to help them classify the situation in to a type they are familiar with. Once the type of problem becomes apparent, so too does the typical course of action required to counter it. The task then becomes

one of action; generating, monitoring, and modifying the plan to meet the needs of the situation. When utilizing the NDM approach, an experienced officer will give little explicit consideration to alternative options unless the first decision is proving ineffective (Klein & Klinger, 1991).

Because police officers are often required to make use-of-force decisions within seconds of entering dynamic situations in unknown environments, the naturalistic approach represents the best alternative for understanding tactical decision-making by officers in tense situations. It permits the flexibility required to quickly adapt when a routine traffic-stop violation turns into a hostile encounter with a drunk driver, pursuing a fleeing suspect on foot, or engaging in a standoff with an armed suspect.

In general, decision-making includes the processes that individuals use to analyze a problem, identify objectives, develop alternatives methods of achieving those objectives along with the consequences of each, and finally, to decide on the option believed to hold the most potential benefit. Efficiencies can be achieved through being able to match the demands of the current situation with past situations as a guide for one's actions. On the other hand, decision-making can also be damaged when pattern-making is applied indiscriminately. When interaction outcomes are sub-optimal (e.g., resulting in officer injury, inappropriate use of force, etc.), some have argued that the likely reason is more due to a failure to recognize situational cues that might suggest an alternate course of action, rather than a lack of officer proficiency in the execution of use-of-force tactics (Benge & Williams, 2007). On the other hand, it can also be problematic if the officer is spending too much time trying to infer meaning and establish context in order to make the best decision, only to have their action come too late to effectively manage the situation. Observation ability involves visual, perceptual and cognitive skills. Observation skills help law enforcement officers assess the world around them; they are always consciously or unconsciously observing nonverbal behaviors and drawing conclusions based on their observations. Based on their observations, LEO can identify escalating situations; modify their approach to a tactical problem, etc. Observation skills can be improved with training; military sniper programs utilize "KIMs" and field observation "games" to hone student snipers' ability to look at things critically. A number of computer-based observational games are also available to help train people to accurately gauge their surroundings.

Anecdotal evidence suggests that experts may possess superior visual abilities and skills than novices. Some researchers also believe that experts employ better search patterns, have fewer but longer eye fixations and fixate on more informative areas of the visual field. As well researchers believe that expert search strategies are less affected by changes in emotional states (Williams and Elliot, 1999). Experts have been shown to have superior pattern recognition abilities than novices. Recognizing the evolving pattern of play or events is the strongest predictor of anticipatory skill in team ball sports (Williams and Davids, 1995). Experts also have increased visual cue utilization, i.e. the ability to make accurate predictions based on information from the opponent's posture, body orientation, etc. Research has shown that experts exhibited improved performance at the start of the event as compared to novices. For the LOE more experienced patrol officers detect cues from assailants quicker than novices. Experts have more accurate expectations than novices of the events likely to occur in any given situation (Ward and Williams, 2002).

In actuality, however, it seems likely that optimal decision-making is the combination of analytic processes of scanning the environment, searching for information and weighting its value, as well as using expertise and pattern-matching to speed up decision-making processes. In considering how people make decisions in tactical situations, it is important to recognize there are a complex set of factors likely to influence how decisions are made. The section that follows explores these factors in more detail.

Factors that Influence Tactical Decision-Making[2] Even if officers arrive on a scene with enough time to observe and orient themselves to the situation, and are able to make a decision about how to respond, there are often a range of factors impacting an officer's ability to do so with accuracy. According to Dror (2007) even the decision of whether to use force is not simple and straightforward, and involves the consideration of a number of factors, as follows:

> *Decision factors*, which refer to the structure of the decision as afforded by the situation, such as the choice of alternatives (e.g., array of use-of-force options) and the complexity of the decision (e.g., risks of media attention, presence of multiple onlookers who may intervene);
>
> *Internal factors* or characteristics of the decision maker (e.g., the amount of experience they have in similar situations, confidence level, cognitive ability, and state of mind, etc.), as well as any cognitive biases the individual may be prone to making. For example, one controversy noted in the literature is that some police officers may direct more force at citizens with diverse ethnic backgrounds (Ho, 1997; Wortley, 2006).
>
> *External factors*, such as time pressure and the context of the situation also play a role in a use-of-force decision. For example, officers may be more likely to be prepared to exert force if they are patrolling in what is known to be a dangerous area of a city.

A Scottish study explored police officers' decision-making in operational situations by having officers sort a range of written operational scenarios on a number of dimensions such as familiarity, level of stress, time required to make a decision (Flin, Pender, Wujec, Grant & Stewart, 2007). Results determined that upon encountering a new situation, police officers first gauge the familiarity of the situation, and the amount of risk it poses to the officer and others. A second study determined that most situations required a decision about how to proceed within the first three minutes of arriving on the scene. Even more telling was once the decision to engage a firearm is made, the process of preparing the weapon and firing an aimed shot is usually completed within 1.25 seconds (Burrows, 1992; cited in Burrows, 2007). This speed obviously leaves little time to thoroughly compare alternative courses of action and to weigh the consequences of each. Unfortunately, the officers also evaluated the situations requiring the quickest decisions as the most unfamiliar, as posing the greatest risk to themselves and others, and as the most stressful to be involved in. This research provides a start to understanding the cognitive processes that officers work through when encountering tactical situations.

Decision-making researchers have found that time pressure can narrow the officers' attentive focus. In other words, the anxiety produced by the need to act quickly can cause the officer to

[2] The role of acute stress is considered separately in the section that follows.

resort to a simpler mode of information processing that does not take all aspects of the situation in to account, but instead focuses only on elements believed to be critical (Hammond, 2000; cited in Kowalski-Trakofler & Vaught, 2003). Although this narrowing may help the officer to come to a decision more promptly (a significant advantage in most situations), it is only helpful if the officer actually comes to the appropriate decision under the circumstances. When this is not the case, errors in judgement may have serious impacts.

Stress and Tactical Decision-Making - Many factors are likely to affect the performance of critical policing skills, but stress is perhaps one of the most critical factors. The ability to make decisions, especially while under stress, is a critical skill of law enforcement officers (FLETC, 2004). Officers routinely encounter stressful situations that require making decisions that could ultimately result in life or death. In addition, many shooting incidents occur in poorly illuminated environments, at close range, with multiple subjects, sometimes including innocent bystanders. Most of these incidents are over in less than 3 seconds. Unfortunately, there are a number of ways in which stressful situations can affect officers' normal cognitions and their ability to make decisions (e.g., working through the OODA process). Widely used phrases, such as "choking under pressure" and "inaction paralysis" are a testament to the effects that acute stress can have on the execution of otherwise routine responses. This section explores the role of stress on skilled performance in more detail.

A stressor is any external stimuli or event that puts demands on us (Selye, 1956; as cited by Kavanagh, 2005) and stressors can be classified as being either acute or chronic.[3] Acute stress is sudden, intense, and only lasts for a short period of time. Acute stressors include issues like time pressure, high levels of risk or threat of attack. It is clear from the literature that the impact of stress is subjective rather than objective. Put simply, the interpretation of stress by the perceiver rather than the absolute level of stress is the best indicator of its actual effect (Lazarus & Folkman, 2004). Situations in which people feel acute stress are often called critical incidents. Critical incidents are "sudden, powerful events that often expose the officer to dangerous situations that are perceived as being outside of the officer's immediate control" (Anderson, Litzenberger & Plecas, 2002, p. 403).

Exposure to stressors initiates a range of physiological responses that prepare the body to function effectively in challenging situations (Selye, 1956; as cited in Kavanagh, 2005). Examples of physiological responses common in the available literature (and relevant research findings) are as follows:

Increased heart rate. Anderson, Litzenberger & Plecas (2002) found that police officers have increased heart rate when there is a potential for threat as well as during periods of anticipation. Such situations include:

- When hand is placed on holstered gun or opened snap to gun holster, especially if a suspect was present (potential threat)
- During and up to 60 minutes after critical incidents (potential threat)

[3] Chronic stress, however, is long-term exposure to acute stresses or low stress situations. Sources of chronic stress can be organizational, such as lack of administrative support, or inherent to the job, such as shift work (Anderson et al., 2002). Stress research in the policing literature has tended to focus on the effects of chronic stress (e.g., burnout).

- When talking to a suspect after a critical incident (potential threat)
- At the beginning of a shift (anticipation)
- When providing back up (anticipation)

According to Siddle (1998, as cited in FLETC, 2004), people perform best when their heart rate is between 115 and 145 beats per minute. Police officers' heart rates have been shown to increase during acute stress situations, and to remain elevated for more than an hour after debriefing from such situations (HeartMath Research Center, 1999). Increased heart rates can also have a negative impact on performance. For example, changes due to heart pulse can displace a rifle muffle a fraction of an inch and, consequently, a shooter can miss the target (Chung et al., 2005). However, FLETC (2004) research showed that this was not always the case, as participants with higher heart rates did not show decreased performance.

Elevated levels of cortisol. Regehr et al. (2008) found police recruits with higher levels of cortisol performed better in high-stress training scenarios. They conclude that moderately elevated cortisol levels "enhance arousal levels and to increase an individual's readiness to behave" (p. 301). However, elevated levels of cortisol have been associated with impairment in verbal, social and declarative memory, as well as with selective attention (Dickerson & Kemeny, 2004; cited in Regehr et al., 2008).

Increased breathing. As with heart rate, increased breathing can displace a rifle muffle a fraction of an inch and, consequently, the shooter is likely to miss the target (Chung et al., 2005).

Stress is thought to have an inverted U-shaped relationship with performance (Kavanagh, 2005). That is, moderate levels of stress can improve performance but high levels of stress can decrease performance. Several critical aspects of officer performance including the processing of information, motor skills and decision-making have been shown to be impacted by stress.

In terms of information processing, acute stress scenarios have been shown to influence police officers' reaction times and communication skills. Reaction times have been found to decrease during stressful events. This includes freezing in place, failure to remember training, failure to perceive important factors or irrational acts (Siddle, 1998, as cited in FLETC, 2004). After a scenario in which the partner appears to lose control of the vehicle and spin out of control, law enforcement trainees were found to take 9.5 seconds to respond to their call sign and only 68.7% of them correctly handled radio communication procedures (FLETC, 2004). In another high stress situation, in which the trainee's partner and a hostage had been shot, trainees took 4 seconds to draw their guns and raise it in the direction of the threat. The researchers conclude that in such a high stress situation, the trainees lacked "recognition and/or comprehension of the events in front of them during the first few seconds" (FLETC, 2004, p. 30).

Research also clearly shows the impact of stress on officers' ability to focus on the right information. Officers in acute stress situations have been found to have a narrowed focus or to focus on the wrong aspects of the situation. Nieuwenhuys and Oudejans (2011) found that police officers who were shooting at a target that shot back (high stress situation) spent less time focusing on the target and more time focusing on the threat (e.g., opponent's gun and face) and other elements in the environment (e.g., their own gun, the wall, or the ground). In a stressful

training scenario in which law enforcement trainees had to take a report with a number of distractors (e.g., argument, barking dog, loud music), trainees were found to focus on the hostilities but were unable to divide their attention in order to manage other critical activities such as communication with the dispatcher (FLETC, 2004).

Recent research explored the impact of threat and emotionality on police shooting behaviour (Kleider, Parrott & King, 2010). Working memory (the amount of information stored about recent events) has been shown to be negatively affected by perceived threat and anxiety and this reduction has been shown to lower performance. This research first measured the working memory capacity of 24 urban police officers. Participants were then shown FBI footage containing both baseline footage (i.e., a friendly officer-suspect interaction) and threat footage (i.e., officer shooting). Participants' mood and arousal were measured in response to the video footage, and participants completed a simulated shooting task. Results showed that officers with a limited working memory capacity and high emotionality were more likely to make shooting errors (i.e., shooting unarmed targets, or not shooting armed targets) than officers with more working memory capacity and those with low emotionality. These results were not the result of differences in reaction times. Incorrect decisions to shoot (or not to shoot) were the result of the officers' reduced or limited ability to account for all of the relevant factors of the situation (Kleider, Parrott & King, 2010). Explained in terms of the OODA loop framework, although the officer tended to observe all of the critical features of the situation, there was a failure to adequately orient this raw data prior to committing to, and acting on a decision. In short, officers' state of high anxiety and lower working memory capacity seemed to have hindered their ability to simultaneously consider all that they had observed.

In acute stress situations, people can also show a decrease in the ability to perform fine motor skills and complex motor skills, such as chambering a round, handcuffing a suspect, and performing weapons retention manoeuvres (FLETC, 2004). Research by Nieuwenhuys et al. (2009) found that police officers showed poorer performance conducting the hammer-lock, direct punch, forward kick, and vertical handcuffing method in high pressure situations than in low pressure situations. With respect to shooting a weapon, a number of studies have shown that acute stress negatively impacts shooting accuracy. For instance, only 21% of all rounds fired by police officers during acute stress situations hit the intended target (FBI Uniform Crime Report, 2000, as cited in FLETC, 2004). Chung et al. (2005) found that worry and anxiety during rifle marksmanship qualification negatively impacted novice shooters' performance. Police trainees were also found to have lower shooting percentages when firing in a high pressure situation than in a low pressure situation (Oudejans, 2008; Nieuwenhuys & Oudejans, 2010). A pervasive finding in the literature is that shot accuracy of police officers is higher in low pressure situations than in high pressure situations (e.g., Nieuwenhuys and Oudejans, 2010). According to attentional control theory, this is the case because stress directs attention away from the goal (i.e., focusing on the target) and directs it toward less critical stimuli within the environment (i.e., looking at the head or gun of the target), making behaviour less efficient and diminishing task performance. Good attentional control, then, would demand longer fixation on the target and less visual distraction from other sources.

Stress also impacts negatively on decision-making. In an acute stress scenario in which their partner and a hostage had been shot, law enforcement trainees performed weapons handling

skills in the incorrect sequence or performed the wrong function altogether. The researchers concluded that this poor performance was due to an impaired decision-making ability rather than impaired motor skills (FLETC, 2004).

Although there are a number of studies showing that acute stress can impact both the physiology and performance of police officers, our search of the literature revealed no research that looks specifically at the perishability of police use of force skills over a prolonged period of time in either stressful or non-stressful situations. However, there are a limited number of studies that shed some light on this important issue.

Research conducted the Federal Law Enforcement Training Center (FLETC, 2004) provides some information relevant to skills perishability under stress, but only within a very limited time frame. In a study conducted to look at physiological and psychological reactions to stress, researchers had law enforcement trainees complete a scenario that included a number of events, each with a unique stress level (FLETC, 2004). Overall, trainees did quite well in low stress events but did considerably worse in high stress events. Of particular interest for this report was an event in which trainees had to drive on the same emergency response course they had been tested on 3 weeks earlier. It was believed this event presented a moderate level of stress to trainees. The average score for this skill (i.e., techniques, proper line of travel through the turns) during the actual training test was 91.28%, and all participants passed in the allotted time. After only 3 weeks, however, this dropped to 86.58%, and only 67% of participants passed in the allotted time. Trainees' average scores were about 5% lower after only 3 weeks, and speed at which they were able to execute those skills had diminished significantly. Although this research addresses driving skills, it clearly shows the problem of skill retention when under moderate stress. Unfortunately, it is impossible to know the contribution of stress to skill fading.

A study conducted by Ho (1997) also provides insight into police use of deadly force and length of officer experience. This study explored differences in the use of deadly force between rookie (less than 5 years of experience) and veteran (at least 5 years of experience) police officers in Tallahassee. Each of the officers completed simulated life-threatening (shoot) and non-life-threatening (don't shoot) scenarios. In the life-threatening scenarios, officers were required to identify a life-threatening suspect (judgement), respond promptly before the suspect employs lethal force (reaction time), and exhibit good marksmanship to eliminate the threat (shooting accuracy). Officers were deemed to have survived the scenario if they accurately identified the suspect as life-threatening, reacted to the suspect in a timely manner, and were able to successfully hit the target suspect.

Results showed that rookies displayed better judgement and shooting accuracy than veterans (Ho, 1997). For example, in the non-life threatening scenarios, 90% of rookies and 75% of veterans were deemed to have shown good judgment by averting or withholding fire when confronting a harmless suspect during high-risk encounters. Relative to the non-life-threatening scenarios, both rookies and veterans performed poorly in the acutely stressful life-threatening scenarios. However, rookies still did considerably better than veterans, as follows:

- 64% of rookies and 56% of veterans were able to identify a life-threatening suspect
- 96% of rookies hit the target suspect whereas only 77% of veterans hit the target suspect
- A total of 54% of rookies and 39% of veterans survived the scenario

- There were no differences, however, in reaction times

Whether a life-threatening scenario or not, rookies were deemed to have performed better than veterans in the scenarios. Performance was further decreased when a fatal threat was added to the scenario. Although a fatal threat negatively impacted both rookies' and veterans' performances, the impact was greater on the veterans because their scores were already lower. That is, the added stress worked to further impair the veterans' judgments in a crucial situation. These findings are potentially relevant to understanding retention of key skills over time, as the time between initial use of force training is likely to be longer for veterans than rookies. Unfortunately, there is no information about the time since training or refresher training available in this report, so it could be that rookies and veterans received other intervening training, so the conclusion of this representing skill perishability is tenuous. Recent work by Nieuwenhuys and Oudejans (2011) suggests that practice in intense situations may help to sustain shooting skills over time. The researchers had police officers execute a shooting exercise against an opponent in either a high anxiety situation (the target shot back) or a low anxiety situation (the target did not shoot back). Officers engaged in shooting exercises at 3 different times: pretest, posttest (4-6 weeks later) and a test of retention (4 months later). After the pretest, participants in the experimental condition received 4 training sessions (1 per week for 4 weeks), in which they executed shooting exercises like the test exercise, conducted at police academy training facilities. In all, participants fired 48 rounds over the 4 weeks of training. Officers in the control conditions received no training. Measures of anxiety, heart rate and mental effort confirmed that participants in the high anxiety group experienced more stress than those in the low anxiety control group.

Analyses compared shooting accuracy from pre-test to post-test and from post-test to retention test. Results showed that although police officers (both experimental and controls) generally had a lower shot accuracy when they were in a high anxiety situation than when in a low anxiety situation, for the post-test, this effect only held for control participants, as the experimental participants (who had received training) showed no significant gap between high and low anxiety shooting. This effect, they argue, relates to the training that they received. Comparing the post-test results with those after 4 months, participants showed a decrease in shooting accuracy for participants in both low and high anxiety situations, but participants in the control group showed improved shooting accuracy. Nieuwenhuys and Oudejans (2011) suggest this improvement in the control group between posttest and retention test was due to the experience of shooting under anxiety provoking situations during the testing, and concluded that practicing under acute stress can improve retention. However, this conclusion seems tenuous given that it does not address the fact that participants in the experimental condition would have had the same practice opportunities but showed diminished shooting performance. Nonetheless, this research represents an important start to being able to quantify the impact of both time and stress on use of force skills.

The literature reviewed within this section hopefully shows some of the complexities in thinking about the factors that influence skill perishability, and the difficulties likely to be facing in disentangling the many possible influences on it. Although there is good evidence that acute stress does indeed impact police officers' performance, there is very little current research that helps to understand the impact of skill perishability on performance, or how often critical skills

would need to be refreshed. Fortunately, there is some evidence in the literature of empirical work that touches on this issue, but much more controlled research would need to be undertaken to fully understand this problem.

From this perspective, then, the failure to display the appropriate "use of force" skill in a given situation may be because the skills have faded, or because available skills exist within the person but cannot be accessed when under high stress. Although these two explanations have the same ultimate effect (i.e., the skill cannot be displayed), the underlying reasons are critical to understanding the issue of skill perishability and the research and training that would be required to address the problem in the long term. For example, there is consistent agreement in the literature that many of the challenges that police officers face are not really about the discrete skill itself, but about decision-making processes around the skill and managing one's level of stress in high intensity situations. For example, some researchers have argued that "…regular police training focuses predominantly on the technical, tactical and physical aspects of performance and largely neglects the role of psychological factors such as stress and anxiety" (Oudejans, 2008; cited in Niewenhuys and Oudejans, 2011, p. 1). If this is the case, then the focus of future research and training should be more on understanding the impact of stress on skilled performance. However, it is impossible to separate this issue from skill perishability, because the literature is also clear that skills will diminish at varying rates over time. This area is in particular need of research attention because the literature simply does not provide much insight about the perishability of police skills.

Conduct research on the psychological factors that affect skill retention.

3.3.2 Police Psychomotor Skill Acquisition

Typical instruction at police academies include professional orientation, community relations, law, laws of evidence, communications, vehicle operations, force and weaponry, patrol procedures, traffic, criminal investigations, custody, and physical fitness and defence tactics.

Table 8 (below) presents the skills noted and the associated training hours provided to recruits at the Saskatchewan Police College in 2002-2003 (Saskatchewan, 2004); although these hours may vary between academies, they are presented as a guideline.

Table 8: Saskatchewan Police College Training Hours by Skill (2002-2003)

Skill Area	Number of hours
Communication Skills	26.75 (includes 17.5 hours of Cultural Relations)
Criminal Justice	30.00
Criminal Law	46.75
Crisis Intervention	24.00
Federal Statutes	19.25
Force Options (includes Defence and Control, Firearms Training, and Public & Officer Safety Training)	173.75
General hours (previously called miscellaneous, includes 21.25 hrs. a.m. recruit briefing)	43.75
Human Behaviour	24.50
Personal Development	42.25
Police Procedures	153.75
Provincial Statutes	19.50
Total hours of instruction per recruit (Excludes remedial firearms training and fitness programs outside scheduled classroom hours.)	602.50
Actual Hours of Instruction	757 hours

A review of the training curriculum will identify considerable emphasis on the development of psychomotor skills. Initial training raises performance to a criterion level (pass level) at the academy and the cadet is then posted to his field unit. Psychomotor skill refresher training is conducted periodically to maintain performance at or above criterion. For reasons of efficiency and economy, it is important to not conduct more refresher training than is necessary to keep performance at the desired skill level.

3.3.3 Law Enforcement Psychomotor Skills

Law enforcement use of force skills involves a variety of perceptual, cognitive, affective and psycho-motor abilities. While one task may involve predominantly perceptual skills (i.e., identification of partially concealed weapons), others require cognitive skills (i.e. assessing a potentially hazardous situation and moving behind cover). Use of force skills vary from soft skills where body harm is not intended, to hard skills where injuries are expected and finally to lethal force. Tools used in use of force applications can have soft and hard applications (e.g. an open-handed slap can be used as a soft distraction technique or the fist can be closed as a hard application). Similarly, a baton can be used to control an assailant's movement (soft application) but it can also be used in a slash or blow (hard application). Simply drawing a Conductive Energy Weapon (CEW) may cause an actively resistant opponent to stop resisting without the need for

using the system. For the purposes of this investigation, use of force skills were identified as follows:

- Soft intervention skills
  - Officer presence (non-verbal communications)
  - Verbal communications
  - Empty hand techniques – soft
    - Handcuffing and leg restraints
    - Distraction strikes
    - Control bars and locks
    - Pressure points
- Hard intervention skills
  - Empty hand techniques-hard
    - Fist strikes
    - Brachial pressure strike
    - Kicks
    - Carotid Hold
- Impact weapons (Batons)
  - Soft techniques
  - Hard techniques
- Aerosol Spray
- Conductive Energy Weapon
- Lethal force

3.3.3.1 Lethal Force Psychomotor skills

The lethal force skill literature review results will be organized as follows:

- Lethal force skill training programs
- Lethal force training techniques
- Lethal force skill perishability

Lethal Force Skill Training Programs

While In-service pistol recertification is mandatory in Canada, such is not the case in the United States, for example pistol requalification was mandated by the vast majority (98%) of police and correctional departments surveyed in Washington State, with many also requiring shotgun (82%) and rifle/carbine (56%) in-service training (Morrison, 2003). While the majority of (USA) departments surveyed had policies regarding training session frequency (68%), requalification interval (72%), and minimum re-qualifying score (71%), a minority also had policies regarding training session duration (11%), tactical training (29%), judgment training (22%), or requalification course composition (43%) (Morrison, 2003). Handguns received the majority of attention for in-service training, with nearly 9 in 10 (87%) departments using more than two-thirds of their training resources on handgun activities; however a large proportion of departments also allocated resources to shotgun (85%) and rifle/carbine (60%) activities (Morrison, 2003). Resources were typically equally distributed between in-service training activities and

requalification activities, with a slight emphasis on requalification while training activities were used to maintain or improve existing skills in the majority (77%) of departments (Morrison, 2003). Cartridge allocation for each officer per year was found to vary widely from 0 to more than 1,000, while instructors recommended 1,000 cartridges as the minimum per year allocation (Morrison, 2003). Firearms training time per year averaged 13 hours, of which nearly all departments devoted at least half to handgun training (Morrison, 2003). Quarterly in-service training sessions were the most common frequency (47%), which corresponds with the recommendation of the majority of instructors (64%); other departments were evenly split between more frequent and less frequent training sessions (Morrison, 2003). Historically, requalification on the handgun has been required semi-annually or annually (Matulia, 1982 and Skillen & Williams, 1977 as cited by Morrison, 2003). Morrison (2003) found quarterly or semi-annual requalification to be preferred, although annual qualification with supplemental training sessions may also be acceptable. Traditionally handgun proficiency is qualified by marksmanship scores on a set course against an absolute threshold, which have varied from 60 to 85 percent (Morrison & Villa, 1998); recently there has been a trend towards using a pass-fail system without recorded scores that would facilitate tracking officer skill over time (Morrison, 2003). Separate tests were used to assess general gun handling and combat-related gun handling by some departments (37& and 44% respectively) in Washington state (Morrison, 2003). Policies regarding failure to re-qualify varied from the most frequent policy of immediately repeating the test until passed (40%), to disarming and reassigning affected personnel (1%), to giving supplemental instruction prior to a subsequent requalification attempt (28%) (Morrison, 2003). Rates of officers failing to re-qualify on their first attempt were not surveyed.

Morrison (2006) conducted a similar survey of larger police departments on the state, municipal/metropolitan, and county levels. The size of the department, as measured by the number of officers in field assignments, was not significantly correlated with handgun activity hours or requalification emphasis (Morrison, 2006). Departments were approximately evenly distributed in the hours of handgun training activity between fewer than 8 hours, 8 hours, and 9 to 16 hours (Morrison, 2006). A slight majority (51%) of departments surveyed devoted more than half of their training time to requalification (Morrison, 2006). The basis for requalification was split between traditional point scoring systems (43%) and newer pass/fail schemes (53%) (Morrison, 2006). The vast majority of departments surveyed used requalification thresholds between 70% and 80% (Morrison, 2006). Morrison (2006) concludes that competence should be the major determining factor in violent encounter outcomes, competence that should be developed in deadly force programs that practically prepare officers for field performance.

Lethal Force Training Techniques

The effects of different training techniques on lethal force skill retention have been explored. Augmented auditory feedback provided as an aid to detect and correct errors related to rifle balancing was found to both increase learning as measured by post-test performance and increase skill retention tested 10 and 40 days after post-test relative to control conditions (Konttinen et al., 2004).

In novices learning pistol shooting, the impact of varied schedules of practice amongst three different range protocols was found to be significant (Keller et al., 2006). Participants who

practiced in a serial schedule, rotating between the 3 ranges every 5 shots, had depressed performance during initial training showed better performance on retention tests relative to participants with blocked practice, completing each range before moving to the next (Keller et al., 2006). The additional adjustments to different targets and shooting protocols required in serial practice were demonstrated to aid performance at retention testing.

Shooting accuracy has been shown to deteriorate when performed under pressure (e.g. Nieuwnehuys & Oudejans, 2010); however, these deleterious effects of pressure can be countered by training with pressure (Oudejans, 2008). Furthermore, training with pressure has been argued to demonstrate both short and long term improvements in skill retention of handgun shooting performance (Nieuwenhuys & Oudejans, 2011).[4]

Mental training, in the form of meditation and biofeedback, has been shown to improve accuracy of shooting (Couture et al., 1999). The meditative technique was used to relax participants while the biofeedback training involved lowering muscle tension and heart rate, and increase peripheral digital temperature.

As a whole, then, there is some evidence of training techniques supporting retention. However, it is important to note the relatively short retention intervals in play.

Lethal Force Skill Perishability

While police officers have carried firearms since the mid-nineteenth century, efforts to develop skill in using lethal force have lagged considerably behind (Morrison & Villa, 1998). As New York City Police Commissioner, Theodore Roosevelt implemented semi-annual handgun instruction in 1895 in response to his inquiry into accidents and miserable gunfighting performances (Morrison & Villa, 1998). However, by the 1920s, the majority of American municipal police officers still did not receive departmentally organized and mandated handgun training (Morrison & Villa, 1998). Initial training regimes were based on military doctrine of handgun skill using bull's-eye shooting, which were furthered by the National Rifle Association (NRA) influences of pseudo-combat matches (Morrison & Villa, 1998). The authorization of Federal Bureau of Investigations (FBI) special agents to routinely carry handguns spurred the FBI into training of lethal force skills and led to the development of the practical pistol course (PPC) (Morrison & Villa, 1998). A performance threshold of 60 percent was used in the early qualification tests, but the FBI raised the threshold for the PPC to 85 percent in 1943 (Morrison & Villa, 1998). In the late 1960s New York City was using a PPC-style course with a 75 percent performance threshold (Morrison & Villa, 1998). By the 1950s, police handgun training was common; however, these early training and qualification schemes are criticized for having little to do with police gunfighting in terms of environmental and physiological demands, qualification expectations, performance thresholds, and validity (Morrison & Villa, 1998).

The felonious killing of police officers peaked in the United States in 1973 at 134 (Morrison & Villa, 1998). Although the rate of felonious killing of police has dropped dramatically (70 percent) from 1971 to 1990, Morrison and Villa (1998) suggest that this reduction in officer deaths is primarily due to the introduction of soft body armour and improved field tactics. Improved field

[4] This assertion is explored in more detail in the Tactical Decision-Making section

tactics would include teaching officers handgun retention skills, to beware of their surroundings, to use cover and increase separation from armed criminals, and better procedures for high-risk encounters (Morrison & Villa, 1998). The decrease in rate of felonious killing of police is less attributable to the development of lethal force training and qualification, as statistics show low levels of field shooting accuracy (Morrison & Villa, 1998). These low levels of field shooting accuracy call into question the validity of contemporary lethal force training (Morrison & Villa, 1998). Despite advances in firearms technology and equipment, and the introduction of training, only modest improvements in field shooting performance have been achieved since the nineteenth century (Vila & Morrison, 1994). The relation of bullets hits to shots fired by police was one-in-seven from a study of nineteenth century New Orleans police; whereas, for contemporary police this ratio is typically one-in-five (Morrison & Villa, 1998). According to Morrison and Villa (1998), police handgun training doctrines and techniques may be poor preparation for the challenges of armed confrontations.

Use-of-force tactics are perishable skills that deteriorate without practice, decay over time, and become less memorable without recall in work conditions, and thereby require refresher training (Gallo et al., 2008). Retrospective reviews of use of force by police provide another avenue of insight into lethal force skill. A review of police use of force revealed that the use of any weapons is a rare event, occurring in 2.3 percent of arrests studied; however, agencies with relatively greater use of force rates also typically had more hours of in-service training (Lee et al., 2010). From a review of police shootings in Philadelphia, White (2006) recommends additional firearms training at longer distances (greater than 20 feet) and during a struggle when the likelihood of a miss was extremely high.

3.3.4 Conductive Energy Device, OC, and Baton Training and Retraining

Police agencies in Canada have been using conductive energy weapons since 1999. In Ontario, following field tests conducted by Ottawa and Toronto Police Services in 2000 and 2001, the Taser was approved by use as a less lethal conducted energy weapon (Policing Standards Advisory Committee, 2009). Across Canada there is no consistent training and refresher training program. For example, for a RMCP officer to be authorized to use a Taser they must complete a 16 hour course, over the period of 2 days, compared to Ontario legislation that states that initial Taser training must be a minimum of only 4 hours of classroom and practical training. Unlike some other less than lethal weapons used by police agencies, there is a requirement across most police agencies that Taser end users must re-certified after a discrete period of time. However, there are differences between the amount of refresher training that is required and the duration of certification. The RCMP requires their officers to be re-certified every year by taking a 4 hour training course. A review of conducted energy weapons in Ontario states that refresher training should be at least 2 hours in length and be conducted every twelve months.

Other intermediate tools such as Oleoresin Capsicum (OC) spray and batons may not, depending on the force, require any refresher training. The initial certification for OC spray use is approximately 3 – 4 hours in length and is valid for up to two years. Baton training is similar with the respect that after the initial 4 – 8 hour training period the officers are typically certified for up to three years.

Research has shown that distributed practice is better for skill retention than massed practice indicating that it might be a mistake to try to conduct all training into a single session, or in a single day (Baddeley & Longman, 1978).Currently, there is no research that identifies the appropriate level of Taser, OC, and baton retraining, but research in other areas shows that longer intervals between retraining sessions will demand a longer relearning process (Ginzburg & Dar-El, 2000). Also, the amount of information retained declines in a non-linear manner (Kamuche & Ledman, 2005). The level of retraining also depends on the complexity of the skills and the level of use between retraining sessions. Forgetting a skill is a function of the amount learned and the break duration (Ginzburg & Dar-El, 2000). Therefore, if an officer uses the skills on a frequent basis there is less need to be retrained as frequently as someone who rarely uses that skill. If we compare police officers to military personnel who do not perform specific psychomotor skills often (i.e. firing a taser, using a baton or OC spray), then refresher training is required in order to achieve skill retention (Ginzburg & Dar-El, 2000). In fact, research has shown that pilots have shown a critical decline in helicopter flight skills after six months of no flying (Ginzburg & Dar-El, 2000). Helicopter flight skills have both procedural and psychomotor components, as opposed to the use of a Taser, OC spray, or a baton which require primarily on psychomotor skills. Since procedural skills are not retained as well as psychomotor skills, there should more intensive training done on procedural skills (Ginzburg & Dar-El, 2000). Once it has been deemed necessary to use a Taser, the main procedures involved in deploying it involve withdrawing it from the holster, determining where to shoot the target, and pulling the trigger. Similarly, when using OC spray, the main procedures include withdrawing it from the holster, pointing/ aiming at the target, and then depressing the trigger. However, the use of baton involves slightly more complex procedures. The officer must determine whether to use the baton in open or closed mode, what type of stance to take, the type of strike to use, and the location of the strike. Therefore, the increased complexity of baton use, when compared to Tasers or OC spray, identifies a need to include refresher training. Baton tactics can be thought of as self-defence tactics which are not learned once for all time. In order to maintain proficiency, self-defence tactics must be practiced weekly (Baker & Mackie, 1995). Weapons proficiency degenerates rapidly as a function of time and self-defence proficiency has an even faster cycle (Baker & Mackie, 1995). Therefore, the use of a baton, which is can be used for self-defence, may need to be practiced more frequently than weapon use.

The interval between the initial training sessions and subsequent training/refresher sessions depends on a variety of factors. As previously mentioned, procedural skills are forgotten at a faster rate as psychomotor tasks, so skills that involve more procedural knowledge should undergo refresher training more often. Ginzburg & Dar-El (2000) found that after 3 months without training of the helicopter skills, three 30 minute training sessions were not enough to bring the operators back to a required performance level. However, after one month and two month breaks without training, participants were able to achieve a full restoration of skills after the three 30 minute training sessions. Bahrick (1979) stated that the amount of retraining depends on the level of use. For instance, the access to certain information (i.e., using a Taser) is highly probable if the retraining session interval does not exceed the access interval (time between initial training and time when used). Bahrick also claimed that much of what is learned during a first exposure is forgotten during the interval between exposures and must be relearned later to become part of semi-permanent knowledge. This would suggest that there is a need for

officers to take part in refresher training for the use of OC spray and batons because much information presented during the initial training may be forgotten without any additional exposure. The same may not be true for Taser use. It is unlikely that a police officer will deploy their Taser within a year of their initial training. However, the likelihood of using the Taser increases if the officer is a part of a tactical unit or a hostage rescue team. Currently several police agencies only train officers of a tactical unit or the hostage rescue team to use the Taser. This increases the likelihood of them deploying the Taser before they receive their annual refresher training. Barhrick (1979) found that the intervals between relearning sessions (refresher training) had an impact on retention. Subjects trained with long intersession interval (30 days) had a better opportunity retain necessary information when compared to those with short intersession intervals (one-day).

As a whole, then, although there is little research directly exploring the perishability of Taser, OC, and baton skills, related literature does provide some helpful information about retention and need for refresher training of these skills.

3.3.5 Hand to Hand Defence and Control Skill Acquisition and Retention

In a 1998 report by Marion (Marion, 1998) polling 28 students at the Ohio University Police Academy reported that only 30 hours of training and instruction was dedicated to self-defence while 64 hours was dedicated to weapons training. (Please note the number of academic hours devoted to personal defense tactics is not reflective of that provided in Canadian training institutions surveyed. The reader is referred to Section 4 for a review of training hours in Canada). In a separate report by Kaminski and Martin (2000), the authors note that because of the decentralized structure of policing in the USA, there are no nationally agreed upon standards regarding the amount of defence and arrest and control tactics training, the duration and frequency of training, the method of instruction (i.e. which methods are most efficient for adequate skill acquisition and retention), or which specific techniques are the most effective for safely gaining control of subjects and officer self-defence. A 1990 survey of municipal and county police agencies with 500 or more sworn personnel (n = 72) found that the number of hours of defensive tactics instruction for recruits ranged from a low of 10 hours to a high of 148 hours. Only 7 agencies (of 72) reported that officers received any in-service training in defensive tactics. There appears to be no formal research on how best to ensure law enforcement officers acquire and retain adequate skill levels in defence and control tactics. Injuries sustained by personnel during training have limited the amount and fidelity of unarmed combat training that LEO currently experience (Czarnecki and Miller, 2006).

Police departments have tended over time to teach martial-arts based systems to their officers based, presumably, on their assumed ability to execute effective defence and control maneuvers with an economy of energy and speed. However, many of the martial art-based systems have failed to take known, human motor performance limitations into consideration, such as physical lag times, attention, and deterioration of fine motor skills under stress (Martin 1997; Redenbach, 1998). Most often, the end result was abandonment of the training in stressful field conditions. Officers would commonly revert back to whatever was their most dominant response to a given situation, such as using a flashlight or a nightstick to club suspects over the head or simply brawling (Cox et al., 1987; Redenbach, 1998). Kaminski and Martin (2000) further note that

another limitation of the traditional, martial arts-based systems, are their over-reliance on pain-compliance. Typically, officers are trained to place subjects into a preparatory control hold such as a joint lock. The most common problem associated with the pain-compliance philosophy is that many individuals the police detain and arrest are under the influence of drugs, alcohol or adrenaline and their ability to feel and react to pain may be impaired or absent (McLaughlin, 1992).

Considering the stressful (and likely violent) environment in which police officers would find themselves, when using these aforementioned hand-to-hand defence and control tactics, Kaminski and Martin (2000) contend that given the deterioration of fine motor skills, the limited ability to remember multiple tasks, and diminished perceptive abilities under stressful conditions, the related training methods are not ideal. Training, should involve as few procedures as possible to deal with the widest variety of situations (e.g., handcuffing in a variety of risk settings and arrestee positions). As well, training should not exceed the limitations of human performance, such as reaction time and attention; techniques should be based on gross motor skills and use large muscle groups since fine motor skills are more difficult to learn, maintain, and are the first to deteriorate under stress. As well, training should occur in environments as similar as possible to those officers encounter in the field. A study consisting of in-depth interviews involving 91 representatives from 65 private and police agencies with the province of Quebec found that a confrontational attitude rather than a more collaborative standpoint was the norm in arrest negotiations (Alain and Crete, 2009). Further, these 91 representatives suggested that training must be of immediate relevance to the job; however, both police employers and employees were resistant to new and higher training standards imposed by governments and public sector professionals, who are often suspected of not knowing much about the "reality" of police work.

In their survey of approximately 600 officers Kaminski and Martin (2000) found that nearly 60% of officers surveyed said that they had experienced a violent line-of-duty assault and that the training they received failed to adequately prepare them for the attack. Nearly 50% of the total sample felt that more time should be devoted to defensive tactics training. Only about 25% of those surveyed felt additional time should be devoted to arrests and control tactics. The authors noted that such high levels of dissatisfaction suggest that many officers' experiences with the tactics in the field were less than satisfactory or that a lack of confidence in the tactics precluded their use in the first place. With regard to how their in-service training might be improved, officers expressed high levels of interest in wrestling, takedowns, punching, kicking, defence against multiple assailants, defence against pepper spray, and gun retention techniques. Officers expressed moderate levels of interest in pressure point controls, baton controls, and firearms training, and relatively little interest in verbal tactics, locks and holds, training with pepper spray, and baton strikes. More than half (51%) of respondents indicated they had studied wrestling, boxing, or martial arts outside of the department and virtually all (99%) of these officers reported that these methods were helpful during arrest or self-defence situations. Based on the finding that officers spend more time in private training than in in-service training, and that they found their prior training helpful during arrest and self-defence situations, Kaminski and Martin argue that agencies might want to increase in-service training time to improve technique effectiveness. However, the authors note that it is possible that these officers' responses are overly optimistic because they self-selected into their training. In their post-hoc evaluation of officer data,

Kaminski and Martin (2000) found that previously assaulted police officers were less likely than unassaulted officers to agree that defensive tactics are useful for self-defence and more likely to indicate that they are ineffective for dealing with resistive or assaultive subjects. This finding is important in that it relates the training provided to officers and their impressions of the training realized under actual field conditions. Assaulted officers were more likely than unassaulted officers to express interest in additional hours of defensive tactics training. If a substantial proportion of officers find the methods do not work on the street, instructors and administrators need to determine whether additional training time, alternative tactics, or different instructional methods (or all three) are needed for appropriate skill acquisition and retention and effective field application. In an analysis of Mississippi conservation officer satisfaction with weaponless tactics training (Minnis and Parker, 2002), 104 respondents to a survey were categorized by their experience (<5 years' experience, 5-15 years' experience, >15 years' experience). Officers with more experience were likely to find weaponless tactics training important, and were less likely to find weaponless tactic techniques easy to learn and remember. Officers felt the number of hours received in firearms training and pressure point control techniques were satisfactory whereas training in other defence areas was less than adequate. More than 60% of respondents indicated that too little time was spent training in verbal tactics, punching techniques, defending punches, kicking techniques, and throwing/takedown techniques. More than 70% of respondents indicated that too little time was allotted for training in defending against kicks, ground wrestling, and gun retention. Over 85% felt there should be an increase in multiple-assailant defence training. This survey indicated a lack of satisfaction in how officers feel they have been trained to protect themselves in their daily work and the authors suggest that the current training paradigm for conservation officers in Mississippi needs to be re-evaluated.

Nieuwenhuys et al. (2009) evaluated the performance of five physical self-defence skills that are regularly used in the line of duty in controlled low-stress and high-stress environments: the hammerlock, the direct punch, the forward kick, the vertical handcuffing method, and the forehand with the short baton. These skills were selected because they are a representative reflection of all available skills; they are all relevant, suggesting that each skill is necessary, frequently used, and/or difficult to execute. The skills were evaluated using a validated 5-point scale by experts. Results showed that police officers' performance suffered under pressure. The authors suggest that in order to bring training into line with the physical and psychological stressors experienced "in reality", incorporating stressful factors would increase the success of officers' execution of these relevant skills.

In a 2008 survey (Gallo et al.) of 3300 adult arrests made by officers from 16 Rhode Island (RI) police departments servicing rural, suburban, or urban regions, it was found that RI officers used physical force at a lower rate than did officers from other previously surveyed police jurisdictions; RI officers' use of force were mostly commensurate to suspects' actions of resistance during arrests. In this study, the levels of suspect resistance and levels of police force are shown Table 9.

Table 9: Suspect Resistance-Police Force Continua

Levels of Suspect Resistance	Levels of Police Force
1: Compliance	1: Presence
2: Verbal resistance	2: Verbal commands
3: Defensive resistance	3: Restraints
4: Bodily force	4: Pursuit
5: Deadly force	5: Bodily force
	6: Chemical agents
	7: Impact weapon
	8: Deadly force

Of the 3300 arrests studied by Gallo et al., police used behaviours at all levels of the force continuum. In order of decreasing number of arrests made at a particular level of force used, in 2735 (82.88%) restraints was the highest level of force; in 242 (7.33%) arrests bodily force was the highest level of force used; in 187 (5.67%) presence was the highest level of force; in 66 (2.00%) pursuit was the highest level of force used; in 31 (0.94%) arrests, chemical agents was the highest level of force used; in 30 (0.91%) deadly force was used; in 9 (0.27%) impact weapons was the highest level of force used. These results are presented in Figure 7.

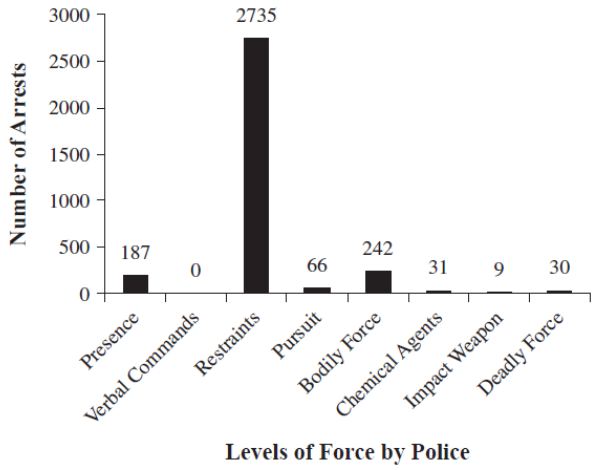

Figure 7: Levels of force used by Rhode Island police officers in 3300 arrests

These results suggest that in the vast majority (97.9%) of surveyed arrests in Rhode Island, the greatest level of force needed to arrest suspects was "Bodily Force" (Level 5). Conversely, in the remaining 70 arrests (2.1%) police used combinations of force levels that were more forceful than was the standard combination of presence (Level 1) and bodily force (Level 5). These results indicate that the need to utilize use of force tactics that include weapons (i.e. chemical agents, impact weapons, or deadly force weapons) is infrequent and that most police force occurs at the lower end of the force continuum. Indeed, of all the 3300 arrests studied by Gallo et al., 2922 (88.5%) involved no physical force whatsoever and consisted primarily of officer-presence, verbal commands, and restraints – even in situations that had a greater potential for violence. These findings are consistent with use of force results from Canada. In the Durham Region Chief of

Police's annual report on adequacy and effectiveness of Police services (Durham,2010) the use of force option deployed by his 800 officers included a mix of use of force techniques.

Table 10: Use of Force Option Deployed by Durham Regional Police Service 2008-2008

Year	Discharged	Pointed	Aerosol	Impact hard	Empty hard	Other (includes CEW)	Canine	Total
2008	41 (39 for destroying injured animals)	136	16	10	75	38	23	323
2009	21 (21 for destroying injured animals)	175	12	9	81	38	54	333

Given that there were approximately 46,000 disorderly conduct calls in Durham Region in 2009 (Durham, 2009) and only 333 cases of notable use of force deployments, it can be inferred the vast majority of interventions did not involve suspect injury. It can be surmised that the bulk of these cases were resolved with officer presence, verbal negotiation and soft empty hand techniques.

This finding was also supported by Smith and Petrocelli (2002) who argued that officer expectations and training regarding the use of force continuum should be brought into line with the reality that most arrests will be nonviolent and will not require the application of physical force. However, Gallo et al. also contend that the data shows there is some obvious element of force in police work. Subsequently, there is a need to train officers on the proper use of weaponless (use of an arm bar or pressure point) and weapon tactics (baton, chemical agent, or firearm).

Legal precedent in the United States (Canton v Harris, 1989) has indicated that a failure to train police in the use-of-force tactics that they are likely to use against probable forms of citizen resistance in the work field can amount to a "deliberate indifference" to constitutional rights of citizens to be free from unreasonable uses by police.

3.3.5.1 Application of the UDA Model to a wristlock

The Army Research Institute (ARI) model for User Decision Aids (UDAs) was initially constructed by Rose et al. in 1985a in their seminal paper "Acquisition and Retention of Soldiering Skills". It is an internally validated and often cited methodology for describing the relative perishability of skills after training. For the purpose of describing police retention of common and relevant skills, the ARI model for UDAs was applied by an SME on our research team to four simple defence and control policing tasks:

- the wristlock
- the wristlock to come-along
- the wristlock against a weapon
- an armbar

For the purposes of this report the results of the UDA model for the wrist lock will be presented here. The sequence of steps describing a properly executed wristlock are illustrated in Figure 8 and described in Table 11. These steps were obtained from a United States Marine Corps Close Combat Training Manual (FM 3-25.150, 2002).

Figure 8: A USMC wristlock

Table 11: The Steps Involved in Executing a USMC Wristlock

Step		Description
1		Use the right hand to grab the opponents left hand by placing the thumb on the back of the opponents hand so that the Marine's knuckles are facing to the left
2		Hook the fingers across the fleshy part of the opponent's palm below the thumb. The fingers are used to anchor the hand so leverage can be applice to twist and bend the joint
3		Exert downward pressure with the thumb to bend the opponents hand to the right to twist the joint
4		Step in to the opponent to keep the opponent's hand in close to the body to control him and provide more leferage on the wristlock

Applying the ARI model for UDAs to the above steps for conducting a wristlock a score of 123 is obtained –Table 12. Rounding the wristlock UDA score of 123 up to 125, it is observed that using

the UDA skill perishability curve only 67% of novice officers would be able to successfully execute this skill 1 month after training (Table 12 Figure 9).

Table 12: An Application of the ARI model for a USMC Wristlock

Question		Rating Scheme		Task Response	Description	Score
1	Are job or memory aides used by the operator in performing (and in the performance evaluation of) this task?	Yes No	1 0	Yes	Photographs of steps are provided	1
2	How do you rate the quality of the job or memory aid?	Excellent Very good Marginally good Poor	56 25 2 1	Very Good	Photographs may not be entirely clear as to what is being described	25
3	Into how many steps has the task been divided?	One Two to Five Six to Ten Ten+	25 14 12 0	4		14
4	Are the steps in the task required to be performed in a definite sequence?	None Some All	10 5 0	All		0
5	Does the task provide built-in feedback so that you can tell if you are doing each step correctly?	All steps Most Few None	22 19 11 0	Few	There are few (if any) built-in feedback mechanisms to performing a wristlock task that would suggest that the performer is successfully executing the skill	11
6	Does the task or part of the task have a time limit for its completion?	No Limit Easy Limit Difficult Limit	40 35 0	Difficult Limit	Given the stressful (and likely violent) environment in which the skill would likely be performed, it would need to be performed as quickly as possible	0
7	How difficult are the mental processing requirements of this task?	Almost none Simple Complex Very Complex	37 28 3 0	Simple	More physically stressing than cognitively	28
8	How many facts, terms, names, rules, or ideas must an operator memorize in order to do this task?	None A few (1-3) Some (4-8) Very many (8+)	20 18 13 0	Some	All steps must be memorized, in their proper sequential order, to successfully execute the skill	13
9	How hard are the facts, terms, names, that must be remembered?	N/A Not hard Somewhat hard Very hard	34 31 12 0	Not hard		31

Question		Rating Scheme		Task Response	Description	Score
10	What are the fine motor control demands of the task?	None Small Considerable Very large	2 0 16 3	Small	There are small fine motor control demands associated with this task	0
Total for this task						**123**

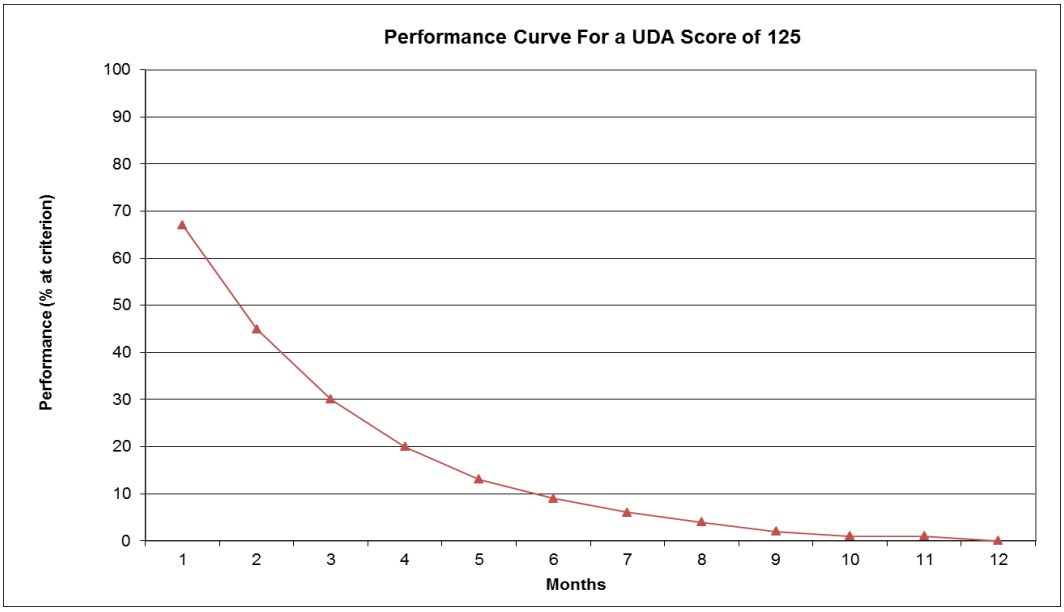

Figure 9: Performance curve for a UDA score of 125

Note this estimation is based on the assumption that the novice officer does not perform or practice the technique, either physically or mentally. As described earlier, a significant number of LEOs participate in some form of martial arts training where this activity could be rehearsed. Without performance of the technique or practice, less than half (45%) of the training cohort would be able to successfully execute the skill in only two months. After 12 months, none (0%) of novice officers may be able to perform the wristlock successfully. The UDA model does not take into consideration previous experience or trainee expertise, rather it makes an estimation as to the sample as a whole. The UDA was originally developed to investigate skill fading for procedural tasks and thus may be overly sensitive for psychomotor skills.

Summarily, evidence from several studies suggests that police officers want training that matches "reality" (Alain and Crete, 2009; Kaminski and Martin, 2000; Minnis and Parker, 2002; Nieuwenhuys et al., 2009). Police arrests that require the use of defence and control tactics are usually performed in stressful environments; research has indicated that fine motor control and cognitive ability decreases in these situations. These decreases can contribute to an officers inability to perform defence and control tactics properly.

It is further noted (Gallo et al., Smith and Petrocelli, 2002) that defence and control (i.e. weaponless) tactics are used significantly more often in arrest scenarios than in situations

involving weapons (e.g. batons, CEDs, side arms). Studies further show that experienced police officers and officers who have been previously assaulted in the line of duty are more likely to suggest that hand-to-hand and defence and control tactics are underemphasized in training and that more time should be devoted to their learning and application. Ninety-nine per cent of police officers who have outside training (i.e. not learned during police academy or in-service training) in some martial art (wrestling, boxing, jiu jitsu, etc.) have commented that their training has assisted them in their work.

When the United States Army Research Institute's model for User Decision Aids is applied to basic defence and control techniques highly relevant to a police officer's ability to perform weaponless arrests a suspect (wristlocks and armbars) it becomes apparent that the retention of these relatively simple skills amongst LEO may be poor. The analysis conducted by the SME on wristlock and armbar techniques show that 1 month after training, 67% of officers would still be able to perform the skill successfully; however, two months after training less than half (45%) of officers would be able to perform the skill successfully. One year post-training, none of the officers would be able to perform the skill successfully. With slightly more complex tasks such as the wristlock to come-along and the wristlock against a weapon, the ability of officers to retain these skills is even lower. One month after training, 63% of officers would be able to successfully execute these skills. Three months after training one quarter (25%) of the training cohort would be able to successfully execute these skills. After less than one full year (11 months), none (0%) of officers would be able to perform the wristlock to come-along and wristlock against a weapon tasks successfully.

This preliminary research suggests that there may be an under emphasis of hand-to-hand defence and control training in police forces across North America. Police have requested that training paradigms reflect the "reality" of their work; evidence suggests that the reality of police work involves predominantly weaponless arrests escalating no further on the force continuum than "Bodily Force".

3.4 Skills Perishability within the Use of Force Context Literature Review Summary

Our view of the literature relevant to skills perishability in the use of force context supports the following conclusions:

In general, the policing skill retention literature is underdeveloped. Either due to a lack of funding, lack of academic access or due to the sensitivity of the subject itself, substantive research has not been undertaken. The state of Canadian police use of force skills perishability is unknown. Only isolated anecdotal information is available on the degree of refresher training across police agencies beyond their statutory requalification requirements.

Searches for empirical evidence quantifying use of force skill perishability yielded little. The UDA skill perishability model may provide some utility for evaluating police skill perishability.

The use of force experts workshop supported the view in many of the policing use of force publications that perception and decision making issues need to be addressed. Prior to any application of use of force techniques the police officer needs to assess the situation and then make the decision to use the proper use of force technique. This necessitated the need to look at tactical decision making in the use of force context.

It is believed that the OODA Loop model is a more appropriate model for explaining the recognition and action components involved in psychomotor skills.

The evidence suggests that acute stress does impact police officers' performance. Key findings in this areas showed that acute stress can adversely affect an officer's tactical decision-making ability due to physiological (hyper)arousal, reduced information-processing ability, lowered comprehension, narrowed attention focus, reduced working memory capacity, decrements in fine and complex motor skills, as well as reduced shooting accuracy. However, there is very little research that helps to understand the impact of skill perishability on performance, or how often critical skills would need to be refreshed

Section 4: State of Use of Force Skills Training Survey

4. State of Use of Force Skills Survey

4.1 Goals

The primary goal of the survey of police officers, trainers and officials was to:

- Identify basic approaches used by training academies for use of force skill acquisition
- Identify refresher training approaches.
- Identify empirical based evidence that supports the timing of police use of force skills refresher training and recertification.
- Identify the research required to provide an impartial evidence-based recertification strategy with the ultimate goal of establishing national standards for skills training/maintenance that meet operational policing needs.

4.2 State of Use of Force Skills Survey Method

There are a number of subjective methods for obtaining information on the state of use of force training and all have their pros and cons. The approach followed in this study was a preliminary focus group session and follow-up interviews. The key for the interview portion of the study was to develop a framework for capturing information quickly using a systematic question-based framework. Unlike questionnaires with rigid questions, the interview–based approach blended fixed questions with the ability of the interviewer to explore other avenues of discussion.

4.2.1 Preliminary Focus group

In March 2011 a focus group was conducted with over 20 experts attending a use of force workshop in Regina, MB. Attendance at the use of force workshop was by invitation only and thus may not be representative of the Canadian policing community as a whole. The aim of the focus group was to identify individual perceptions on use of force skills deterioration and to gain insight into where in the use of force continuum was the problem (i.e., is the problem in execution of the technique or is it in the early problem recognition stages). As well, participants were asked to identify specific issues in the different forms of use of force techniques. An audience response system from Turning Point Technologies (2011) was used to capture and display participant responses.

The results of the focus group served to focus both the literature review and the survey.

4.2.2 Develop Interview Script

The first step of the interview process was to develop a core set of questions to identify the current state of use of force training or maintenance training. A number of set questions were developed that served as discussion points in the interview. The script was structured such that it could easily be adapted to training institutions as well as police force training academies (in-service). The script included a standard introduction statement as series of open and closed questions similar to the following:

- What soft technique skills are taught at the academy/refresher at the agency?
  How are they taught and tested? (e.g. #hrs classroom, # hrs gym, #hrs sparring)
    - Demonstrate skill?
    - Timed event?
    - Compliant adversary/non-compliant adversary?
- Recertification?
- How often do trained constables do refresher training (e.g. on soft techniques)?
- What is reviewed during refresher training?
- How often do constables have to recertify their soft technique skills?
- What is refresher training policy based upon?

Please note, scripts in both official languages were developed.

4.2.3 Identify Survey Participants

The next step of the process involved identifying participants who could represent the state of use of force training in Canada. In addition to interviews with local police officers and use of force instructors, the PSC forwarded a list of use of force instructors. The instructors were grouped by initial training institution and included the following:

- Justice Institute of British Columbia
- Edmonton Police Service College
- City of Calgary (Chief Crowfoot Learning Centre)
- Lethbridge College
- Saskatchewan Police College
- Assiniboine College
- RCMP Depot
- Winnipeg Training Academy
- Ontario Police College
- C.O. Bick Police College
- Ecole Nationale de Police du Quebec
- Halifax Police Academy

The decision was made to utilize training academies as the initial framework for recruiting subjects. Efforts were made to interview use of force instructors from the training institutions themselves and use of force instructors that conduct refresher and recertification training of these same recruits. Letters of introduction were provided to the academy directors as well as Chiefs of Police by the PSC. Given ongoing training demands, recruiting interview participants was very challenging and time consuming. In many organizations use of force instruction cadres include both personal defensive tactical trainers and firearms requalification staff.

In an effort to maximize response rates, multiple police agencies were contacted in an effort to obtain feedback. Officers and trainers from the following agencies participated in the survey:

4.2.3 Conduct Interviews

Although telephone interviews were conducted with the majority of the use of force instructors, in isolated cases the participants requested that the questions be forwarded in a hard copy format. There was also some reluctance by the use of force instructors to have their name associated with specific responses and concerns or the assumption that that their answers reflected official agency stance. As a result the interview results have been made anonymous. Both English and French language interviews were undertaken. In general the telephone interviews lasted an hour but in many cases instructors forwarded additional information to the interviewer.

4.2.4 Preliminary Analysis of the Survey

Based on the training institution telephone interviews, we generated a spreadsheet detailing the specifics of use of force skills acquisition. Unfortunately not all training programs responded to the interview request. As well the desire to analyze training programs based on use of force skill technics was problematic. After initial skill instruction, training establishments force recruits to select an appropriate technique depending on the situation. Thus in any one training session, defensive tactics, OC spray, baton, CEW etc. could be practiced.

Based on the telephone interviews with in-service use of force instructors, we generated a second spreadsheet detailing the specifics of use of force skills maintenance and recertification policies. In-service use of force instructors were asked to identify the basis of recertification and refresher training policies. As witnessed with the training academies, quantifying the amount of skills refresher training, recertification and practice in any one area was extremely challenging. Instructors were asked to estimate the hours associated with recertification or skills maintenance training for the various techniques.

4.2.5 Definitions

During the telephone interviews, it became evident that the use of the term “refresher training” was a misnomer for many interviewees in the policing context. Many use of force instructors stated that officers “training” ceases once a cadet leaves a training academy. These instructors stated that a trained officer only receives training when a new technique or weapon is introduced to the force or conversely, when the officer joins a specialized team requiring training on new systems. Rather than using the term refresher training, many use of instructors preferred the use of the term “skills maintenance” when describing refresher activities. The terms refresher training, practice and requalification do have specific meanings in the policing context:

- Refresher training is training which does not involve a pass/fail test (Ontario, 2010). Refresher is conducted in the presence of an instructor/evaluator. Note: refresher training typically involves practice.
- Practice is the repetition of a procedure/action as a way of improving one's skill in that activity.
- Requalification training: is training with pass/fail evaluation of an individual’s skills or knowledge (Ontario, 2010).

In order to assess police competency, many provinces mandate the use of certified Use of Force trainers (e.g., the RCMP requires the use of trainers with the Public and Police Safety Instructors Course (PPSIC) certification). Depending on the certificate granting organization, accreditation in a skill can be for life or for a shorter period of time.

4.3 State of Use of Force Skills Survey Results

The state of use of force training scan results are organized as follows:

- Use of force experts workshop
- Skill retention and perishability
- Transfer of training

During the SME review of the preliminary literature results, concerns were expressed by some on the lack of discussion on motor learning theories and the lack of discussion on skills transfer. The literature review was expanded to introduce these areas.

Throughout the literature review every effort was made to identify evidence justifying police use of force refresher training. Except for CPR training, no empirically based evidence justifying police use of force recertification or refresher training was identified. Although the SA had indicated that the Ottawa Police Force had empirical evidence justifying their skill refresher training program, we were unable to make contact with their use of force instructors.

4.3.1 Use of Force Experts Workshop

As described in Section 4.2.1, in March 2011 a focus group was conducted with the use of force experts working group in Regina, MB. The aim of the focus group was to identify their perceptions on use of force skills deterioration and to gain insight into where in the use of force continuum was the problem (i.e., is the problem in execution of the technique or is it in the early problem recognition stages). As well, participants were asked to identify specific issues in the different forms of use of force techniques.

The question as to where the problems in the use of force process proved challenging to some of the participants as they were being asked to break down use of force activities into discrete recognition, decision and action processes using the Observe-Orient-Decide-Act (OODA) Loop (Boyd, 1986) as a framework. The 21 participants identified issues throughout the process (note; participants were free to identify more than one area). Interestingly, participants added a fifth use of force activity (coded-other) which entailed the proper reporting of a use of force incident-see Figure 10.

> ***Caution is suggested in interpreting these results as there were a series of discussions surrounding each process and thus each participant may have interpreted the question differently. Moreover, the group of experts had convergent opinions on the role of skill perishability throughout the perception- action process.***

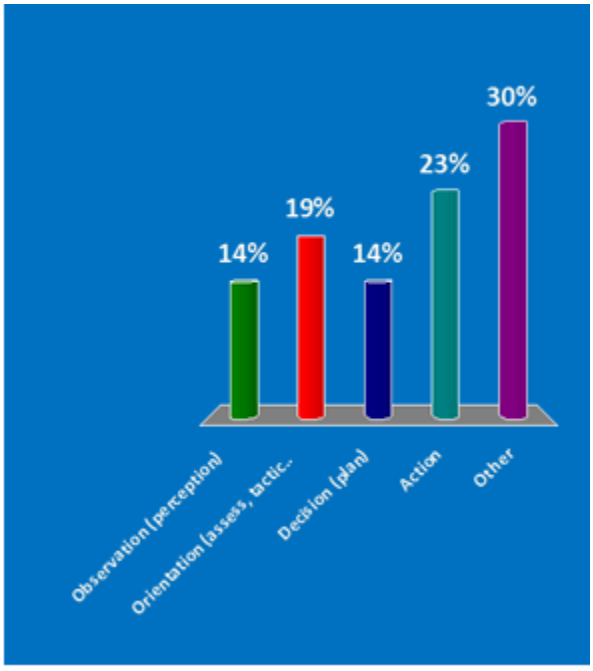

Figure 10: Where in the use of force continuum is the problem?

Perception issues identified by the workshop participants included inadequate officer training and attention narrowing due to stress. Orientation issues included inadequate officer training and hyper vigilance due to stress response. Over two thirds of the participants identified decision making skill loss issues. Issues such as inadequate tactical decision making experience and older officer complacency were reported. When asked if there were use of technique perishability problems the participants identified a number of concerns. Skill perishability concerns were highest for the unarmed combat techniques (including handcuffing) and lowest for the verbal techniques – see Figure 11.

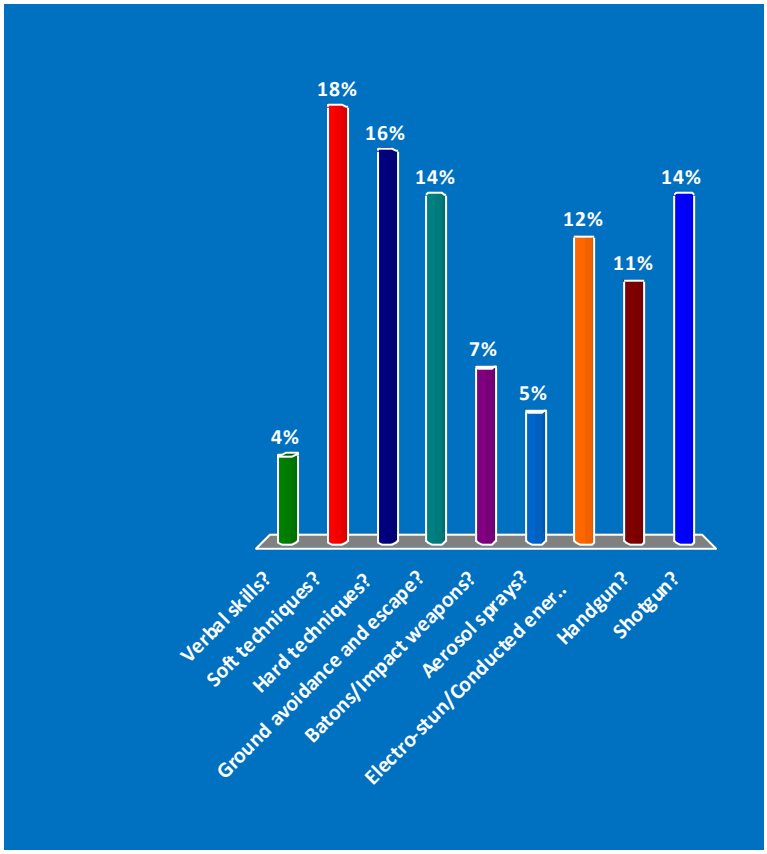

Figure 11: Which use of force technique has skill perishability issues?

During the session participants were also asked to identify what they thought the motor-skill loss issues were for a number of the use of force techniques. For the open hand soft use of force skills the participants believed that forgetting the technique or sequence of moves was the biggest issue, followed by adapting to circumstances, i.e. a non-cooperative offender – see Figure 12.

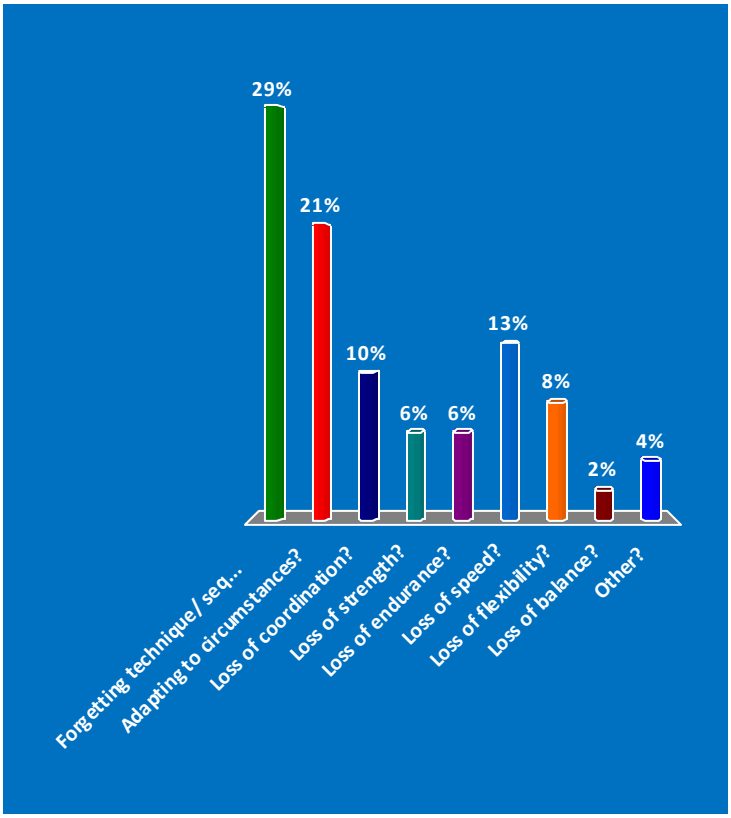

Figure 12: What are the open-hand psychomotor skill loss issues?

The results of the meeting with the use of force experts working group gained valuable insight into the use of force skills perishability problem. The original approach to focus on the motor aspects of the use of force techniques would not have addressed the recognized issues surrounding officer observation, orientation and decision making skills perishability. As a result, the literature search was expanded to include tactical decision making which include those processes. A detailed description of the OODA Loop is described in the following section.

4.3.1.1 OODA Model

The process of a police officer responding to a use of force situation can be understood in terms of the OODA Loop. The OODA loop has been used to understand the human decision-making process under conditions of acute stress, and was originally developed in the 1950s by Col. Boyd of the U.S. Air Force for use by military commanders (Boyd, 1986). The OODA Loop has served as the U.S Air Force/Army's model of human decision-making for more than 50 years. As a whole, the framework consists of four main steps which are argued to constantly loop, with a primary focus of expediting the process by which decisions are made, such that one's own decision-making cycles are faster than those of the enemy, as shown in Figure 13.

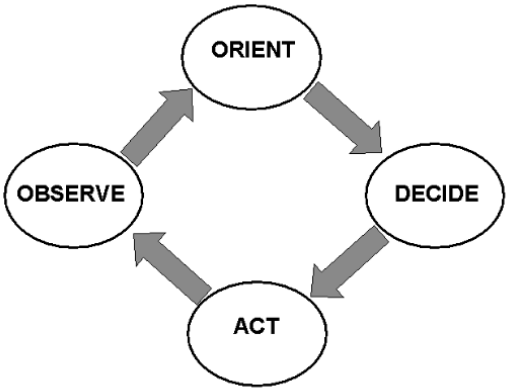

Figure 13: The Observe-Orient-Decide-Act Loop (Bryant, 2006)

The sections that follow describe the OODA loop in more detail.

Observe - The initial observation stage involves the use of bodily senses (i.e., sight, hearing, touch, smell) to gather information prior to assigning meaning to it. For example, at this stage, the officer might see the suspect's movements and hear other officers yelling.

Orient - The next phase involves assigning meaning to observations and putting them into context. At this stage, raw information collected from the senses is understood through attempts at pattern recognition. For example, seeing a suspect reaching for their waistband after the officer has instructed them to put their hands on their head may fit the pattern of reaching for one's weapon in preparation for firing. Through either training or experience, the officer may be familiar with this pattern of escalating aggression and knows how to respond to it. In other cases, however, the officer may be unable to assign meaning to their observations because they have never before encountered a similar scenario. When the information being attended to does not match a known pattern, because the costs and consequences of making a wrong decision are so high (e.g., shooting an unarmed suspect, or being shot themselves), inaction is a possible response. As time passes, the pressure to do something to diffuse the situation builds, which, in turn, makes it even more difficult to properly make sense of the situation (Benge & Williams, 2007).

Decide - According to the OODA framework, this is the stage where contextual information is used to make a decision. Here, relying on the information gathered so far, officers will commit to the first reasonable solution available to them. Using the example of the suspect reaching for their hip after being told to place their hands on their head, the first reasonable decision might be for the officer to defend themselves.

Act - Finally the officer's decision is acted upon. This action might include a use-of-force behaviour for which the officer has received much training, if this is the case then the action is carried out easily and most likely accomplishes what the officer had hoped it would. If, on the other hand, the act involves behaviour that the officer is less proficient

at performing (due to limited training or practice), the chances of successfully executing the action (and resolving the situation) is lessened.

Col. Boyd later generalized and expanded the simple OODA loop to make it more relevant to everyday activities (Boyd, 1995) see Figure 14.

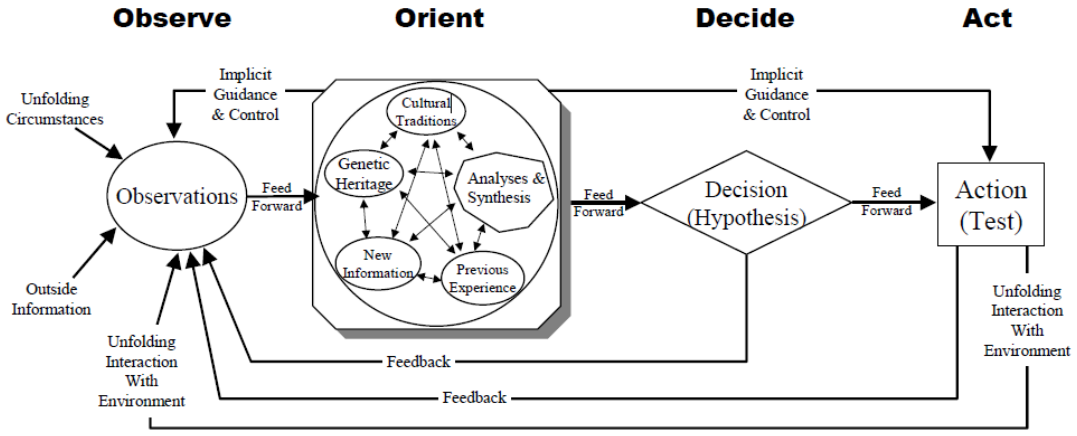

Figure 14: Detailed OODA loop model (Boyd, 1995)

Within the police use of force context, the OODA model's observe and orient activities could include:

- Rapid threat detection
- Facial recognition
- Behavioral assessment
- Frame of reference
- Situational awareness
- Pattern recognition

In high stress incidents, police officers rely on intuitive or naturalistic decision making processes. (Tactical decision making is examined in further detail in Section 3). Action activities for police officers include the spectrum of use of force techniques.

4.3.2 Training Academy Scan

A series of interviews were conducted with a number of use of force instructors form various police recruit/cadet training academies. The aim of the interviews was to gain an understanding of the overall state of use of force instruction, specific differences and if possible rational as to their use of force curriculum. Feedback from 11 training establishments was received.

The number of weeks spent in police academic training varied between in-house police force training academies and external academies – see Table 13. Recruit training generally followed a blocked approach where field training follows academic training. In some cases field training is sandwiched between academic blocks. A number of forces also include orientation sessions with the force prior to attendance at the training academies. Within the use of force context the bulk

of use of force training is undertaken in the first major academic block. It should be noted however that at JIBC, use of force training is reassessed in Block 3 (i.e. after the recruit has completed the field element of their training). The use of force instructor noted that a number of technical skills have to be refreshed.

The telephone survey indicated that academies are typically spacing use of force training out throughout the curriculum. In the Halifax Regional Police in-house training academy, trainees now undertake use of force training every other day throughout their stay.

Table 13: Sample Police Training Programs

Training Institution/ Police force	Orientation	Academic Block 1	Field training (Typically Block 2)	Academic Block 3	Academic Block 4
Justice Institute of British Columbia	1 week	13 weeks Block1	13-17 weeks	8 weeks	
Halifax Police Academy		21 weeks Block 1	12 weeks	6 weeks	
Atlantic Police College		23 weeks Block 1	10 weeks	2 weeks	
Ontario Provincial Police (*note change in training block progression)	1 week	12 weeks Ontario Police College	5 weeks* Provincial Police Academy	Approx. 34 weeks field training	
City of Toronto Police (*note change in training block progression)	2 weeks at C. O. Bick College	12 weeks Ontario Police College	6 weeks* C. O. Bick College	10 weeks field training	
Edmonton Police Service College (William Griesbach Training Centre)		22 weeks	16 weeks	2 weeks	2 weeks
City of Calgary (Chief Crowfoot Learning Centre)		20 weeks	13 weeks		
RCMP Depot		24 weeks	26 weeks		
Saskatchewan Police College		18 weeks	24 weeks		
Winnipeg Training Academy		19 weeks	16 weeks	2 weeks	
Ecole Nationale de Police du Quebec		15 weeks			

The number of weeks spent in training varies between police forces and training academies. The reader is referred to the parallel PSC review of training academy programs for further details. When asked to comment on the efficacy of their program, a number of instructors commented that an additional block of training was required months after the recruit had graduated from the academy. Of particular concern to a number of trainers was the poor handcuffing skills exhibited by new officers. The Edmonton Police Service does bring its recruits back at the 12 and 16 month timeframe. According to their recruiting website "…recruits will be brought back together for a period of Post Foundational Assessment and Development. Their skills will be assessed and developed further focusing on maximizing individual potential. Additional strategic training opportunities will also be provided to develop knowledge and skill sets based upon experiences to date." Given use of force skill perishability this approach appears to be progressive in terms of providing refresher training approximately 6 months and 10 months after initial instruction. Although a number of police training programs include a second academic block after field training, interviews with their instructors suggest that use of force refresher training is not part of this second academic session.

> *The efficacy of returning students to the initial training academy for post foundation use of force skills assessment should be explored. Other approaches such as instituting in-service assessment of recruits as they complete filed training may be just as effective (providing resource availability).*

During a number of telephone interviews with in-service use of force instructors, the issue of the quality of recruits coming from training academies was raised. For the most part, instructors did not report any systematic issues; rather they all acknowledged that new recruits quickly forgot what was taught to them months previously. One experienced RCMP instructor commented that even at the Depot, he witnessed cadets barely passing their firearms test and failing when retested just prior to graduation. He reported that even a few weeks of non-practice will affect performance.

> *The RCMP depot may be able to provide empirical evidence of firearms skill retention if new recruits are still tested at multiple times during their training program.*

As part of the interview session, instructors were asked to report why academic training takes over 24 weeks in some academies and less than 15 in another. While the instructors could not adequately answer this question, some referenced longer field training times to balance total training time, others reported that the program length was also based on recruit burden some programs are not subsidized and the longer the program the greater the hardship. The majority of instructors (even in the longer programs) reported that even more training should be supplied. More use of force training was provided in the longer programs than the shorter.

Instructors were asked to estimate the number of hours devoted to specific use of force techniques, tactical scenarios, etc. Outside of firearms training, this question proved challenging. Personal defensive tactics training is included in many other activities; indeed it was reported that Halifax police cadets practice personal defence tactics during every other physical training period. The number of direct training hours devoted to use of force varied between approximately 100 hours to 170 hours. While 100 hours may seem low, it complies with recommendations from a number of reported leading use of force trainers (Brave, 1994). These trainers recommended an

initial use of force training program (not including firearms) that included approximately 64 to 80 hrs of instruction. This program included OC spray, baton, LVNR, handcuffing, defensive tactics and knife defence techniques.

The efficacy of the different use of force training programs will be challenging to assess once recruits are deployed to their field detachments. A standardized personal defensive tactics skill test like the firearms national course of fire could serve to allow comparative testing across all agencies.

4.3.3 State of In-Service Use of Force Training Scan

A series of interviews were conducted with a number of in-service use of force instructors and patrol officers. The aim of the interviews was to gain an understanding of the overall state of use of force recertification and retraining policies. Interviews were conducted with 22 officers. The number of days spent in annual recertification and retraining varied dramatically – see Table 14. Some organizations can devote up to 7 or 8 days of use of force retraining a year, while others devote just one. The number of hours a Tactical Response Units (TRU) trains significantly exceeds that of a duty patrol officer (e.g., 52 hours of training for TRU vs. 2 for duty patrol officers with the City of Guelph). While all organizations require annual pistol recertification, a number do not require defensive tactics retraining or recertification.

Table 14: Sample Annual Use of Force Training Days

Police Force	Annual Training Days/
Guelph	2 days
Guelph Tactical Res[pnse Unit (TRU)	52-60 days
Prince Albert	2 days
Edmonton	4 days
Peel	2 days
RCMP Manitoba	7 days every 3 years (not including Taser)
RCMP Ottawa	7 days every 3 years (not including Taser)
RCMP NB	4 days every 3 years (not including Taser)
RCMP Block (Regina)	7 days every 3 years (not including Taser)
Thunder Bay	6 - 8 days
Toronto	3 days
Calgary	2 - 3 days
Peterborough	2 - 3 days
Lethbridge	5 days
Taber	5 days

Police Force	Annual Training Days/
Winnipeg	1 day for PDT
Saanich	3 days
Brandon	1 - 2 days
OPP	4 days
Outaouis MRC	3 days every 3 years for PDT, and 1 day a year for Intermediate weapons and handgun
Halifax	3 days - 30 hrs

When asked why the force settled on the number of use of force training and recertification days, the instructors replied that provincial legislation mandated minimums for many use of force skills. Specifically, in Nova Scotia, police governance standards mandate (Nova Scotia, 2006) that:

> *010.05 The police agency is to assure all operational police officers have received training and/or recertification training from a recognized and certified police or subject matter instructor specific to the police agency approved Oleoresin Capsicum devise, as required and police officer certification is not to exceed every 36 months.*

Many organizations conduct recertification and refresher training more often than provincial mandates. For many forces, the number of use of force training days is budget driven. In an effort to refresh skills in a restricted budget environment, police forces are conducting training on a multi-year cycle.

Personal Defence Tactics

As part of the interview session instructors were asked to comment on their approach to recertification and the number of times this was done per year for the various use of force skill. Participants found it difficult to differentiate soft and hard unarmed physical techniques and thus the combined category personal defence tactics (PDT) was used. All surveyed agencies (other than one which plans to institute it in the near future) conduct PDT requalification training. The majority of the agencies conduct PDT training once a year but some agencies conduct training more often. Three agencies conduct PDT training every two or more years.

Table 15: Sample Annual Personal Defensive Tactics Training

Personal Defence Tactics			
Police Force	Requalification	Approach	Times / Year
Guelph (patrol)	Yes	Demonstration and Scenario	2
Guelph Tactical Response unit	Yes	Scenarios	52

Personal Defence Tactics			
Police Force	Requalification	Approach	Times / Year
(TRU)			
Prince Albert	Yes	Demonstration	1, 4 hours
Edmonton	Yes	Lecture and Scenarios	1, 10 hours
Peel	Yes	Lecture and Demonstration	1, 4 hours
RCMP Manitoba	Yes (only carotid control)	Scenarios (3 days)	Every 3 Years (1-2 hours)
RCMP Ottawa	Yes (only carotid control)	Scenarios (2 days)	Every 3 Years (1-2 hours)
RCMP NB	Yes (only carotid control)	Lecture and Demonstration	Every 3 Years (1-2 hours)
RCMP Block (Regina)	Yes (only carotid control)	Lecture and Demonstration (3 Scenarios)	Every 3 Years (1-2 hours)
Thunder Bay	Yes	Practice and Demonstration	3, 24 hours
Toronto	Yes	Demonstration of Skill	1, 2 hours
Calgary	Yes	Scenarios	1, 4 hours
Peterborough	Yes	Demonstration of Skill and Scenario	1, 2 hours
Lethbridge	Yes	Lecture and Demonstration	1, 4 hours
Taber	Yes	Lecture and Scenarios	1, 12 hours
Winnipeg	Yes	Lecture and Scenarios	Every 2 Years for 8 hours
Saanich	Yes	Review and Scenarios	3, 12 hours
Brandon	Yes	Demonstration	1, 1 – 1.25 hours
OPP	Yes	Lecture, Demonstration, and Scenarios	1, 1.5 hours
Outaouais MRC	Yes	Demonstration and Scenario	Every 3 Years for 3 days
Halifax	Yes	Review and Scenarios	6 year rotational schedule except VNR – 2 yr cycle

Personal Defence Tactics			
Police Force	Requalification	Approach	Times / Year
Ville de Longueuil	No		

The approach to PDT requalification varied amongst the police forces. Some schools require a simple demonstration of skill while others require the demonstration of skill in a scenario situation. A number of PDT requalification sessions begin with instructor briefing, lectures and practice sessions prior to the test. The number of hours devoted to PDT retraining and requalification varies dramatically. When asked if officers are required to demonstrate all the unarmed PDT taught at the force's training academy, the answer was no. In many cases, officers are left to choose the techniques that work for them.

OC Spray

Not all of the agencies surveyed conducted OC Spray requalification training; of those that did, the majority conduct retraining/requalification once per year. A number of forces conduct retraining every two or three years. The retraining sessions themselves typically last approximately one hour.

Table 16: Sample Annual OC Spray Training

OC Spray			
Police Force	Requalification	Approach	Times / Year
Guelph (patrol)	Yes	Demonstration and Scenario	2
Guelph Tactical Response unit (TRU)	Yes	Demonstration and Scenario	2
Prince Albert	Yes	Lecture	1, 1 hour
Edmonton	No	No	No
Peel	Yes	Demonstration and Scenario	1
RCMP Manitoba	Yes	Scenarios (3 days)	Every 3 Years (1 hour)
RCMP Ottawa	Yes	Scenarios (2 days)	Every 3 Years (1 hour)
RCMP NB	Yes	Reviewed	Every 3 Years (1 hour)
RCMP Block (Regina)	Yes	Reviewed (3 scenarios)	Every 3 Years (1 hour)

OC Spray			
Police Force	Requalification	Approach	Times / Year
Thunder Bay	Conducted with PDT		
Toronto	Yes	Review and Scenario	1, 1 hour
Calgary	Yes	Online and Scenario	
Peterborough	Yes	Demonstration of Skill and Scenarios	1, 0.25 hour
Lethbridge	Yes	Lecture and Demonstration	Every 2 years as part of PDT
Taber	No		
Winnipeg	No		
Saanich	Yes	Lecture and Demonstration	1
Brandon	Yes	Lecture, Practice, and Demonstration	1
OPP	Yes	Lecture, Demonstration, and Scenario	1
Outaouais MRC	Yes	Lecture, Practice, and Scenario	1
Halifax	Yes	Lecture, Demonstration, and Scenarios	6 year rotational schedule
Ville de Longueuil	No		

The use of force instructors reported that OC Spray requires minimum retraining.

Baton

All agencies surveyed but one conducts baton requalification training. The one agency that currently does not conduct baton retraining plans to institute it in the near future. The majority of the agencies conduct baton training once a year but a few conduct training more often. Three agencies conduct baton training every two or more years. The baton retraining sessions typically last approximately one hour.

Table 17: Sample Annual Baton Training

Baton			
Police Force	Requalification	Approach	Times / Year
Guelph (patrol)	Yes	Demonstration and Scenario	2
Guelph Tactical Response unit (TRU)	Yes	Demonstration and Scenario	2
Prince Albert	Yes	Lecture, Demonstration,	1, 4 hours
Edmonton	Yes	Lecture and Scenarios	Depends on Training Plan
Peel	Yes	Demonstration of Skill	1
RCMP Manitoba	Yes	Scenarios (3 days)	Every 3 Years (1 hour)
RCMP Ottawa	Yes	Scenarios (2 days)	Every 3 Years (1 hour)
RCMP NB	Yes	Lecture and Demonstration	Every 3 Years (1 hour)
RCMP Block (Regina)	Yes	Lecture and Demonstration (3 Scenarios)	Every 3 Years (1 hour)
Thunder Bay	Conducted with PDT		
Toronto	Yes	Demonstration and Scenario	1, 2 hours
Calgary	Yes	Online and Scenario	
Peterborough	Yes	Demonstration of Skill and Scenario	1, 1.5 hour
Lethbridge	Yes	Lecture and Demonstration	Evert 2 years, as part of PDT
Taber	No	Scenarios	No
Winnipeg	Conducted with PDT		
Saanich	Yes	Lecture and Demonstration	1
Brandon	Yes	Lecture, Practice, and Demonstration	1
OPP	Yes	Lecture, Demonstration, and Scenario	1, 0.5 hours
Outaouais MRC	Yes	Lecture, Practice, and Scenario	1
Halifax	Yes	Lecture, Demonstration, and Scenarios	6 year rotational schedule
Ville de Longueuil	No		

One use of force instructor commented that he had reviewed only two Subject Behavior Officer Response (SBOR) reports in the past few years involving the use of the baton. Many instructors reported that baton usage was not as prevalent as it was before the fielding of CEWs. When questioned as to the difficulty in retraining baton skills the use of force instructors reported that "anyone can swing a bat".

When asked if a baton was still required, use of force instructors believed that officers still require a blunt impact weapon, even if it is just used in a show of force.

CEW

The fielding of CEW systems across the police forces surveyed was not universal. Some agencies issue CEW systems to tactical response units or sergeants. All agencies that do issue CEWs re-qualify at least every two years, with majority every year. CEW retraining sessions typically last approximately six hours. Most police services follow the Taser® International recertification program of instruction.

Table 18: Sample Annual CEW Training

CEW			
Police Force	Requalification	Approach	Times / Year
Guelph (patrol)	No	No	No
Guelph Tactical Response unit (TRU)	Yes	Lecture and Demonstration	1
Prince Albert	No	No	No
Edmonton	Yes	Lecture and Demonstration	1, 8 hours
Peel	Yes	Lecture and Demonstration	1, 2 hours
RCMP Manitoba	Yes	Lecture and Demonstration	1, 4 hours
RCMP Ottawa	Yes	Lecture and Demonstration	1, 8 hours
RCMP NB	Yes	Scenario and Demonstration	1, 8 hours
RCMP Block (Regina)	No	No	No
Thunder Bay	Yes	Lecture and Demonstration	1, 8 hours
Toronto	Yes	Lecture and Scenario	1, 4 hours
Calgary	Yes	Lecture and	0.5, 8 hours

CEW			
Police Force	Requalification	Approach	Times / Year
		Demonstration	
Peterborough	Yes	Lecture and Demonstration	1, 8 hours
Lethbridge	Yes	Demonstration	1, as part of PDT
Taber	Yes	Lecture and Demonstration	0.5, 4 hours
Winnipeg	Yes	???	1
Saanich	No	No	No
Brandon	Yes	Demonstration and Written Exam	1
OPP	Yes	Lecture, Demonstration, and Scenario	1, 4 hours
Outaouais MRC	Yes	Lecture, Practice, and Scenario	1
Halifax	Yes	Lecture and Demonstration	1, 4 hrs
Ville de Longueuil	No		

The instructors interviewed did not believe that there were skill perishability issues surrounding the actual use of a CEW, rather they believed that the issues surrounding CEWs were in the decision making process.

One instructor directed us to the 2009 RCMP annual Report on Conducted Energy Weapons (RCMP, 2010). In the annual report, the RCMP identified 676 CEW usages (from SB/OR reports). In the report, usage involved either CEW activation or presentation. Of the 676 deployments 84 were reported as being not effective. And of these 84 ineffective deployments, only 29 could be attributed to skill loss (not factoring in wind, outside distance parameters, operator error etc.) Thus there was only a 4% skill failure rate for CEW use by RCMP officers.

Due to budgetary restrictions not all police forces issue CEW devices to all patrol officers. In the Halifax Regional Police force CEWs are issued on a first come, first served basis. The use of force instructor reported that some officers do not draw CEWs even when available due to the recent controversies surrounding their use. Selectively not handling a CEW will exacerbate CEW skill loss.

Handgun

While all police forces interviewed recertify on their handgun every year, a number of agencies recertify two or more times a year. The number of hours spent on recertification varies from a low of approximately two hours to a high of 16 hours (over two days).

Table 19: Sample Annual Handgun Recertification

Handgun Recertification			
Police Force	Requalification	Approach	Times / Year
Guelph (patrol)	Yes	Skill Building and Scenario Qualify	2
Guelph Tactical Response unit (TRU)	Yes	Skill Building and Scenario Qualify	26
Prince Albert	Yes	Lecture and Shoot, maybe some skill building, Qualify	1, 4 hours
Edmonton	Yes	One on One Skill Building, Qualify	2, 16 hours
Peel	Yes	Practice and Qualify	1, 4 hours
RCMP Manitoba	Yes	Qualify	1, 2 hours
RCMP Ottawa	Yes	Qualify	1, 2 hours
RCMP NB	Yes	Qualify	1, 2 hours
RCMP Block (Regina)	Yes	Qualify	1, 2 hours
Thunder Bay	Yes	Skill Building and Scenario Qualify	3 - 4, 24 - 32 hours
Toronto	Yes	Qualify (but opportunity to practice skills every month)	1 (but opportunity to practice every month)
Calgary	Yes	Skill Building and Scenario, Qualify	2, 10 hours (but are able to shoot up to 200 rounds per week on range)
Peterborough	Yes	Lecture, Practice, and Qualify	1, 8 hours
Lethbridge	Yes	Skill Building, Scenario, and Qualify	1, 12 hours

Handgun Recertification			
Police Force	Requalification	Approach	Times / Year
Taber	Yes	Skill Building , Scenario Qualify	1, 12 hours
Winnipeg	Yes	Qualify	1, 2 hours
Saanich	Yes	Lecture, Skill Building, Qualify	3, 12 hours
Brandon	Yes	Qualify	??
OPP	Yes	Lecture, Practice, and Qualify	1, 5 - 6 hours
Outaouais MRC	Yes	Lecture, Practice, and Scenario, Qualify	1
Halifax	Yes	Skill Building and Qualify	1, 8 hours
Ville de Longueuil	Yes	Qualify	??

A number of police agencies have instituted a more rigorous program or course of fire than mandated by their province. Rather than shooting the 31 round AACP course of fire, they inject more challenging engagement serials. Many police forces provide practice and skill building opportunities prior to shooting for requalification. As a result the number of pistol cartridges fired during training varies across training establishments. If a cadet passes the standard, they may not fire the same number of rounds as a cadet who initially fails. Some organizations provide hundreds of rounds free to officers for skill practice while other more fiscally restrained agencies make ammunition available at cost.

When questioned about skill loss in firearms proficiency, the instructors reported that if a cadet was weak when they graduated from the training academy, they will be weak shooters while in-service. One senior instructor reported that based on his 30 years of experience, police officers score 10% lower on retests after even short periods of non-practice. For example if a cadet shoots 210 out of 240 and passes his qualification test (minimum is 200), they will score 10% less or 190 when retested after periods of disuse and thus fail. The same instructor said that a minimum amount of training will bring the officer to acceptable standards. When asked why the passing grade wasn't set higher to mitigate this known skill loss, the instructor reported that too many cadets would fail a more rigorous standard placing strain on the training system.

Interestingly, some instructors reported that some borderline proficient officers will deliberately fail their requalification test in order to obtain quarterly refresher training practice and coaching.

Of importance to this study, some agencies do conduct an abbreviated handgun skill perishability assessment. While most recertification programs follow a period of practice and then test, these agencies conduct a "cold shoot" at the beginning of the session to identify skill states. Feedback

from instructors conducting “cold shoots” indicates that officers are meeting the standard without additional training.

Some police agencies augment handgun recertification with dynamic tactical simulations. The extra training is dependent on range resources, officer availability and budget. During the interviews instructors expressed a desire to augment marksmanship recertification with tactical shooting. The instructors acknowledged standardized tests provided a baseline test of weapon handling competence and that it allowed standardized recertification across the country. Instructors pointed out that some officers who did well on marksmanship tests perform poorly in real life scenarios and conversely officers who had performed poorly in marksmanship tests performed exceedingly well in real life high stress quick reactive shooting incidents.

Carbine

Approximately one-third of the agencies surveyed issue their officers with carbines. Most recertify on their carbine every year, one agency recertifies twice a year. The number of hours spent on recertification varies from a low of approximately two hours to a high of 16 hours (over two days). The number of rounds fired during carbine recertification also varies and appears to be agency dependent.

Table 20: Sample Annual Carbine Recertification

Carbine Recertification			
Police Force	Requalification	Approach	Times / Year
Guelph (patrol)	No	No	No
Guelph Tactical Response unit (TRU)	Yes	Skill building	18 - 26
Prince Albert	No	No	No
Edmonton	Yes	Shooting	12
Peel	Yes	Lecture and Shooting	1, 2 hours
RCMP Manitoba	No	No	No
RCMP Ottawa	No	No	No
RCMP NB	No	No	No
RCMP Block (Regina)	No	No	No
Thunder Bay	Yes	Skill building and Qualify	12
Toronto	No	No	No
Calgary	Y	Skill Building and Qualify	2, 16 hours
Peterborough	No	No	No
Lethbridge	Yes	Skill Building, Scenario,	1, 12 hours

Carbine Recertification			
Police Force	Requalification	Approach	Times / Year
		and Qualify	
Taber	Yes	Skill Building and Scenario	1, 12 hours
Winnipeg			
Saanich	Yes	Shooting and Qualify	2, 16 hours
Brandon			
OPP	Yes	Skill Building and Qualify	1, 0.5 - 1 hours
Outaouais MRC	No		
Halifax	Yes (P90)	Skill Building and Qualify	1, 8 hours
Ville de Longueuil	No		

Carbine skill perishability was a significant concern amongst the firearm instructors whose agencies are thinking of fielding this weapon. Police officers handle their pistol nearly every duty day and the same will not be the same for carbines. Carbines are more complicated weapons and thus require more training and practice.

The agencies interviewed utilized a number of different courses of fire and it appears that to the reviewer a national carbine course of fire was lacking.

Shotgun

A number of police forces still issue shotguns to their police officers. For the most part shotguns are issued to Sergeants and above and thus regarded as outside the scope of the review.

4.4 State of Use of Force Skills Survey Discussion

4.4.1 Overview of the state of use of force training

The telephone interviews with the use of force instructors at the in-service training cells reflected the preliminary feedback obtained at the use of force expert workshop. Skills perishability was noted across the spectrum of skills. Officer decision making under stress was believed to be a bigger issue than that of demonstrating proper technique. All the use of force instructors expressed the desire for more scenario based training in order to challenge officers decision-making and action responses.

In-service use of force instructors reported that officers self-select personal defense tactics that work for the individual. While the initial training academy provides an introduction to various techniques, the instructors argued that teaching balance, footwork, etc. were the most important

aspects. Every situation is different and they argued that a solid understanding of the basics allows officers to respond to dynamically changing situations.

The telephone interviews also supported the view of the use of force experts that the reporting of incidents is challenging to police officers. The Incident Management/Intervention Model (IM/IM) training provided the RCMP specifically exercises the officer on communicating and reporting the facts surrounding an intervention.

The telephone interviews also supported the view of the use of force experts from the working group that the use of batons or OC spray did not pose significant skill perishability challenges. When questioned as to issues with the CEW, the telephone participants reported that the issue was not with using the device but related to timely use of the device when required (i.e., tactical decision making).

The telephone interviews also supported the view of the use of force experts from the working group that significant issues were not associated with handgun skill retention. Individual differences appeared to be the biggest factor in skill perishability.

4.4.2 Review of the Skill Acquisition Literature Review Recommendations

The initial literature reviews identified a number of principles relevant to training skills and skill retention, this section summarizes these recommendations and discusses the extent to which training institutions follow them:

Provide practice:

The level of use of force skill training and practice provided to police trainees varies dramatically between instructional institutions. Use of force training and practice varies from a low of approximately 140 hours to a high of approximately 180 hours. Use of force training includes applied physical skills, defensive tactics & movement, decision making and intervention articulation. The majority of use of force training is practical and experiential in nature.

> *There is no standard across the country for use of force skills training. While notionally a training program of 180 hours would appear to be more comprehensive than one of 140 hours, the shorter program may in fact embed use of force training in other activities such as physical training.*

Trainees typically practice unarmed defensive tactics on compliant and "notionally" uncooperative assailants because of the chance of injury. Thus many cadets do not experience the true effects of a more violent altercation because full force strikes, head strikes, etc. are not permitted during training. Historically this may not have been an issue as cadets will have typically played in contact sports or will have participated in a form of Martial Arts. The changing demographic profile of recruits may mean that many current trainees will have limited experience grappling with violent and uncooperative individuals. It was reported that at the RCMP Depot, training with uncooperative assailants is reserved for the end of the course.

> *Sports psychology suggests that competitors should be exposed to "competition-like" events prior to the competition itself (Orlick, 1986). In the policing context officers should be mentally and physically prepared for the rigors of restraining uncooperative assailants.*

Officers should be allowed to gain confidence in their open hand use of force skills and knowledge of what to expect in a confrontation. Concern over building officer confidence must be balanced with the need to expose trainees with real life experiences. It is believed that more practice (individual and team) should be given in restraining uncooperative assailants.

The number of non-marksmanship skill repetitions performed by officer trainees was generally unknown. At JIBC, it was estimated that new recruits draw their pistol during training a minimum of 100 times. This situation can be contrasted to a reported situation of when Guelph police force issued new pistols and holsters to their force. In this case officers were told to practice drawing their pistol 1000 times to build muscle memory.

There is no standard across the country on the number of practice events required by the average trainee to initially master a use of force skill. As well, the number of practice events required by trainees to retain a skill is not currently standardized. Although a large number of factors affect skill acquisition and retention, the amount of practice is critical. Efforts should be undertaken to see whether it is possible and practical to quantify the amount of practice trainees receive on individual use of force skills. If it is possible to quantify the degree of practice, efforts should be undertaken to examine the efficacy of different use of force training curriculums.

Training institutions typically provide OC spray training to their recruits. Some institutions also deliberately expose their cadets to OC spray while others cannot due to provincial workplace health and safety legislation. Although the amount of OC training varies between training institutions, details as to what is trained also varied. OC training at ENPQ includes training on how and when to use the tool. The ENPQ reported OC training as lasting 4.5 hours while the JIBC reported OC training as lasting just 2 hours. In the JIBC case, they reported just the time spent on physically learning how to use OC spray and not when as in the ENPQ case. The JIBC include OC deployment training in their use of force scenarios.

Although there is no standard across the country for OC training, the instructors interviewed believed that the system is simple to use. The instructors reported that the emphasis of training is on when to use the tool and not how.

Officers should be mentally and physically prepared for the effects of inadvertent OC contamination. Although it is believed that health and safety concerns do not justify the risk to the officer's safety, the current frequency of OC deployment is relatively low.

Although some training institutions do not train their cadets on how to use CEWs, they do train cadets on how to properly work with other officers in situations where CEWs are deployed, i.e. keep hands away from the area between the barbs. If a training institution provided CEW training the number of cartridges used in training generally followed the Taser® International standard.

There is no standard across the country as to if or how CEW should be undertaken at a training academy. Given the adhoc deployment of CEW systems across police forces, centralized training to a common standard appears logical.

The number of pistol cartridges fired during training varies across training establishments. If a cadet passes the standard, they may not fire the same number of rounds as a cadet who initially fails. Handgun instructors generally reported that pistol training was inadequate.

> *There is no standard across the country as to the number of pistol engagements a trainee should conduct. The courses of fire also used by the training establishments vary. While some institutions use a provincial or national standard they may augment the course of fire with additional serials. Some institutions that provide officer training for their own municipality appear to have established more rigorous performance standards than other training institutions. There appears to be a need to valid handgun standards and courses of fire.*

Provide explicit knowledge of results to trainees early in training but decrease as skills become automatic:

The telephone survey suggests that training institutions do provide explicit knowledge of results to trainees. The degree to which instructors tailor their feedback as the trainees acquire more skill is unknown.

Learning a generalized motor pattern can benefit from using a random practice approach vice a blocked practice approach:

The telephone survey suggests that training institutions generally use a blocked and random practice approach when teaching use of force skills. Blocked practice is used during initial skill acquisition and random practice is used during the application of use of force skills. Trainees typically have to respond to an opponent using the appropriate use of force skill and or tool available to them. One scenario may require verbal negotiation, another time a show of force and still other times the application of an intermediate weapon.

Utilize a spaced practice approach:

The telephone survey suggests that academies are now spacing training out throughout the curriculum, rather than using a concentrated blocked approach to use of force training. In the Halifax Regional Police in-house training academy, trainees now undertake use of force training every other day throughout their stay. Previously, the academy utilized a less effective 6-week blocked approach.

The Winnipeg Police Training academy appears to still utilize a concentrated practice approach for its use of force training. Recruits are divided up into groups and use of force training is conducted in a concentrated period of time using a round-robin approach.

> *Skills perishability research suggests that the City of Winnipeg's concentrated training approach does not support skill retention.*

Introduce an environmental context into training:

The telephone survey suggests that training institutions do introduce environmental context into training. Training sessions typically culminate in a use of force scenario allowing the cadet to put their skill within the wider operational context.

Introduce inter-trial variability to challenge the trainee's attentional processes:

The telephone survey suggests that some training institutions do introduce inter-trial variability into use of force training. Scenarios are never the same; thus challenging a trainee to use the proper use of force intervention technique. Some scenarios allow the use of alternative intervention techniques and trainees are forced to properly articulate why they chose the method utilized. Apart from initial skill acquisition, rote practice approaches were not utilized by the training institutions interviewed.

Given that new learners may preferentially reduce their degrees of freedom when learning a new motor skill, training schemes that utilize this concept may be promising (e.g. part task training that isolates limb movement during firearms skill acquisition):

The telephone survey did not identify any academies examining this approach.

> *Studies should be undertaken to identify the differences between good shooters and bad. A part-task training approach may help identify problematic behaviours and thus support remediation efforts.*

Assess trainees to determine if they have reached the autonomous stage. Explore the training approach that utilize skill "expertise" as a go/no go graduation measure versus passing a single performance test, e.g. tailored assessment:

The use of force instructors (from the training academies) surveyed did not believe their recruits had reached the autonomous stage in skill performance. The telephone survey identified the use of pass/fail standards at the training academies. It was also reported that individual officer training scores are not retained because of a concern for potential litigation issues if an officer's records are subpoenaed. The training staff did report that informal feedback on weaker students was provided to future employers in many cases.

Handgun instructors interviewed reported that weaker performing students who barely graduate from the training academies are likely to be the same officers who fail their annual qualification test. One senior instructor believed that all police officers will score 10% lower on their requalification test than their score from training. For an RCMP officer this may mean an officer who scores 240/250 at Depot would score approximately 218 a year later. An officer who graduates with a score of 210 will probably score in the area of 190 and thus not pass their re-qualification test (minimum 200 to re-qualify). The same senior instructor believed that the same officers will reacquire their lost skills with minimal refresher training.

An RCMP Depot instructor reported that a number of cadets who pass their firearms test at week 20 pass will fail a month later. The instructor reported that these trainees are poor shots and the lack of practice from week 20 to 25 sees a marked decline in performance. This notable decline in marksmanship and other skill performance has been a complaint amongst other police forces who reported that cadets straight out of training institutions fail to make the grade when tested at their new units.

The firearms performance standard utilized in training institutions was reported by many trainers to be insufficient, i.e. it is not a good assessment of marksmanship expertise and does not in their opinion prepare cadets adequately for the field. These trainers reported that the pass/fail standard is based more on the training time available rather than operationally requirements. These instructors acknowledged the challenges of having a higher standard i.e. more failures and

more training time at the academies. When questioned over skill loss after graduation, these same instructors commented that without regular practice or refresher training all officers will lose their marksmanship skills.

Maximize the use of training scenarios during initial training. Utilize cognitive and behavioral task analysis to explicitly identify the important concepts, cues and proper procedures to use in each scenario:

Training institutions report that although significant amounts of training time is scenario-based, the majority of the class is observing the activity and while valuable lessons are learned, physical participation is reduced. While each trainee must pass a number of use of force scenario assessments to graduate, the number of use of force scenarios that each trainee participates in is generally unknown. Use of instructors reported that trainees require more scenario-based practice.

There is no standard across the country as to the number of use of force scenarios that a trainee should experience. One senior use of force instructor commented that some scenarios end with minimal officer intervention and thus trainees are not equally exposed to the more demanding scenarios. Efforts should be undertaken to see if it is possible and practical to quantify the degree of difficulty of the use of force scenarios. If it is possible then efforts should be taken to expose all trainees to a series of use of force scenarios that require mastery of all use of force skills. It is also believed that the focus of use of force training should be centered on scenario-based practice and efforts should be undertaken to provide more scenario-based practice.

Rather than using behavioral or cognitive analysis in the development of their scenarios, training institutions often utilized actual and well analyzed events as the basis of their scenarios.

The development of training scenarios appears to be idiosyncratic. While this approach allows training institutions to tailor training to their particular operational environment, recent lessons learned can be lost. Police agencies should be canvassed to forward real life scenarios for use by police training academies and other police forces.

Examine the efficacy of schema-based learning techniques for elements of use of force skill training:

The telephone survey suggests that training institutions do utilize schema-based learning techniques. Instruction is grounded in real-life situations, allowing the expert instructor to guide the trainees in understanding their expert "mental models". Experts identify the rules of practice for recognizing and describing cues involved when deciding use of force intervention techniques.

Utilize part task training so that task components are mastered individually, e.g. perceptual components, decision making components, and action components:

The telephone survey suggests that training institutions primarily utilize part task training techniques for action components, i.e. action skills are broken down to sequential components. The limited telephone interviews did not identify institutions that separated out perceptual or decision making components from action components. Perception and decision making skills are not mastered before the introduction of use of force skills.

The development of part-task e-based learning programs and decision-based intervention simulations should allow trainees to gain more knowledge on when to use a use of force intervention technique. Part-task trainee could expose trainees to a much larger and wider variety of situations drawn from real-life.

Simulation technologies can assist transfer of training in a cost effective manner

While the literature review identified that simulation technologies can assist in the transfer of training, some training institutions reported a significant operations and maintenance burden was attached to the use of sophisticated trainers. As well instructors reported that although FATS™ and PriSim™ simulators have their place in use of force skills training, they only augment scenario-based training. Instructors at JIBC reported that trainee's excitation levels quickly drop after the first FATs™ session. They reported that the current suite of simulators do not provide enough consequential feedback. Instructors reported success with FX training ammunition

Section 5: Summary Discussion and Recommendations

5. Discussion

The goals of this project were many; one concerned the identification of factors that influence skill perishability. A number of these factors are identified in Section 2, but there is more complexity in existing research than can reasonably be accommodated in this literature review. The first step in predicting skill perishability must always be determining the factors that are likely to provide the maximum predictive power in police use of force skill retention. The literature review identified a number of factors that impact skill perishability:

- Retention Interval
- Personal Characteristics
- Initial learning
- Retraining
- Job Conditions
- Task Characteristics

Few studies have attempted to rank the relative strength of these factors on skill retention. The impact of skill retention factors on skill perishability is not a straight forward process, and many of these factors interact with each other in a complex way. Depending on the nature of these interactions, retention of some use of force skills may be best predicted by one set of factors and retention of other skills by a different set of factors. The most advanced model that targets prediction of skill retention is the UDA model (Rose et al., 1985a, 1985b). However, this model was developed and validated for a fairly restricted range of proceduralized skills.

A primary goal of this project was to identify literature evidence that supports the timing of police use of force skills refresher training and recertification. Despite a comprehensive search, little empirical evidence was discovered in the existing research and literature. This suggests that the retention of Canadian police use of force skills is for the most part unknown. Literature reviews and feedback from use of force experts indicate that issues with use of force skills have many dimensions. Concerns with perception and decision making skills in high stress tactical situations were a particular concern, in fact some believe that the apparent perishability of these skills were more important than the loss of the motor techniques themselves. As a result, tactical decision making under stress was examined in greater detail (Section 3). Operational evidence suggests that tactical decision making under stress is a significant issue.

Subject matter expert concerns with the efficacy of traditional marksmanship firearms training programs and the applicability of skills learned on the range to reactive shooting on the street led to a brief review of transfer of training. The fear expressed by these experts was “how can we evaluate skills perishability when we can’t be sure that we are training properly?” As skill retention and skill transfer are different concepts, our review considered the issue of transfer of training (Section 5). However, the broad scope of this literature review meant that only limited coverage could be provided.

Another goal of this project was to identify "evidence-based" (best practices) during acquisition to support skill retention. Teaching principles and techniques that promote long term skill retention were identified throughout the report. Many of these principles are being applied by training institutes already. These principles include:

- Blocked practice for faster initial learning; spaced practice for better retention and transfer; decision practice for highly motivated learners
- Explicit instruction for faster initial learning; implicit instruction for better retention and transfer
- Internal focus of attention for initial learning; external focus of attention for more skilled performers
- Knowledge-of-performance feedback early in skill development; knowledge-of-results feedback later; fade feedback as skills develop
- Artificial simulation feedback early in learning; natural simulation feedback later in learning
- Constant, augmented feedback for initial learning, delayed augmented feedback (e.g., video) with more advanced learners
- Questioning by trainer to help advancing learners develop self-coaching
- Train recognition and decision making skills separate from motor skills

One of the goals of conducting the use of force instructor was to identify refresher training policies and any empirical based evidence that supports the timing of police use of force skills refresher training and recertification. One line of investigation not completed was the report that the Ottawa Police Force had conducted studies justifying their refresher training policy. The use of force instructor interviews did not identify any empirical evidence that supported refresher training timing. The amount of initial use of force training varied widely between the training institutions. As expected programs that last over 20 weeks provided more use of force training than those of shorter duration. What is taught at the training academies also varies across Canada. The amount of use of force retraining and recertification also varied across the agencies surveyed. For the majority of forces interviewed use of force refresher training is conducted annually. Evidence to support annual or biannual use of force training was not demonstrated.

One final goal of the literature review was to identify the research required to provide an impartial evidence-based recertification strategy with the ultimate goal of establishing national standards for skills training/maintenance that meet operational policing need. This goal is the focus of this section.

Subject Matter Expert Working Group

Before detailing potential research efforts, it seems important to first address the important question as to whether it will be possible to develop empirically based recertification standards. This question was asked directly to SMEs in the 10 to 11 May Police Skill Retention Workshop. Unanimously, the attendees believed that sufficient research evidence could be captured to inform and to empirically justify recertification standards and refresher training cycles. However, there was also unanimous agreement that such an effort will require significant investment in resources, time and cooperation. Even though the literature includes significant numbers of

references to U.S. military skills retention studies, the U.S. military to date has only quantified a few skill retention rates.

Suggestions for future research that emerged (in no particular order) from the Police Skill Retention Workshop included the following:

- Compile a list of "evidence-based best practices" in the areas of both skill acquisition (e.g., random practice better than blocked) and skills perishability (e.g., level of original learning is the best predictor of retention).

  Based on discussions surrounding this recommendation, it was believed by the authors that the SMEs were recommending detailed literature reviews by academic experts and authors in the kinesiology and psychology fields.

- Take the ARI model and use it to apply to a few skills. SMEs suggested that this could be done in schools where trainees naturally have to return for future training (e.g., OPC, BCIJ, etc.)

- Develop and implement a survey to identify the use of force concerns amongst serving officers, use of force training cadre and leadership officials.

  The degree of skills perishability amongst Canadian police officers is currently unknown. A survey may serve to identify skill perishability concerns and thus foci of research projects.

- Need to better quantify the impact of stress on decision-making skill retention. Although marksmanship is a critical skill, the problems of skill acquisition and skill fading extend far beyond it – need to simulate the actual situations that recruits will face through scenario-based training – need to create a more interactive environment that extends beyond motor learning.

- Conduct research at Canadian universities.

  Issues surrounding the need to gain access to recruits and the requirement to publish were raised as potential challenges to their support of this research by the academic experts (the open publication of the FLETC, 2004 report was reported to have been withheld for years because of the sensitivity of the results).

  The traditional academic approach for evaluating skill retention factors in isolation (controlled environment) and using artificial tasks is a potential concern. Academic research needs to address the complex use of force tasks in real world situations.

- Need to focus beyond shooting skills (e.g., handcuffing, ankle kick, carotid hold etc.)

  Based on discussions surrounding this recommendation, it was believed by the authors there may be an over-emphasis on the retention of lethal weapon skills. Skills perishability research must include the spectrum of use of force options and skill components.

- Need to distinguish long-term retention from transfer

  As a result of this comment, a section on skill transfer was included this report. The question as to whether current marksmanship training transfers well in high stress reactive shooting scenarios is a specific concern.

- Compare training standards against research literature with academic researchers/experts in each area. However, given that reviews of training are likely to show both consistencies and inconsistencies with best practices, SMEs also raised the question of whether academies will be willing to subject themselves to potential criticism

  Once a set of evidence-based best practices are identified, the recommendation is to review the training academies to see if their curriculum and teaching methods can be improved. The authors were informed by the sponsor that this is one of the current goals of the overarching PSC project.

- Multi-tasking may be an overlooked area

  One specific skill issue not addressed in the literature review is the impact of multi-tasking on skill perishability. This issue should be investigated.

- Explore simulation-based training

  Unfortunately the academic experts in this workshop were not conversant with the state of the art of simulation-based police training. The review by Bennell (2005) should serve as a good starting point for simulation-based training research questions.

- Begin a program of research with multiple lines of inquiry. Module 1 – Job Task Analysis – what skills are we going to focus on (e.g., handcuffing, baton). Module 2 – how can performance be measured (e.g., objective, time/cost, multi-task). Module 3 – how do we train for that? Module 4 – what is the retention curve or drift in the real world – might want to have an SME for each of the identified skills – researchers are working simultaneously at different stages

  Although this recommendation outlined a program research, significant efforts have been undertaken in the area of job and task analysis by the PSC. The proposed program does lay the groundwork for a potential research program.

- Need to design a comprehensive research plan and program. Workshop discussions with SMEs indicated a wide range of interests and ideas, and many possible funding models and possibilities, depending on the research plan (e.g., CACP, OACP, CPRC, university graduate students).

  The SMEs identified the need to develop an overarching research program with multiple efforts and funding sources. Critical questions are who should chair the program, who should advise on research, how should the research be done, etc.

- Efforts to design a comprehensive research plan and program should be paired with development of a simultaneous communications plan. This plan needs to clearly articulate the motivation and rationale for initiating such a program of research (i.e., there is no current crisis. Need to design a communications plan at the same time. Need to emphasize there is no current crisis – it's good – we want to make it better)

- Need to explore collaborative international efforts (e.g., Home Office Scientific Development Branch – Graham Smith, New Zealand – John Rivers, Penn State, FLETC, INTERPOL – R & D group).

Given the limited research funds available, every effort should be taken to identify efficiencies and leverage ongoing international research efforts.

- Create a mind map of who is doing what – where are we going – who are the experts in each area?

  The police use of force domain includes many different research areas such as simulation, psychomotor skills, decision making, perception, etc. Prior to developing an R&D program the PSC should develop a mind map of who is researching what area of interest, i.e. if there are Canadian experts who are currently evaluating use of force trainers there may be less of a need for sponsoring a new research project in this area.

- Consider conference (s) that bring experts together

  One approach for identifying potential research collaborators is to sponsor a conference. The conference serves two purposes it introduces the complicated use of force retention issues to a wider academic audience and the PSC develops a more robust research network.

- A number of discussions were held amongst the workshop attendees as to how to conduct skills perishability research. During the discussion the RCMP and the University of Regina reported that they are in the process of developing a Law Enforcement Research Institute on the campus of the University of Saskatchewan in Regina. A doctoral candidate from the RCMP research group at Depot Division will be conducting research at the University to support his dissertation.

  The Working Group members expressed their support for the concept of establishing a research centre hub. Additional approaches for engaging academics in policing research were also proposed by some member (establishing multiple chairs in a number of universities, NSERC grants, annual PSC calls for research, virtual research institute modeled on existing programs, etc.). Potential challenges and solutions were briefly discussed. The PSC currently sponsors research and thus may wish to become an interested observer in this new RCMP - University of Saskatchewan joint venture

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