Pistols Skills Transfer from a Synthetic Environment to Real World Setting

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ABSTRACT

Pistol training, be it military or law enforcement, has traditionally occurred in live-fire environments. However, many agencies are being challenged to find new and innovative ways in which to deliver not only existing pistol training programs, but are being tasked to add more to their training programs without increasing training time. One approach that is beginning to attract attention is how technology can be used to enhance and augment current training practices, while creating efficiencies that address those critical training gaps (Krätzig & Hudy, in press). While the use of heavy artillery and rifle simulation technology within a military setting is well established, the existing body of literature does not adequately address how this technology can be used in a pistol-training program, or whether these skills can be acquired without live-fire exposure. The purpose of this research is to provide empirical evidence that pistol training in a laser-based synthetic environment is as effective as traditional live-fire training, and that an entire pistol course-of-fire training program can be delivered without live-fire instructional time. An experiment was conducted using 124 Royal Canadian Mounted Police (RCMP) trainees (cadets) designed to compared live-fire pistol training performance with those cadets who were trained exclusively in a laser-based dry-fire environment. Our results indicate that cadets who were trained in a simulated environment had higher scores than a typical live-fire trained cadet. This paper will systematically discuss methods, measures, and results along with the future research directions.

ABOUT THE AUTHORS

Gregory P. Krätzig
Mr. Krätzig is responsible for investigating the efficacy of simulator technology in a law enforcement training environment. During his tenure he has lead research projects investigating; 1) skills acquisition during simulator exercises (e.g., driving, course-of-fire, and use-of-force), measured against real world tests, His research has resulted in the integration of driving simulators into the RCMP Driver Training program. He was awarded a Doctoral Scholarship from the Natural Sciences and Engineering Research Council (NSERC), as well as numerous other scholarships and awards, and was recently awarded a $150,000.00 DRDC/CPRC grant to further his research investigating the efficacy of simulation technology as a training tool. He has a book chapter (in press) discussing simulation as a law enforcement training tool and his driving simulation work has been published. He has been invited to speak on the topic of simulation as a training tool at the Federal Law Enforcement Training Centre, the Canadian Military Council, the Justice Institute of British Columbia, Corrections Services Canada, and the University of Regina, and has presented his findings at I/ITSEC2010, the FBI academy, and the Canadian Psychological Association. He received his Masters Degree in Experimental and Applied Psychology, and is nearing completion of his PhD in the same area. His dissertation topic in Experimental and Applied Psychology is an investigation of pistol skill acquisition in a synthetic training environment and the effects of skill retention between live and synthetic-fire trained cadets.

Curtis Parker
Cpl. Parker joined the Royal Canadian Mounted Police (RCMP) in 1990, and has 12 years of operational policing in British Columbia, which included General Duty, General Investigation Section, Drugs, and Street Crew Teams. He was a member of the Vancouver Island Tactical Troop before becoming a member of the North Island Emergency Response Team. In 2003, Curtis transferred to the Canadian Air Carrier Protective Program in Ontario, where he was immersed in a simulation training environment. In 2006, he joined the RCMP Training Academy in Regina, Saskatchewan, and after a brief stint as an instructor in Applied Police Sciences moved to the Simulator Training Unit. With his extensive firearms experience, he immediately began working within the synthetic range environment, and was the lead instructor in the pilot project that saw 19/21 University of Regina students who were taught the RCMP course-of-fire, successfully complete the course after being trained exclusively in a synthetic environment. He is an expert marksman and instructor whose skills were essential to the success of the pistol course-of-fire research. This team is investigating the efficacy of technology for use in the Cadet Training Program, and other law enforcement agencies. Curtis has a Bachelor's Degree in Physical Activity Studies from the University of Regina.

Michael Hyde
Cpl. Hyde joined the Royal Canadian Mounted Police (RCMP) in 1995, and had 7 years of General Duty operational policing in Prince Edward Island before being transferred to the Canadian Air Carrier Protective Program in Ontario. In 2007 Michael transferred to the RCMP Training Academy in Regina, Saskatchewan, and began his instructional career as a firearms instructor before bringing his extensive firearms expertise to the Simulator Training Unit. Michael's firearms expertise as both an expert marksman and instructor has played a pivotal role as part of the research team that is investigating ways in which simulation technology can be integrated into the current training program. Michael has a Bachelor's of Science Degree from the University of Prince Edward Island.

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INTRODUCTION

The first use of handguns by law enforcement officers (LEO) can be traced back to the mid 1800's (Morrison & Vila, 1998); however, it was not until the early 1900's that police organizations first attempted to develop police shooting skills. Although LEOs have used hand guns for more than 150 years, formalized training and (re)certification is a relatively novel concept, with the latter not occurring until the 1960's. Even though policing has over a century and a half of history, there have been very few changes to handgun training. In fact the revolver had remained the standard tool used by LEOs until it was replaced by the semi-automatic pistol in the 1990's.

Typically law enforcement pistol training occurs with a student shooting a predetermined number of rounds at a target placed a set distance away from the student. For example the Federal Bureau of Investigation (FBI) requires their agents to shoot at distances between 7 - 25 yd, while general duty Royal Canadian Mounted Police officers shoot at targets 3 - 25 m away. In both cases students are evaluated based on achieving a minimum percentage score within a specified time limit[1]. Although LEO course-of-fire (COF) training programs have been modified over time, most of this change had more to do with each agency's "ideas" of how the course-of-fire should be taught instead of using empirical evidence to guide decisions (Morrison &Vila, 1998). For example, in 1895, then Police Commissioner of New York City Theodore Roosevelt, introduced handgun training to his LEOs. Although their training consisted of a dry-fire warm-up session followed by shooting 10 rounds at a bull's-eye target, this training would be considered the best training available for at least 25 years. Years later the National Rifle Association (NRA) developed a handgun course using military training as a design template. It was not until the NRA developed a handgun course that this type of instruction gained real credibility with American police agencies. Although most police departments used the NRA training program, by the end of the Second World War this type of instruction was challenged by the FBI's practical handgun course, now known as the practical pistol course (PPC; Morrison, & Vila, 1998; Weston, 1973). Although these two courses tried to position themselves as being diametrically different from each other, it can be argued that both courses-of-fire just score a LEOs performance using a bull's-eye target placed down range.

While police training is constantly evolving, a recent shift by the RCMP to a problem-based learning (PBL) training environment has created LEOs who are better prepared for the field. The PBL instructional paradigm has, through the identification of training gaps, created opportunities to use simulation as a means to train high risk procedures in a safe, efficient, and realistic environment (Krätzig & Hudy, In Press) see also, (Anesthesiology; Abrahamson, Denson, & Wolf, 2004; Airline pilots; Bürke-Cohen, Go, & Longridge, 2001; Best evidence in medical instruction; Issenberg McGaghie, Petrusa, Gordon, Scalese, 2005; Emergency response intersection clearing; Krätzig, Bell, Groff, & Ford, 2010).

A review of the literature has revealed a paucity of research using simulation as a training tool in a law enforcement setting, and the efficacy of simulation technology as a means of replacing basic live-fire pistol training, has not been thoroughly investigated. Although there was interest to see if simulation training could replace live-fire training, conducting

[1] Agencies are not consistent in target size, shot distance, or scoring requirements for qualification targets.

such a study with police cadets was not viable because there was no empirical evidence to suggest that this type of training was effective. However, an earlier study conducted between the University of Regina and the RCMP, (MacLennan & Partyka, 2009) provided convincing evidence that pistol shooting skills can be acquired in the absence of live-fire training. Their participants were recruited from a Police Studies undergraduate program at the University of Regina and the results provided the evidence (19 out of 21 passed the Final Qualification exam) needed to conduct a similar study with RCMP cadets.

EXPERIMENT 1

Participants

Four troops of RCMP cadets (N = 124; 31 Female, 93 Male), mean age of 29.02, S.D = 7.52, were used for this experiment. One troop was selected to complete all of their pistol training in a synthetic range environment (N = 32; 8 Female, 24 Male) mean age 29.19, S.D. = 7.00. Although this troop was selected due to training considerations (i.e., availability of the instructors), it is important to note that the recruiting personnel were not told that this troop would complete the COF training in a synthetic environment, and as such the loading of this troop was free from any potential bias. Data for 3 cadets were excluded from this analysis due to their contract termination for deficiencies in other skill areas.

Materials

In order to become a regular member in the RCMP, each cadet is required to successfully pass a 24-week training program, with the pistol training occurring over eighteen-50 min sessions. Although this training traditionally occurs exclusively on a live-fire range, these cadets would receive all of their pistol training in a synthetic range environment, and shoot live rounds only during the three evaluation sessions (i.e., Benchmark 1, Benchmark 2, and Final Qualification). Cadets who train on a live-fire range shoot on average 2300 rounds; however, for this experiment the cadets who were trained in the synthetic environment shot only 200 live rounds (i.e., the three evaluation sessions).

The training system we used was purchased from Advanced Interactive Systems (AIS, 2010), who modified their existing software to recreate the RCMP pistol COF. The computerized system projects a digital 25 m range complete with 16 lanes of fire. Digital photos of the actual range were taken and digitized to replicate, as close as possible, what the cadet would see if they were on the 25 m live-fire range at the academy (e.g., target carrier system, lighting, shadows, etc.). The targets used were jpeg images and digitized to resemble the targets cadets use in training (i.e., upper human torso bull's-eye targets). Additionally, targets were resized to accurately represent how they would appear when placed at distances of 3, 5, 7, 15 or 25 m. All shooting scores were calculated by the AIS system, and stored on the computer as well as manually recorded in the cadets training file. The pistols used were the standard Smith & Wesson model 5946 but were modified (i.e., live-fire capability removed) to emit a laser beam, and were dry-fire weapons only. All other equipment used (e.g., duty belt, ear protection, body armor, etc.,) were standard issue equipment that the cadet would wear during live-fire training. In an effort to keep as close to in situ training as possible, the cadets were required to adhere to all safety protocols in the synthetic environment as if they were on a live-fire range (i.e., pistols pointed down range, body armor, ear and eye protection needed to be worn, etc.). These data were analyzed using SPSS 19.0 (IBM, 2011) statistical software, and the results are considered significant at $p < .05$.

Methods and Design

Course-of-Fire

During the entire training program, as well as each of the three evaluation sessions, cadets use a two-handed grip using the Modern Isosceles Stance (Avery, 2000; White, Carson, & Westmoreland, 1989), unless otherwise specified. A training requirement for cadets is to pass the Final Qualification exam; however, they first must participate in two initial evaluation sessions (i.e., Benchmark 1 and 2). Cadets who failed the first attempt at either Benchmark 1 or 2, are afforded two additional sessions of remedial training, before being given a second chance at either Benchmark 1 or 2. Although there are no negative career ramifications if they fail their second attempt, this is not the case if they fail the Final Qualification. Cadets who fail this evaluation session are afforded five additional 50-min sessions of remedial training before being allowed a second attempt at the Final Qualification. If the cadet fails this second attempt, they are recommended for termination and are not allowed to continue training with their troop.

Benchmark 1. The targets are placed at 15 m, and the cadets are taught over five-50 min sessions. The sixth session (Benchmark 1) requires the cadet to shoot a minimum of 15/18 rounds (no time limit) into the centre of the target (centre mass).

Benchmark 2. This evaluation session is made up of four stages, and each stage must be completed sequentially, and must achieve a minimum overall score of 168/210.

Stage 1. Requires the cadets to shoot 14 rounds at a distance of 25 m. The cadet must achieve a minimum point total of 46/70 in 120 s or less. This stage includes shooting in the standing (i.e., 7 rounds), kneeling (i.e., 5 rounds), and prone (i.e., 2 rounds) positions. Additional requirements include clearing a stoppage (i.e., clearing a dummy round), and reloading a magazine before going to the prone position.

Stage 2. This target is shot at a distance of 15 m with 4 rounds shot first from the standing position followed by 4 rounds from the kneeling position. Cadets have 20 s to complete this stage and must achieve a minimum score of 26/40.

Stage 3. Eight rounds are shot at a distance of 7 m and it is the only stage where the cadet begins the session with their pistol out of their holster (i.e., low ready). Cadets have 2 s to shoot 2 rounds while standing on the right side of their lane. When finished, they move to the left hand side of the lane and shoot 2 more rounds also in 2 s or less. Once completed, they repeat this process. The minimum point score for this stage is 26/40.

Stage 4. This stage is shot at a distance of 5 m and requires the cadet to shoot 12 rounds. Cadets have 5 s to sequentially shoot three rounds (i.e., 2 centre mass, 1 head) and then re-holster. They will repeat this exact procedure three more times and need to achieve a minimum score of 40/60 to pass.

Final qualification. This evaluation session is the last time the cadets will be tested on the range before they leave the training academy. This session includes each of the four stages that make up benchmark 2 plus an additional stage.

Stage 5. Cadets shoot at a target placed 3 m away, and is the only test of one-handed shooting. Cadets must first fire 4 rounds with their dominant hand, reload, then switch to their support hand and shoot an additional 4 rounds. Cadets have 15 s to complete this stage and must achieve a minimum score of 26/40. Cadets must pass each of the 5 stages and achieve a combined score of at least 200/250 to pass this evaluation session.

RESULTS

Pass/Fail Rates

Pass/fail rates between the two groups (synthetic vs. live-fire trained) were compared across the three evaluation sessions using a χ^2 contingency table analysis. There were no pass/fail differences observed between the two groups for Benchmark 1 and 2, but significantly more cadets who were trained in the synthetic environment failed their first attempt at Final Qualification. However, these differences were no longer evident following the reshoot of the Final Qualification exam; in fact 100% of the synthetic-fire trained cadets passed the pistol COF training program (Table 1).

Table 1. χ^2 Analysis for Each Evaluation Session

Evaluation Session	χ^2	*df*	*p*	ϕ^2
BMK1	0.46	1	.497	.063
BMK2	3.64	1	.056	.177
FQ1	7.56	1	.006	.252*
FQ2	0.65	1	.418	.074

Note. BMK1 = Benchmarks 1, BMK2 = Benchmark 2, FQ1 = Final Qualification First Attempt, FQ2 = Final Qualification Second Attempt.
* $p < .05$

Mean Scores

Shooting performance were analyzed using a 2(Environment; Live-fire vs. Synthetic-fire) X 3(Evaluation Session; Benchmark 1, Benchmark 2, Final Qualification) repeated measures ANOVA with Environment as the between subjects factor (Table 2). Data were analyzed using the final results of each of the three evaluation sessions. There was a main effect of session with percentage scores increasing between Benchmark 1 and Final Qualification $F(1,105)$, $MSE = 93.43$, $p = .019$ (Benchmark 1 = 87.06% vs. Final Qualification = 90.70%). There was no interaction of Training Environment, $p = .94$ with similar shooting performance observed regardless of the training environment (Live-fire, 87.94% vs. Synthetic-fire, 85.19%).

Table 2. Total Mean Percentage Scores for All Cadets. Results include Reshoot Results.

Evaluation Session	Live-fire Mean	SE	Synthetic-fire Mean	SE
BMK1	87.71	1.71	86.42	2.94
BMK2	85.02	1.12	79.61	1.93
FQ Total	91.82	0.65	90.33	1.11

Note. BMK1 = Benchmark 1, BMK2 = Benchmark 2, FQ Total = Final Qualification.
* $p < .05$

Benchmark 1

Shooting scores between all cadets in both groups were compared, and no significant differences were observed. However, data for those cadets who failed this benchmark were compared using a 2(attempt; first vs. second attempt) X 2(Training Environment; Live-fire vs. Synthetic-fire) repeated measures ANOVA. Both groups of cadets significantly improved their scores between attempts $F(1,43) = 49.70$, $MSE = 149.07$, $p < .001$, (First Attempt; 63.35%, vs. Second Attempt; 82.07%). There was a main effect of training environment (live vs. synthetic) $F(1,43) = 6.20$ $MSE = 209.43$, $p = .017$, with live-fire trained cadets scoring higher than synthetic-fire trained cadets (live; 76.63% vs. synthetic; 68.79%. Independent samples *t*-tests were conducted to compare mean score differences between live-fire and synthetic-fire trained cadets. It was found that there were significant differences between these two groups during the first attempt Live = (M = 69.84, SD = 8.72) vs. Synthetic = (M = 56.86. SD = 14.10); $t(44) = 3.89$, $p < .001$,(2-tailed). However, differences between the groups were no longer evident after the second attempt $p = .571$ (2-tailed), no other effects were found (see Table 3 for means).

Benchmark 2

Shooting scores between all cadets in both groups were compared and no significant differences were found. Mean score percentage differences for cadets who failed this benchmark were compared with their second attempt using a 2(Attempt; First vs. Second Attempt) X 2(Training Environment; Live-fire vs. Synthetic-fire) repeated measures ANOVA. There was an effect of session $F(1,37) = 11.11$, $MSE = 38.15$, $p = .002$, with cadets improving between their first and second attempt (First attempt; 69.51%, vs. Second Attempt; 74.45%). Independent samples *t*-tests were conducted to compare mean score differences between live-fire and synthetic-fire trained cadets, and it was found that there were no significant differences between these two groups during either their first or second attempts all $p > .20$, (2-tailed), no other effects were found (Table 3).

Final Qualification

Mean score percentage differences for cadets who failed the Final Qualification were compared with their second attempt using a 2(Attempt; First vs. Second Attempt) X 2(Training Environment; Live-fire vs. Synthetic-fire) repeated measures ANOVA. There was an effect of session, with percentage scores improving over time $F(1,13) = 20.84$, $MSE = 35.50$, $p = .001$, (First Attempt; 76.40 vs. Second Attempt; 86.35%). There was a Session x Training Environment interaction $F(1,13) = 10.02$, $MSE = 35.50$, $p = .007$, with cadets trained in a synthetic-fire environment improving 16.86 percentage points over their first attempt, whereas those who were training in a live-fire environment improved only 3.05 percentage points over their first attempt (Table 3). No other effects were found, all $p > .05$. Independent samples *t*-tests were conducted to compare live-fire and synthetic-fire trained cadets mean score differences, and it was found that there were no significant differences between these two groups during either their first or second attempts all $p > .05$, (2-tailed).

Table 3. Total Mean Percentage Scores, only for Cadets who Failed an Evaluation Session.

Evaluation Session	Live-fire Mean	SE	Synthetic-fire Mean	SE
BMK1	69.84	2.10	56.86	2.69*
BMK1a	83.41	2.90	80.72	3.72
BMK2	69.56	2.38	69.45	3.36
BMK2a	77.07	2.21	71.83	3.13
FQ	79.20	2.34	73.60	2.50
FQa	82.25	3.18	90.46	3.40

Note. BMK1 = Benchmark 1 first attempt, BMK1a = Benchmark 1 Reshoot, BMK2 = Benchmark 2 first attempt, BMK2a = Benchmark 2 Reshoot, FQ = Final Qualification First Attempt, FQa = Final Qualification Reshoot.
* $p < .05$

DISCUSSION

The following experiment provided evidence that the skills needed for basic LEO pistol shooting, can be

acquired in a synthetic environment. The results of Benchmark 1 were encouraging, in that there were no pass/fail differences regardless of the environment the cadets were instructed in. Although the data indicated that there were significant score differences between live-fire and synthetic-fire trained cadets following the first attempt at this benchmark, these differences were no longer present following their second attempt. It is important to note that cadets who were trained in the synthetic-fire environment had mean scores 13 percentage points lower after their first attempt than their live-fire peers. As a result, the improvement in mean scores was greater for the synthetic-fire trained cadets than the live-fire cadets. Although it is unclear why the synthetic-fire trained cadets performed so poorly, it was speculated that these difference may have been due to the absence of the concussion blast and recoil that is experienced by a live-fire weapon, even though this issue was no longer apparent when the cadets were given a second opportunity to shoot this benchmark.

Further scrutiny is placed on the recoil and concussion blast argument when opposite performance results were found following Benchmark 2. While there were still no pass/fail differences for this benchmark, in this instance cadets who were trained in the synthetic environment but failed, outperformed the live-fire trained cadets (live-fire; 65.92% vs. synthetic-fire; 70.64%). Although, this time it was the live-fire trained cadets who increased their scores more than the synthetic-fire trained cadets after their second attempt at this benchmark exam. If the absence recoil and concussion blast are factors to be considered for these differences at Benchmark 1, it can be argued that they are just momentary distractions, which are quickly overcome during the reshoot of Benchmark 1. However, this argument does not explain any of the performance differences observed for Benchmark 2.

When these data for the Final Qualification were examined, we found that there were significant pass/fail differences, with more failures experienced by cadets who received their pistol training in the synthetic environment than was found with live-fire trained cadets. Although there was no initial explanation for the high number of failures after Final Qualification, we continued with the five remedial training sessions that all cadets who fail this test are afforded. However, for these sessions, the cadets participated in their remedial training in the live-fire environment. The first remedial session consists largely of classroom exercises that end with a visit to the range where the cadets shoot < 30 live rounds. The second, third, fourth and fifth remedial sessions require the cadet to shoot the COF for the entire 50-min session. What became evident after the second remedial session was that each cadet who had trained in the synthetic environment had successfully scored above the required 200/250 needed to pass the COF. Not only had each of the cadets successfully completed the COF, but some cadets had improved their score by over 40%, a result not observed with live-fire trained cadets who had failed their first attempt at the Final Qualification. In fact performance appeared to have peaked following the second remedial session, with only nominal improvement in sessions 3, 4 and 5. The results of the second remedial session seem to suggest that there was no skill deficiency, but that some other factor or factors may have negatively impacted their initial Final Qualification performance. While there was no conclusive evidence available as to why they failed, it is an important question to try and answer. Regardless of the reason, their initial results should not overshadow the performance of these cadets following the completion of the five remedial sessions. The results of their second attempt of the Final Qualification saw each of the cadets who were trained in the synthetic environment, successfully pass this second attempt (Figure 1), while increasing their overall shooting scores to the point to where there were no differences between the live-fire trained cadets and the cadets trained in a synthetic environment (see Figure 2).

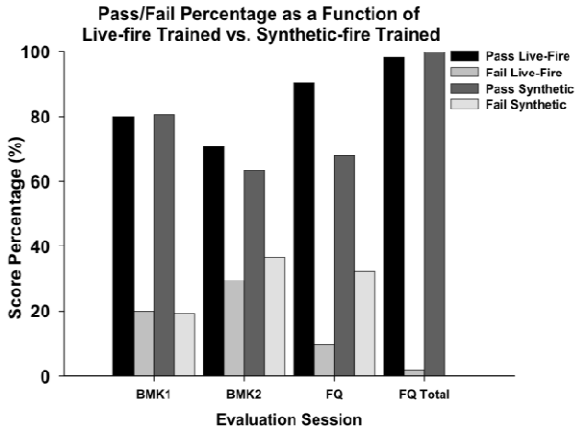

Figure 1.
Note. BMK1 = Benchmarks 1, BMK2 = Benchmark 2, FQ = Final Qualification First Attempt, FQ Total = Final Qualification Second Attempt.

FUTURE DIRECTIONS

These results provide conclusive evidence that pistol

skills can be acquired in a synthetic environment. However, there are still questions that remain to be answered, and plans are in place to repeat this experiment later this year. It is unclear why cadets who were trained in the synthetic environment failed the Final Qualification with greater frequency than the live-fire trained cadets. There was some discussion that the synthetic-fire trained cadets, who failed their first attempt at the Final Qualification, may have experienced some level of test anxiety beyond what would be expected. Therefore it may be useful to measure anxiety levels between live-fire and synthetic-fire trained cadets to see if this was just an anomaly, or, if this is a potential artifact of the synthetic range environment (e.g., Completive State Anxiety Inventory-2; Cox, Martens, & Russell, 2003). Additionally, it was posited that initial performance differences may have been due to the absence of recoil and concussion blast during training. Although this does not properly explain why there were no pass/fail differences between the groups. Nor does it explain why scores increased as dramatically as was evidenced by cadets trained in a synthetic environment, especially following Benchmark 1. Future studies could include the introduction of live-fire instruction before their first pistol training session. If recoil and the concussion blast are important factors, then exposing them to live-fire early in training may provide a reference point for the cadets when they shoot their benchmarks and final qualification.

The Final Qualification test is one of many stressful moments a cadet will experience during training, and failure of the Final Qualification could lead to termination of their training contract and with that the dream of becoming a member of the RCMP. Although no explanation was forthcoming as to why these cadets failed, this issue should be explored further.

The results of this study provide for the first time, that LEO pistol skills can be acquired in a synthetic training environment (Figure 2), all in the absence of recoil. While some would argue that recoil is an important part of shooting a pistol (e.g., re-acquiring the sight after each shot), the successful completion of the COF, (i.e., without recoil) by 100% of the cadets provide a strong argument against this notion, and is contrary to arguments by White, Carson, Wilbourn, (1991), who suggested that recoil is an important part of pistol skill acquisition. Although these results are encouraging, more research needs to be conducted before simulation technology can be integrated into a LEO pistol training program. While these results are positive, there are no plans to fully

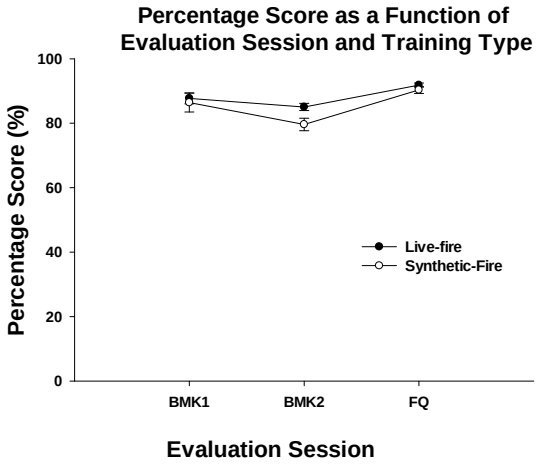

Figure 2. Note. BMK1 = Benchmarks 1, BMK2 = Benchmark 2, FQ = Final Qualification

replace live-fire training with synthetic-fire training, it is apparent that this technology will play an important training role in the future and that some live-fire training will be replaced by synthetic-fire.

While it is clear that this technology has a place in basic pistol training, we have begun to investigate other potential applications for this technology. A recent pilot project incorporated the synthetic training environment for those cadets who were struggling with their pistol training. For this study the eight weakest shooters in each of four troops, were given remedial training in the absence of live-fire, and then tracked through to their Final Qualification exam. Results of this pilot project found that there were significant pass/fail differences, with more cadets passing the Final Qualification if they received their remedial training in the synthetic environment. Although these results are encouraging, additional research using this technology as a remedial training tool for weak shooters needs to be continued. We have also started a project that will see existing RCMP members who did not clear their annual requalification; complete their remedial training in the synthetic environment. Although the initial numbers are small (N = 9), there is evidence that this technology can be used as an effective remedial training tool for those members in the field.

The results of these studies provide convincing evidence that synthetic environments provide an alternative to live-fire training. Live-fire ranges are costly to build, range time for agencies that do not have their own facilities have difficulty securing time on private ranges. Agencies that have multiple detachments, with some being remote, face the additional challenge of recertifying LEOs by having

to incur costly travel of that individual to a central training facility. It is possible that following further research that this technology can be used in some recertification situations.

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