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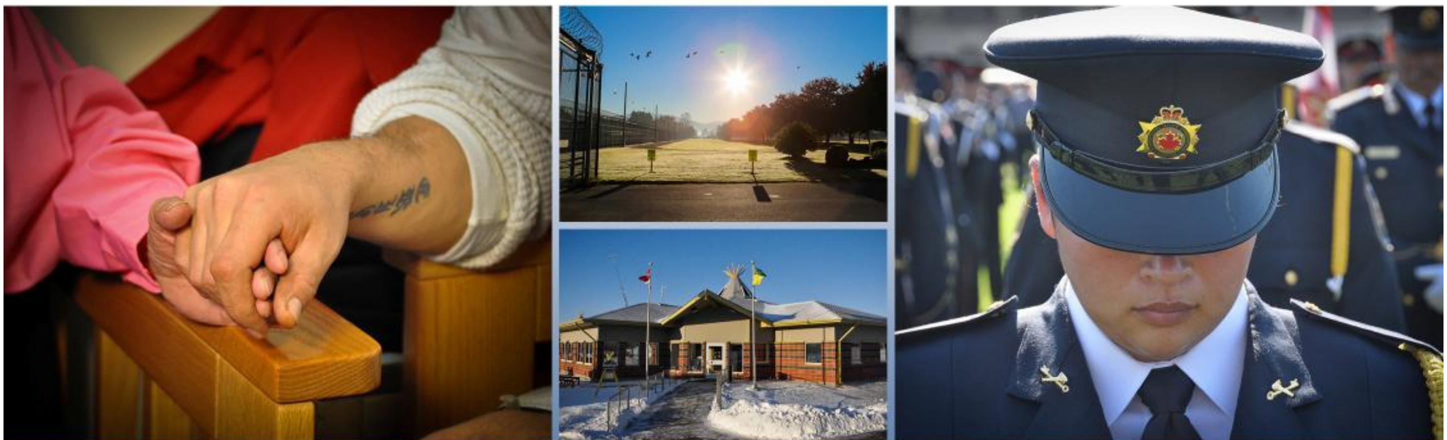

RESEARCH REPORT

The Effectiveness of Simulated Firearms Training for Correctional Officer Recruits

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The Effectiveness of Simulated Firearms Training for Correctional Officer Recruits

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Executive Summary

Key words: *simulated firearms, training, technology, weapons, correctional personnel*.

Simulated firearms training has been piloted by the Correctional Service of Canada (CSC) for correctional officer recruits. This innovative training method involves the use of laser-based technology in a simulated environment, and has effectively been utilized in military and law enforcement settings. Unlike live fire training, no ammunition is required and can result in increased safety, more efficient training and cost savings for organizations.

The purpose of this study was to determine the effectiveness of firearms training delivered in a simulated environment, in comparison to the traditional method of live fire training. The study used a between-subjects design where correctional officer recruits were first trained according to their assigned training modality and then tested using live fire. Outcomes related to theoretical understanding, accuracy, as well as safety and handling were compared between groups.

Recruits trained in a simulated environment had significantly lower scores on accuracy at the second benchmark session and final qualification. Despite these differences in scores, the overall pass/fail rates did not differ between training modalities. This is an important finding as it is ultimately the proportion of recruits passing and failing training that has resource implications, as opposed to scores on individual assessment components. Recruits trained using simulated firearms had higher scores on safety and handling at the final qualification examination, compared to their counterparts. For the simulated firearms group, additional classroom time was dedicated to teaching recruits the firearms manipulations required to meet safety and handling requirements. It appears that the modification made to classroom time was adequate to ensure that recruits gained a comprehensive understanding of firearms manipulations, and were able to apply this knowledge in a live fire setting.

Individual related characteristics were explored to determine whether other factors beyond training modality could have influenced qualification outcomes. The recruit's gender and grip strength demonstrated the strongest correlations with most of the evaluation sessions focused on accuracy, and often these variables influenced outcomes more so than the type of training. Lastly, this study explored whether anxiety levels of recruits predicted their final outcome of the 9mm firearms training. No differences were observed in Somatic Anxiety or Cognitive Anxiety between recruits who received simulated firearms training and recruits who received primarily live fire training. However, recruits trained in the simulated firearms environment reported lower levels of Self-Confidence at each of the evaluation sessions.

The findings of this study suggest that simulated firearms training may be an appropriate alternative or addition to existing training for correctional officer recruits. This training modality offers a viable option to facilitate and reduce costs for CSC's firearms training program. The ideal combination of simulated firearms and live fire training remains to be determined, as there remains an opportunity to balance classroom time, simulated firearms and live fire training to optimize positive outcomes for recruits. Future research will also examine the extent to which firearms skills are retained one year after training and if they differ between types of training.

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Introduction

The use of innovative technologies is being explored in correctional settings in an effort to make operations more effective and streamlined. While many of these innovations are focused on offenders and improving the safety and security of institutions, efforts have also been made to enhance staff training practices through technology. In law enforcement and military settings, agencies have been exploring and implementing simulated firearms training as an alternative or addition to live fire testing for over two decades. Within Canada, both the Royal Canadian Mounted Police (RCMP) and the Canadian Armed Forces have piloted simulated firearms range environments as a training tool. In the United States, the use of simulated pistols and rifles has been implemented in law enforcement training centres and military settings in an attempt to reduce costs while increasing the quality of training. The Correctional Service of Canada (CSC) has followed this approach of incorporating emergent training theories and technologies by piloting simulated firearms training as an alternative to 9mm pistol live fire training for correctional officer recruits.

Correctional officer recruits undergo a Correctional Training Program (CTP) as part of their selection process. All recruits are trained at the Correctional Service of Canada National Training Academy located in Regina, Saskatchewan. The program provides recruits opportunities to practice realistic correctional scenarios where they apply their newly learned skills in a safe environment. It prepares them to work with different offender populations and to resolve complex situations at all security levels in Canadian federal institutions. This training is conducted in a variety of settings including online learning at home and in classrooms; as well in a simulation space, gymnasium, outdoor simulation yard, and at the firing range. As part of the training, recruits learn how to manipulate and use multiple firearms. The 9mm firearms training component of the CTP involves a combination of live fire training (75%) and simulated-fire training (25%). The integration of technology to support learning and training context is a strategic direction for CSC. Hence, the organization has made significant efforts in the past few years to increase the cost effectiveness of its training program to Correctional Officers, including at the CSC National Training Academy. Technology is of particular interest in improving training in areas where traditional training has limitations. This is particularly true in the field of firearms training.

Simulated firearms training is a potential alternative to live fire pistol training that involves training recruits on proper handling, safety and accuracy without the use of ammunition. This innovative training approach involves the use of laser-based technology in a simulated range environment. The potential benefits of using simulated firearms training include cost savings due to a decrease in ammunition usage and reduced firing range maintenance, leaving additional range time to be utilized for more advanced live fire training for officers (Hawthorne, Wollert, Burnett, & Erdmier, 2011). In addition to reduced operating costs and a smaller economic footprint, simulated firearms training has also been found to increase safety (Grant & Galanis, 2009). Instruction can be given to recruits without the need for hearing protection and other safety precautions associated with live fire training, due to the lack of ammunition involved (Hawthorne et al., 2011). This allows for trainers to be in closer proximity to shooters in order to detect errors in weapon handling and to instruct recruits on stance alignment. The laser-based systems can also provides immediate feedback on the recruit's shot placement, which in turn may increase individual shooting accuracy (Hawthorne et al., 2011).

Despite the cited advantages, there is a limited body of research assessing the effectiveness of simulated firearms training in comparison to live fire training. Most of the transfer of training research that has been done has focused on law enforcement or military settings, with few studies conducted within Canada. No research could be located that examines simulated firearms within a correctional context. The existing research on training and marksmanship has examined both simulated pistols and rifles, but it is unknown how generalizable the findings related to rifles would be to pistols.

Within Canada, the use of simulated firearms training at the RCMP was first explored within a group of university students enrolled in a Police Studies program, to determine if the training received would transfer to live-fire performance (MacLennan & Partyka, 2009). The sample consisted of 21 students and was compared to an archival database of 337 RCMP cadets. Though the cadets were older than the students, there were no differences in the proportions of students and cadets who had previous firearms training. Students received twelve 2-hour training sessions, with two sessions providing a general orientation to pistols and ten sessions training students in the RCMP's course of fire using simulated firearms. Performance was evaluated at two benchmark sessions, which are administered to track progress throughout the training program, as well as a final qualification examination. There was a significant difference in the proportion of students and cadets passing for Benchmark 1 (19.0% vs. 50.1%), but not for Benchmark 2 (57.1% vs. 70.6%) or the Final Qualifications (90.5% vs. 92.3%). These findings suggest that students trained in a simulated firearms environment may initially lag behind those trained in a live-fire range, but eventually perform at comparable levels during final qualification. The relationship between trigger finger strength and scores at evaluation sessions was also examined, with results indicating that trigger finger strength enhances firearms performance.

Krätzig, Parker and Hyde (2011) conducted a study comparing simulated firearms training to live fire training with 124 RCMP cadets, 32 of which completed all of their pistol training in a synthetic range environment. There were no significant differences in the rates of pass/fail for Benchmark 1 and Benchmark 2 evaluation sessions. A significantly higher rate of recruits participating in the simulated firearms training failed the final qualification examination in comparison to recruits in the live fire training. However, following five additional sessions of remedial training and retesting, simulated firearms trained recruits had a 100% pass rate for the pistol course of fire training program, resulting in no differences between live fire and simulated fire trained cadets.

A follow-up study by Krätzig (2014), involved a larger sample size of 256 RCMP cadets, 95 of which were in trained in a simulated pistols training environment. This study examined the impact of adding a live fire training component before each test to familiarize cadets with recoil and percussion blast, a feature of the pistols missing in the 2011 study, and hypothesized by the authors to potentially explain the differences between groups in fail rates during final qualification. The study found that there were no pass/fail differences between cadets participating in live fire and simulated firearms training for the Benchmark 1, Benchmark 2 and, unlike the 2011 study, the final qualification examinations. This study also assessed the effectiveness of training on skill retention by examining the Annual Pistol Qualification scores for the 256 cadets over a three year period. Cadets who were trained in a simulated firearms environment actually had marginally higher scores during requalification examinations in comparison to their training academy scores. Krätzig argued that higher retention scores could be related to the increased number of trigger pulls or the greater focus on skill development in simulated firearms training.

Similar transfer of training research has been conducted at the Federal Law Enforcement

Training Centre (FLETC) in the U.S., where the use of simulation to teach basic marksmanship shooting skills has been explored (Hawthorne et al., 2011). Students enrolled in the Criminal Investigator Training Program are required to take both a Basic Marksmanship Instruction (BMI) course and a Semiautomatic Pistol Course (SPC). In order to advance in the selection process, students must achieve a qualifying score of 210 out of 300 possible points on the SPC Course of Fire examination. The first phase of this research was exploratory and utilized 14 college students who volunteered to participate in the study. Students were randomly assigned to either the experimental group, who used a laser handgun in the BMI course, or the control group, who used a live fire pistol in the BMI course. Both groups then completed the SPC and were tested on the Course of Fire examination. The results of this phase of the research showed only a 2.6 point difference between groups (experimental group = 257.8, control group = 260.4), thus justifying the next phase of research.

In the second phase, the same procedure was repeated with 140 students enrolled in the Criminal Investigator Training Program. There were no significant differences in the Course of Fire examination between groups initially trained with laser simulators before switching to live fire weapons and those who progressed through all of training with live fire weapons. Students in the experimental group had a mean qualifying score of 275.8, while students in the control group had a mean score of 278.2. The groups were further stratified into those who had prior military and/or law enforcement firearms training and those who did not. In both the group with prior training and the group without prior training, no significant differences were observed in mean qualifying scores between the control groups and experimental groups.

Simulated firearms have also been utilized in military settings since the early 1990's, and the research support has been promising. A recent Canadian study validated the use of rifle simulators in the Canadian Armed Forces and examined various combinations of live and simulated fire to determine which best prepared firers for their qualification examination (Grant, 2013). Six infantry platoons completed their range practices using either all live fire (n = 110), all simulated fire (n = 38), all simulated fire and completed all practices twice (n = 11), or a combination of simulated fire for the first five practices and live fire for the last three practices (n = 22). The results of this study showed that the combination of live and simulated fire led to the highest scores on the qualification exam, and to the highest proportion of marksmen in each group. There were no significant differences in scores for those cohorts trained entirely using simulated fire versus those trained entirely using live fire. Despite the increased time available when utilizing simulated fire, there were no advantages observed to having cohorts complete the range practices twice using simulated fire. When examining rifle marksmanship training entirely in simulation, the author noted that the effects on confidence and motivation should be considered, hypothesizing that cohorts would likely have greater confidence in their abilities if they have more live fire experience.

In the United Kingdom, English and Marsden (1995) found comparable rates of passing an annual qualification test among soldiers trained using all live fire or a mix of live and simulated fire. In the U.S., Yates (2004) examined the outcomes of Marine Corps recruits who received two days of simulated marksmanship training in place of classroom time and dry firing practice, before beginning live fire training. No significant differences were detected in live fire qualification scores between recruits trained using the rifle simulator versus those who were not afforded simulated marksmanship training. This study focused on whether there was an advantage to providing simulated training as an addition to live fire training, as opposed to considering it as an alternative. Benefits were observed for U.S. Army infantry trainees who participated in simulated rifle training compared to a control group trained using the standard program of instruction (Hagman, 2000). While the simulated training did not improve live fire qualification scores, it did increase the number of known-distance hits, reduced the number of rounds fired and increased the number of trainees firing to standard. Lastly, White, Carson and Wilbourn (1991) found no overall difference between security police trainees receiving 10-20 minutes of simulated rifle and pistol marksmanship training and those receiving 30 minutes of conventional dry fire and sighting exercises during U.S. Air Force Security Police weapons training.

Although the transfer of training research is generally positive and there are numerous empirically supported benefits of using simulated firearms training, this training modality is not without limitations. Training in a simulated environment has various differences in regards to the sounds and smells associated with firing the weapon compared to the live fire method. A commonly cited limitation is that recruits do not obtain an identical recoil or concussion blast that is associated with actual firearms while completing simulated training (Krätzig, Parker & Hyde, 2011). In White and colleagues' (1991) study of security police trainees, different configurations demonstrated that noise and recoil were both important to simulated firearms training in terms of achieving a higher score during evaluation. Krätzig and colleagues (2011) originally hypothesized that the absence of the recoil or concussion blast may have resulted in lower performances during benchmark evaluation sessions for RCMP cadets trained using simulated firearms. In Krätzig's (2014) follow-up study, cadets were able to experience the recoil kick during a round of live firing, prior to being tested using a simulated firearm during benchmark evaluation sessions. In contention to his previous hypothesis, Krätzig (2014) found that including the recoil kick through a round of live firing before evaluations did not impact performance. However, given that an identical recoil system has not been mimicked in simulated firearms studies limits the ability to make conclusions regarding the role of recoil and concussion blast in performance.

A recruit's level of anxiety may also impact their overall performance due to the stress involved with handling a firearm. Previous research has examined the relationship between the use of firearms and increased anxiety. Nagashima, Chung, Espinosa, Berka and Baker (2009) found that anxious shooters may experience physiological symptoms affecting their movement of the firearm and influence performance. Kayihan, Ersöz, Özkan, and Koz (2013) found that state anxiety, measured just before shooting sessions, was significantly correlated to efficiency of pistol shooting in police recruits. Chung, O'Neil, Delacruz, and Bewley (2005) examined the role of anxiety in predicting rifle marksmanship performance and also found that state anxiety and state worry demonstrated significant negative relationships with performance during marksmanship training for U.S. Marines. Conversely, other studies noted that training exercises involving increased pressure, and thus higher anxiety, have been found to improve shooting performance under subsequent stressful circumstances (Oudejans, 2008). The differences in a simulated environment may affect a recruit's level of anxiety differently than a live fire environment. Given that anxiety has been found to influence performance during firearms training and testing, its consideration is imperative in assessing and implementing alternatives to traditional firearms training. As such, the role of anxiety during training and performance should be assessed.

The Current Study

In an effort to determine the effectiveness of firearms training delivered in a simulated environment, an experimental group who received only simulated firearms training were compared to a control group of CSC correctional officer recruits who received primarily live fire training. The goal of this line of research is to determine whether the type of training has an impact on performance in qualification testing in terms of accuracy, theoretical understanding, as well as safety and handling. Individual related characteristics were explored to determine whether pre-existing differences may have influenced outcome. Lastly, anxiety levels were examined to measure the potential impact of Somatic Anxiety, Cognitive Anxiety and Self-Confidence on qualification examination outcome.

This is the first study to examine transfer of simulated firearms training within a correctional setting. Given the differences between countries in weapons, doctrines and tests, it is important to validate this training modality within a Canadian context. The objectives of this study were to determine whether simulated firearms training can effectively contribute to existing training mechanisms and to provide CSC with evidence-based recommendations pertaining to simulated firearms training. By evaluating the effectiveness of simulated firearms training, CSC can gain a comprehensive understanding of whether it is an appropriate alternative or addition to the current firearms training method.

Method

Participants

The sample consisted of 156 correctional officer recruits who participated in the mandatory Correctional Training Program (CTP). For the 9mm pistol training portion of the CTP, approximately half of the sample (*n* = 80) was trained using the traditional firearms methods, which consists of approximately 75% live fire and 25% simulated firearms training. This traditional training program will serve as the control group. The data for the control group was collected between July 2015 and November 2015 from four CTP cohorts. The experimental group (*n* = 76) consists of three CTP cohorts that underwent 100% simulated firearms training. Participants from the experimental group were trained between September 2016 and April 2017.

Data for 27 recruits participating in the CTP cohorts were not included in the study due to their removal prior to the completion of the CTP. Recruits were excluded from the study if they withdrew from the CTP either before or during 9mm firearms training (e.g., medical/ personal reasons) or if they failed C8 carbine firearms training and thus did not begin 9mm training.

Procedure

For both experimental and control groups, the 9mm firearms training consisted of 25 hours of training distributed between classroom sessions, simulated firearms practice, live fire practice and testing. Recruits in the experimental group received more classroom time (775 vs. 650 minutes) to allow for extra time spent on immediate actions (e.g., knowing what to do when the pistol has a jam, what to do when the pistol is empty). These firearms manipulations are taught throughout the 9mm program but cannot be completed during simulation, as the weapon cannot replicate the immediate actions experienced in live fire. The experimental group also received more time in simulated firearms practice (325 vs. 200 minutes) and less time in live fire practice (150 vs. 400 minutes) than the control group. The additional time in simulated firearms practice was provided to mimic the range sessions to ensure that both groups received a similar amount of coaching.

There were two sets of benchmark scores collected throughout the course of the CTP. This provided a measurement of the recruits' performance during the firearms training and allowed recruits to experience live fire prior to the final qualification examination. During the first benchmark session, targets were placed at 3 and 7 meters and recruits were instructed during four-8 second sessions to complete the failure drill from holster (2 shots to body, 1 shot to head). During the second benchmark session, targets were placed at 15 and 25 meters and recruits were instructed during two-4 second sessions, two-8 second sessions and two-60 second sessions to test their marksmanship skills. Benchmark sessions provide an opportunity to identify any potential issues or deficiencies to the trainer and recruit that may need to be addressed in the subsequent training sessions.

During the final qualification examination, the recruit must achieve 70% on each of three components of the evaluation: theory, safety and handling (tested both outside and during live fire testing), and accuracy. If a recruit fails the examination, they receive two hours of remedial time on the specific component that was failed. One retest of the same test was permitted following a failure on the initial evaluation. If the recruit failed either the accuracy or safety and handling components during live fire testing, they were required to pass both portions once again when retesting. If the retest was passed, the recruit remained in the CTP.

Simulated firearms training was conducted using a system called the Professional Range SIMulation (PRISim). PRISim uses high definition interactive videos and game engine technology to address most aspects of firearms training. The PRISim system used in this study is designed to duplicate aspects of live fire training in order to create an alternative that is as proximal as possible. The simulated 9mm pistols used in the study contain recoil kits that are intended to replicate (i.e. about 50%) the recoil or concussion blast associated with live fire weapons. Attempts were made to make the simulated firearms and live fire range environments as similar as possible. Recruits wore the same safety equipment (duty belt, hat, ballistic vest and safety glasses) in the simulated environment as they would on the live fire range. However, they did not wear ear protection to ensure that they were able to hear the directions provided by the trainer. Orders and procedures were called use the same language and commands in both environments.

Most of the CTP's were delivered in English, with the exception of one CTP cohort which was delivered in French. Participants were provided with a detailed description of the study including the goals, duration, methodology, risks and significance of the study. Participants were asked whether or not they understood the project description, whether or not they had questions and were asked whether or not they consented to participate in the study.

Measures

Initial firearms questionnaire. To gather information regarding sample and individual related characteristics, an Initial Firearms Questionnaire was provided to recruits at the beginning of training. The questionnaire contained questions related to demographics, previous firearms experience, previous sport involvement, grip strength and handedness. Grip strength was measured by hand dynamometer ratings (in kilograms) of the dominant hand with three separate ratings, with the mean of the three measurements utilized in analyses. In 72 cases (47 control group, 25 experimental group), only one rating was taken and this was utilized in analyses in lieu of a mean rating.

Benchmark scores. Two sets of benchmark scores were collected during the course of training. At the first benchmark session, a total score (/60), total head shots (/4) and total body shots (/8) were collected. For recruits in the experimental group, this allows the trainers to assess whether the failure drill skills taught in the simulated environment can be transferred to live fire. At the second benchmark session, a total score (/100), number of missed shots, shots at 0, shots in 3 ring, shots in 4 ring, shots in 5 ring were collected. During this session, 20 shots were taken and recruits receive a higher total score for shots closer to the centre of the target. For recruits in the experimental group, this benchmark session allows trainers to assess whether or not the recruit can transfer the marksmanship skills taught in the simulated environment to live fire. The benchmark sessions are not a part of official testing and there are no pass/fail criteria. The scores are documented for research purposes only.

9mm Pistol written refresher exam. To measure understanding of 9mm pistol theory, recruits were required to complete a written refresher exam. The test is 50 minutes in length and recruits must score a minimum of 70% to pass on the 15 questions administered. The written exam was administered at the end of in-class training, prior to the final qualification examination.

9mm Pistol qualification checklist. The 9mm pistol qualification checklist is used as the qualification examination at the end of the 9mm pistol training to assess the recruit's performance in accuracy, as well as safety and handling. Safety and handling is assessed by two tests; the Skills Checklist which is completed outside of live fire testing using dummy rounds, and during the Course of Fire testing which is completed during live fire testing. Accuracy is also tested during live fire testing and is assessed by the precision of 34 shots (calculated by the number of missed shots, shots at 0, shots in 3 ring, shots in 4 ring, and shots in 5 ring), total number of head shots and body shots obtained. In order to qualify on the Accuracy component, 3 out of 4 rounds must impact within the designated head and neck area (i.e., head shots) and all 16 centres of mass rounds must impact within the silhouette (i.e., body shots). In order to pass the 9mm pistol qualification, recruits must obtain a score of 49/70 on the Skills Checklist, 21/30 during the Course of Fire, and 119/170 on the Accuracy component. For recruits that failed the final testing, an additional 9mm Pistol Qualification Checklist was collected during retesting following the completion of remedial sessions.

Competitive State Anxiety Inventory-2 Revised. Anxiety level was measured using the Competitive State Anxiety Inventory-2 Revised (CSAI-2R; Cox, Martens & Russell, 2003) at each evaluation (benchmark sessions, final qualification, and retesting when required). The CSAI-2R is a 17-item self-report measure of Cognitive Anxiety, Somatic Anxiety and Self-Confidence using a Likert scale ranging from 1 (‘not at all’) to 4 (‘very much so’). Scores range from 10 to 40 for each subscale, with higher scores on the Cognitive Anxiety and Somatic Anxiety subscales representing higher levels of anxiety. Lower scores on the Self-Confidence subscale represent lower levels of Self-Confidence. Self-Confidence is related to the belief that one will successfully accomplish the designated task at hand (Tsopani, Dallas, & Skordilis, 2011). Cognitive Anxiety is related to possible fear and negative expectations, while Somatic Anxiety is related to perceptions of one’s physiological arousal (Tsopani et al., 2011).

The CSAI-2R is a revised inventory of one of the most frequently used instruments when assessing competitive state anxiety in sport psychology. The revised version has been suggested to be more psychometrically sound than the original version (Cox et al., 2003). Although typically used in sport psychology, the CSAI-2R was selected as the subscales are also relevant in a firearms setting. The CSAI-2R was translated into French to be used in the one CTP cohort delivered in French. Martinent, Ferrand, Guillet, and Gautheur (2010) previously found support for the reliability and validity of a French version of the CSAI-2R. However, it should be noted that the French translation in this study differs from that of Martinent and colleagues to reflect Canadian French.

Analytic Approach

Sample characteristics. Frequency distributions and cross-tabulations were calculated for categorical variables. Means and standard deviations were calculated for the continuous variables. Pearson Chi-square was used to examine the association between categorical variables. Cramer's *V* values are reported to measure the strength of the association when relationships between variables were significant. Following Cohen (1992), Cramer's *V* values of .10, .30, and .50 were considered small, moderate, and large associations, respectively. Differences between groups on continuous variables were analyzed using one-way ANOVA.

Individual related characteristics. The relationship between individual related characteristics and scores at evaluation sessions was assessed through a series of Pearson *r* correlations. The purpose of this analysis was first to examine whether other factors, beyond training modality, played a role in a recruit's outcome in firearms training. Secondly, this analysis assisted in selecting covariates based on statistical considerations for subsequent analyses. For benchmark sessions and the final qualification examination, a cut-off of $p < .01$ was utilized as the basis for inclusion as a covariate. For retesting, where sample sizes were restricted, a more lenient cut-off of $p < .05$ was set.

Impact of training type. In order to determine if training modality had a significant impact on the recruits' performance, group comparisons were performed using both scores at evaluation sessions throughout training and pass/fail qualification outcomes. Performance was assessed through measures of theoretical understanding, accuracy, and safety and handling. In the case of missing data, cases were deleted from the analysis as necessary rather than estimate missing data. One-factor between-subjects Analysis of Covariance (ANCOVA) was utilized to determine if recruits trained using simulated firearms differed from those trained primarily using live fire at benchmark, final qualification and retest sessions. In an effort to isolate the effect of training modality, individual related characteristics were included as covariates based on statistical considerations. The amount of variance accounted for by the predictors and covariates was established using partial eta (η^2) squared. Pass/fail rates at the final qualification examination, retesting, and overall outcome of firearms training were examined using Pearson Chi-square analysis.

Test anxiety. Somatic Anxiety, Cognitive Anxiety and Self-Confidence were measured at four different sessions (Benchmark 1, Benchmark 2, final qualification and retesting).

Recruits in the experimental and control groups were first compared on these self-reported CSAI-2R subscales at each of the evaluation sessions. Logistic regression (Hosmer & Lemeshow, 2000) was then used to examine the relationship between the recruit's levels of anxiety and Self-Confidence and the outcome of the final qualification examination. Logistic regression is a form of regression in which the dichotomous dependent variable (e.g., qualification outcome: pass/fail) is transformed into log odds. Results are presented in terms of odd ratios, which can be interpreted as the amount by which the odds of the outcome (pass/fail) changes for each one-point increase in CSAI-2R subscale score. Analysis was performed using SAS LOGISTIC procedure. Given that the CSAI-2R was translated into French for one CTP cohort and this particular version has not been validated, the analyses were performed two ways; once for the full sample incorporating the French version of the CSAI-2R, and once for a reduced sample with the French CTP excluded. The pattern of results did not differ between these methods; therefore the results for the full sample are reported herein.

Results

Description of Sample

The experimental group consisted of 47 males and 29 females, with a mean age of 29.2 years (*SD* = 8.3). The control group consisted of 69 males and 11 females, with a mean age of 30.0 years (*SD* = 7.7). The experimental group had a significantly greater proportion of females than male recruits, χ^2 (1, *N* = 156) = 12.18, *p* < .001, Cramer's *V* = .28, bordering on a moderate association between variables. The majority of the recruits in the sample were right handed in both groups (90.8% experimental, 92.5% control). Recruits in the experimental group had significantly lower ratings of grip strength than those in the experimental group, *F*(1,154) = 21.16, *p* < .001. The mean hand dynamometer reading was 39.4kg (*SD* = 11.1) in the experimental group, compared to 48.5kg (*SD* = 13.4) in the control group. This may be attributed to the higher number of females in the experimental group, as it would be expected that females in general would have less grip strength due to their physical attributes. Pearson's correlation coefficient confirmed a significant and strong relationship between gender and grip strength, *r* = .69, *p* < .001.

Table 1

Percentage of recruits with previous firearms experience in experimental and control groups

	Experimental Group	Control Group
Previous shooting experience	42.1	35.0
Previous firearms training	34.2	22.5
Previous training received by:[1]		
Military	10.5	3.8
Police	2.6	5.0
Law Enforcement	2.6	2.5
Recreation/Sport	17.1	6.3
Other	9.2	7.5

Note. Previous shooting experience indicates that the recruit reported shooting a firearm on more than a dozen separate occasions. "Other" training settings include armoured transportation industries, college correctional programs and intelligence agencies.

[1] Type of previous training exceeds the percentage of recruits who have previously received firearms training as recruits may have received more than one type of training.

Although not statistically significant, more recruits in the experimental group had previous shooting experience and previous formal firearms training, in comparison to those in the control group (refer to Table 1). The previous training was most often received by recreation/sport in the experimental group and by other methods in the control group.

Role of Individual Related Characteristics

Prior to examining the effect of training modality on outcome in firearms training, the role of individual related characteristics was explored. Beyond determining whether these characteristics influenced outcome, this analysis also served as the statistical basis for selecting covariates for subsequent analyses. A series of Pearson correlations were computed in order to determine if individual related factors relate to a recruit's scores at evaluation sessions. Table 2 summarizes the impact of age, gender, grip strength, previous shooting experience and previous firearms training on scores at benchmark sessions, final qualification and retesting. Gender and grip strength demonstrated the strongest correlations with qualification scores at most components of the evaluations sessions which focus on accuracy (i.e., Benchmarks 1 and 2, accuracy at final qualification and retesting). On these components, male recruits demonstrated better performance than female recruits. Performance on these components also increased with higher hand dynamometer ratings (i.e., greater grip strength). Age also emerged as a significant correlation with accuracy at Benchmark 1 and safety and handling at final qualification (i.e., Skills Checklist) and retesting (i.e., Course of Fire). The correlation is negative, indicating that performance decreases with age. With the exception of Benchmark 1, neither prior shooting experience nor previous firearms training were correlated to any of the other evaluation session scores.

For subsequent analyses, the individual related characteristic(s) with the strongest correlations to the given evaluation session score were controlled for in the analyses. Given the strong correlation between gender and grip strength, the characteristic with the highest correlation was selected in outcomes where both variables demonstrated the strongest correlations.

Table 2

Correlations between individual related characteristics and evaluation session scores

Characteristic	Benchmarks		Final Qualification			Retesting	
	1	2	Skills Checklist	Course of Fire	Accuracy	Course of Fire	Accuracy
Age	-.27**	-.08	-.22**	-.18	.04	-.39*	.01
Gender	.47***	.50***	.01	.09	.51***	-.04	.44**
Grip strength	.35***	.47***	-.06	-.06	.39***	.15	.48**
Previous shooting	.15	.14	.06	.16	.18	-.24	.13
Previous training	.20*	.14	-.03	-.05	.06	-.31	.18

Note. Previous shooting experience indicates that the recruit reported shooting a firearm on more than a dozen separate occasions.
* $p < .05$. ** $p < .01$. *** $p < .001$.

Impact of Training on Performance

Evaluation session scores. Group comparisons were performed to determine whether the type of training has an impact on performance during evaluation sessions. Performance was assessed through measures of theoretical understanding, as well as accuracy at each evaluation session, and safety and handling at the final qualification examination and retesting. In an effort to isolate the effect of training modality, individual related characteristics were included as covariates based on statistical considerations. As demonstrated in Table 3, no differences emerged between groups in theoretical understanding as measured by the Written Exam.

At the first benchmark session, the scores for head shots, body shots and total score were comparable for those trained in a simulated environment to those trained primarily in a live fire environment. At the second benchmark session, the experimental group scored lower than the control group, suggesting that recruits in simulated training may have experienced some difficulties in transferring the marksmanship skills taught in the simulated environment to live fire. A one-factor between-subjects ANCOVA was performed to examine this difference, while controlling for gender. The covariate, gender, was significantly related to Benchmark 2 accuracy scores, $F(1, 150) = 37.66$, $p < .001$, partial $\eta^2 = .20$. There was also a significant effect of training modality on Benchmark 2 accuracy scores after controlling for the effect of recruit's gender, $F(1, 150) = 8.27$, $p < .01$, partial $\eta^2 = .05$. Although there was a significant difference in Benchmark 2 scores between recruits trained in a simulated environment and recruits trained primarily on a live fire range, training modality only accounts for 5% of the variance in Benchmark 2 scores. On the other hand, gender was found to account for 20% of the variance in scores, suggesting this characteristic may be more predictive of outcome than training modality.

Table 3

Differences in mean scores between experimental and control groups throughout training

Evaluation Session Measure	Evaluation Component	Possible Values	Experimental $N = 76$			Control $N = 80$		
			n	*M*	*SD*	*n*	*M*	*SD*
Benchmark 1								
Head Shots	Accuracy	4	75	2.81	.98	79	3.04	.95
Body Shots	Accuracy	8	75	7.88	.43	79	7.90	.59
Total Score	Accuracy	60	75	53.19	5.91	79	53.85	6.98
Benchmark 2								
Total Score	Accuracy	100	76	61.83	20.67	77	75.58	19.50
Final Qualification[1]								
Written Exam	Theory	15	76	14.66	.56	80	14.64	.58
Skills Checklist	Safety	70	76	67.72	2.91	80	66.48	3.79
Course of Fire	Safety	30	55	28.85	2.09	60	28.80	3.18
Total Score[2]	Accuracy	170	55	143.09	15.27	55	153.07	10.33
Retest[3]								
Course of Fire	Safety	30	17	28.88	1.97	21	29.90	.44
Total Score	Accuracy	170	18	140.67	13.64	21	143.52	14.61

Note. In both experimental and control groups, there were a few cases in which benchmark scores had not been reported, and thus represent missing data.

[1] If recruits did not qualify in the final qualification examination based on missed head shots and body shots, then the Course of Fire and Accuracy portions of the test were not completed. This explains the smaller sample sizes for these variables.

[2] Due to inconsistent record keeping, the scores for head shots and body shots in the final qualification examination were infrequently recorded. As such, mean scores for these outcome variables are not reported.

[3] No recruits failed the Skills Checklist component of the final qualification examination; therefore, no retests were required for this component.

Recruits' performance in terms of accuracy continued to be lower for the experimental group at the final qualification examination. There was a significant difference between the experimental group and control group on the Accuracy component of final qualification after adjusting for gender, $F(1,107) = 6.30$, $p = .01$, partial $\eta^2 = .06$. The covariate, gender, was significantly related to initial qualification Accuracy scores, $F(1, 107) = 26.88$, $p < .001$, partial $\eta^2 = .20$. Again, gender accounted for a larger proportion of the variance in scores than training modality (20% versus 6%).

While considering the reduced sample sizes, the differences between groups in Accuracy scores were less marked at retesting. Grip strength was included as a covariate and was found to be significantly related to retest Accuracy scores, $F(1, 36) = 11.01$, $p < .01$, partial $\eta^2 = .23$. However, the differences between groups in Accuracy scores were no longer significant at retesting while controlling for grip strength, $F(1, 36) = .64$, $p = .43$, partial $\eta^2 = .02$.

In terms of safety and handling, the experimental group scored slightly higher than the control group as tested through the Skills Checklist outside the live fire range at final qualification. Age had emerged as individual-related characteristic with the strongest correlation to the Skills Checklist. This covariate was significantly related to Skills Checklist scores, $F(1, 152) = 7.51$, $p < .01$, partial $\eta^2 = .05$. There was also a significant effect of training modality on Skills Checklist scores at final qualification after controlling for the effect of recruit's age, $F(1, 152) = 5.16$, $p = .03$, partial $\eta^2 = .03$. However, neither age nor training modality accounted for particularly large proportions of the variance in these safety and handling scores.

The other measure of safety and handling is the Course of Fire checklist which is assessed within the live fire range during final qualification. At the final qualification examination, no differences emerged in the Course of Fire between recruits receiving simulated firearms training and recruits receiving primarily live fire training. At retesting, the control group scored slightly higher than the experimental group on the Course of Fire but this difference did not reach significance after controlling for age, $F(1, 35) = 4.06$, $p = .05$, partial $\eta^2 = .10$. The covariate, age, was significantly related to retest Course of Fire scores, $F(1, 35) = 5.10$, $p = .03$, partial $\eta^2 = .13$.

Qualification outcomes. Beyond the scores obtained at evaluation sessions, the outcome of whether a recruit passes or fails qualification stages is of key importance as this determines whether they can continue in the CTP. The rates of pass/fail outcomes were compared between the experimental and control groups across three qualification stages. As demonstrated in Table 4, the rates of pass/fail were comparable between recruits trained using simulated firearms and those trained primarily with live fire for the final qualification examination, retesting and the overall outcome of the firearms training. Chi-square tests yielded no significant differences between training type and the outcome of final qualification, χ^2 (1, N = 156) =.015, p =.902, the outcome of the retest, χ^2 (1, N = 48) = .251, p =.616, and the overall outcome, χ^2 (1, N = 156) = .149, p =.699.

Table 4

Pass/fail rates of experimental and control groups at various qualification stages

	Pass		Fail		Total
Qualification Stage	*n*	%	*n*	%	*N*
Final Qualification					
Experimental	52	68.4	24	31.6	76
Control	54	67.5	26	32.5	80
Retest					
Experimental	17	73.9	6	26.1	23
Control	20	80.0	5	20.0	25
Overall Outcome					
Experimental	69	90.8	7	9.2	76
Control	74	92.5	6	7.5	80

Note. One recruit in the experimental group and one recruit in the control group failed the final qualification examination but did not participate in retesting. These recruits did not have any of their three retest credits remaining to be able to retest as they had failed two tests in other components of the CTP. The failure of the final qualification examination represented their third strike and cause for release from the CTP.

Impact of Test Anxiety on Outcome

Recruits were compared on self-reported Somatic Anxiety, Cognitive Anxiety and Self-Confidence at each of the evaluation sessions. For both groups, Somatic Anxiety and Cognitive Anxiety decreased from Benchmark 1 to Benchmark 2, and then peaked at final qualification (refer to Table 5). For those who were retested, anxiety levels were considerably higher during the retest. These findings are unsurprising given that the stakes are highest during qualification and retesting, when the outcome has implications for whether the recruit will continue in the CTP. No significant differences were found between the experimental and control groups in Somatic Anxiety or Cognitive Anxiety.

Self-Confidence remained fairly stable throughout the evaluation sessions for both groups. The experimental group experienced significantly lower Self-Confidence compared to the control group at both Benchmark 1, ($F(1, 154) = 7.31$, $p < .01$, partial $\eta^2 = .05$, and Benchmark 2, $F(1,137) = 6.39$, $p < .05$, partial $\eta^2 = .05$, sessions. However, the differences between groups in Self-Confidence did not reach significance at final qualification or retesting.

Table 5

Levels of anxiety for experimental and control groups throughout training

CSAI-2R Subscale	Evaluation Session	Experimental Group *N* = 76			Control Group *N* = 80		
		n	*M*	*SD*	*n*	*M*	*SD*
Somatic Anxiety	Benchmark 1	76	17.62	6.29	80	16.77	5.55
	Benchmark 2	76	16.71	6.56	63	16.64	5.30
	Final Qualification	76	18.63	6.96	55	19.74	6.84
	Retesting	23	24.10	10.95	17	18.57	5.34
Cognitive Anxiety	Benchmark 1	76	21.28	7.95	80	21.10	7.39
	Benchmark 2	76	20.63	8.25	63	20.29	6.89
	Final Qualification	76	21.58	8.20	55	21.83	8.26
	Retesting	23	23.83	9.14	17	23.18	9.49
Self-Confidence	Benchmark 1	76	29.62	7.14	80	32.60	6.63**
	Benchmark 2	76	29.89	7.17	63	32.95	6.84*
	Final Qualification	76	30.92	7.41	55	32.04	6.57
	Retesting	23	30.17	7.91	17	32.58	7.34

Note. Due to inconsistent record keeping, the CSAI-2R was not collected for the full control group, and thus represents missing data.
* $p < .05$. ** $p < .01$.

A logistic regression was performed in order to determine if Somatic Anxiety, Cognitive Anxiety and Self-Confidence at final qualification relate to a recruit's outcome. Given the significant differences observed between the experimental and control groups in Self-Confidence in particular, this analysis was performed separately for each training modality. Table 6 summarizes the impact of Somatic Anxiety, Cognitive Anxiety and Self-Confidence experienced during final qualification on the outcome of the examination (i.e., pass/fail). The odds ratio is interpreted as the amount by which the odds of the outcome changes for each one-point increase in CSAI-2R subscale score. When interpreting the logistic regression results, an odds ratio greater than 1.0 implies a positive association between the anxiety measure and outcome, while an odds ratio less than 1.0 implies a negative association. Odds ratios close to 1.0 indicate that unit changes in that anxiety measure do not affect the odds of predicted outcome.

In the experimental group, both Somatic Anxiety and Self-Confidence significantly influenced pass/fail outcome at final qualification. The odds ratio of .88 for Somatic Anxiety indicates that as Somatic Anxiety increases, the odds of passing final qualification diminish. Specifically, the odds of passing the final qualification examination decrease by 12% for each one-point increase in the Somatic Anxiety subscale of the CSAI-2R. The odds ratio of 1.10 for Self-Confidence indicates that as Self-Confidence increases, the odds of passing final qualification increases. For each one-point increase in the Self-Confidence subscale, the odds of passing increases by 10%. Cognitive Anxiety did not significantly influence outcome in the experimental group. In addition, none of the measures of anxiety influenced the final qualification outcome for the control group.

Table 6

Effect of individual related characteristics on final qualification examination outcome

Characteristic	*B*	*SE*	Odds Ratio	95% CI	Wald	*p*
Experimental Group						
Somatic Anxiety	-.13	.06	.88	(.77, .99)	4.28	.04*
Cognitive Anxiety	.09	.06	1.10	(.98, 1.23)	2.50	.11
Self-Confidence	.09	.04	1.10	(1.01, 1.20)	4.59	.03*
Control Group						
Somatic Anxiety	.03	.06	1.04	(.93, 1.16)	.37	.54
Cognitive Anxiety	-.02	.05	.98	(.89, 1.07)	.24	.62
Self-Confidence	.06	.05	1.06	(.97, 1.17)	1.49	.22

Note. CI = confidence interval.

Discussion

This study assessed the effectiveness of firearms training delivered in a simulated environment, in comparison to the current firearms training method for CSC correctional officer recruits, which primarily utilizes live fire. The results of the study provide evidence that simulated firearms training can provide a suitable alternative to live fire training. The main goal of the study was to determine whether the type of training impacted performance in terms of theoretical understanding, accuracy, and safety and handling. Differences were observed between groups, with recruits trained in a simulated environment attaining significantly lower scores on accuracy at Benchmark 2 and final qualification. However, these recruits had higher scores on safety and handling at the final qualification examination, compared to their counterparts trained primarily in a live fire setting. It appears that the additional classroom time spent on learning these firearms manipulations was adequate to ensure that recruits met the safety and handling requirements at qualification.

Despite the differences in scores between groups throughout training, the overall pass/fail rates did not differ between training modalities. In other terms, there were no differences between the experimental or the control group in meeting the shooting standard. This is an important finding as it is ultimately the proportion of recruits passing and failing training that has the most resource implications, as opposed to scores on individual assessment components throughout evaluation sessions. These results are consistent with other transfer of training studies which suggest that simulated firearms training produces similar outcomes to conventional training methods (English & Marsden, 1995; Grant, 2013; Hagman, 2000; Hawthorne et al., 2011; Krätzig et al., 2011; Krätzig, 2014; White et al., 1991; Yates, 2004). The findings related to scores may have more implications for tailoring simulated firearms training. For instance, lower Benchmark 2 scores for recruits participating in simulated firearms training may suggest that more focus be placed on the accuracy component of 9mm firearms earlier in the training program.

Individual related characteristics were explored to determine whether other factors beyond training modality could have influenced qualification outcomes. The recruit's gender and grip strength demonstrated the strongest correlations with most of the evaluation sessions focused on accuracy. Being male and having higher ratings of grip strength was correlated with better performance on these evaluation components. These relationships raise the question of whether there is a minimum grip strength required to have a positive outcome in firearms qualifications. Previous research (MacLennan & Partyka, 2009) has also found that trigger finger strength enhances firearms performance, and as such, recruits should be encouraged to improve their grip strength. In this study, the experimental group had significantly more female recruits and lower mean grip strength, which is unsurprising given the high correlation between gender and grip strength. Age was also significantly negatively correlated with accuracy at Benchmark 1 and safety and handling at the final qualification examination and retesting. As such, these variables were controlled for when examining the impact of training modality on qualification outcome, to isolate the effects of being trained in a simulated environment versus a primarily live fire environment. Interestingly, prior shooting experience and previous firearms training were not significantly correlated to any of the evaluation session scores. This is inconsistent with the results of Hawthorne and colleagues' (2011) study in which students enrolled in a Criminal Investigator Training Program with prior firearms training had significantly higher qualification scores than those without prior training. A more detailed examination of prior shooting experience and training (e.g., number of hours) may result in a more complete analysis of this relationship.

Lastly, this study explored whether anxiety levels of recruits predicted their final outcome of the 9mm firearms training. No differences were observed in Somatic Anxiety or Cognitive Anxiety between recruits who received simulated firearms training and recruits who received primarily live fire training. However, recruits trained in the simulated firearms environment reported lower levels of Self-Confidence at each of the evaluation sessions. This is consistent with Grant's (2013) hypothesis that shooters would have greater confidence in their abilities with more live fire experience. Previous research findings on the relationship between levels of anxiety and marksmanship performance indicate shooting performance decreases in high anxiety conditions (Chung, et al., 2005; Kayihan, et al., 2013; Nagashima, Chung, et al., 2009). Interestingly, both Somatic Anxiety and Self-Confidence predicted the pass/fail outcome at final qualification for recruits who received simulated firearms training. None of the self-reported measures of anxiety were found to influence outcome for recruits who received the traditional live fire training. These results are somewhat inconsistent with previous research that has found a relationship between Somatic Anxiety, Cognitive Anxiety and marksmanship performance. It is therefore conceivable that anxiety plays a different role in performance in a simulated environment.

Conclusions

The findings of this study suggest that simulated firearms training may be an appropriate alternative or addition to existing training for Correctional Service of Canada correctional officer recruits. Given that it is commonly understood in the industry to also facilitate and reduce costs, this training modality may offer a viable option for CSC's firearms training program. Simulated firearms have been proposed as an opportunity for organizations to reduce costs related to live fire ammunition, weapons, and the ranges themselves (Sizemore, 2013). Efficiencies beyond cost savings have also been cited. For instance, simulators have allowed for more effective use of range time as the time normally reserved for cleaning up the range can be used for additional practice (Hawthorne et al., 2011). One of the advantages of simulated firearms is that instructors are able to get closer to students to better detect errors in weapon handling. There are vast differences in the sounds, smells and sights experienced in a simulated environment versus a live fire range. In a simulated environment, there are no barriers between recruits, the sounds are not as loud, and there are no odours of freshly fired rounds as in live fire. Although attempts were made to make the two areas as similar as possible, the simulated range may provide a more relaxed environment for recruits to better absorb the direction provided. Ultimately, this may result in a higher quality of training.

While this study focused on the use of simulated firearms training as an alternative to traditional training, there may be other uses for this training modality. For instance, the RCMP has explored the use of simulated firearms as a method of delivering remedial training to cadets struggling in the firearms training as well as to RCMP members who did not pass their annual qualification (Krätzig, 2011). Performance during skill acquisition is strongly influenced by declarative knowledge that is more readily communicated verbally (Grant & Galanis, 2009). Further practice of the skills results in a more automatic level of performance as the individual becomes better able to chain together the initially separate components of performance. As such, different training modalities may be better suited to support different stages of marksmanship skill (Chung, Delacruz, de Vries, Bewley, & Baker, 2006). Reserving simulated firearms training for initial training when verbal communication is most vital may maximize the utility of this training modality.

The results of this study indicate that simulated firearms can be utilized as a viable alternative to live fire, as demonstrated by the comparable rate of pass/fail outcomes. However, the optimal combination of simulated firearms training and live fire training remains to be determined. In this study, 100% simulated firearms training was compared to a combination of 75% live fire and 25% simulated firearms training. In the context of the CTP, the 25% virtual training was used as a way to progressively bring the recruits towards the use of live fire. There was not a pure 100% live fire control group, nor were other combinations explored. In Grant (2013), a mix of simulated firearms and live fire led to the highest scores on qualification and the highest proportion of marksmen. Hagman (2000) also found that simulated firearms demonstrated benefits in certain aspects of basic rifle marksmanship when used in place of traditional devices, suggesting that augmenting traditional training with simulated firearms in some components could result in cost savings in addition to the positive outcomes. Future research should examine the appropriate level of classroom time, simulated firearms training and live fire training to enhance training and optimize positive outcomes for correctional officer recruits. This line of research could also examine what parts of training can effectively be conducted in simulation, and what parts are more suitable to a live fire environment.

With the advancement of simulation technology, more opportunities will arise to make training more dynamic in terms of resembling scenarios a correctional officer may encounter on the job. Given the positive findings related to simulated firearms training present in this study, more advanced technology should be explored, in order to further add realism to training. For instance, simulators offer a computerized platform in a physical environment that presents scenarios that require decision-based responses reflective of the user's operational realities. This provides staff with the opportunity to experience and participate in realistic situations while being able to integrate the use of firearms and other use of force options. Staff are able to practice the full spectrum of possible intervention options, ranging from officer presence and communication up to lethal level of force. Computerized firearms simulators also provide the advantage of exposing cadets to shoot at moving targets, a training mechanism which is not easily adapted on a live-fire range (MacLennan & Partyka, 2009). Simulators provide decision-based training in which the reasonableness of a recruit's response can be assessed, with feedback given to improve future decision-making. The implementation of new training methods should be empirically supported to ensure that they produce proficiency levels that are at a minimum equal to, if not greater than, those produced by traditional training. While the principal criterion is whether the training modality contributes to successful live fire performance, other potential benefits to be evaluated include increased safety, reduced environmental impact, lower operating costs or a smaller footprint (Grant & Galanis, 2009).

When assessing the ability of a new training modality to produce similar outcomes to the existing training, it is ideal to measure any individual differences between the experimental and control groups. This provides assurance that there are no pre-existing differences among the experimental group that could be mistaken for a differential training effect. An initial firearms questionnaire was administered to identify any pre-existing individual differences between groups, but it is possible that there were unmeasured confounds. Although not statistically significant, more recruits in the experimental group had previous firearms experience in training. However, the results suggest that this did not significantly influence final qualification outcome. It is possible that recruits receiving only simulated firearms training sought out live fire practice outside of the CTP during the course of the program that was not reflected in the Initial Firearms Questionnaire. While this would have introduced a confound to the study, these is also the possibility that the control group participated in additional live fire practice. Future research should gather more detailed information regarding the individual, both before and during training.

Every effort was made at the data collection stage of this study to obtain reliable and valid findings as presented in this paper. Nevertheless, there were a few limitations that should be noted. Given the operational nature of the research and the length of the data collection period, this resulted in some missing data. Efforts were made to standardize data collection and record keeping, and ultimately the missing data did not prevent relevant analyses from being performed. In addition, self-reported data was used to assess recruits' Somatic Anxiety, Cognitive Anxiety and Self-Confidence levels at each of the evaluation sessions. The lack of relationship between Somatic Anxiety, Cognitive Anxiety and outcome may have been explained by inaccurate reporting or incomplete data. Incorporating both self-report and physiological measures of anxiety, such as heart rate and galvanic stress response, may have produced a more complete measure of anxiety (Jensen & Woodson, 2012). Lastly, measuring trainer characteristics was beyond the scope of the study but is a factor which may have influenced the results. Trainers may have differed in their level of confidence in the implementation of a new type of training. It is possible that their enthusiasm and confidence in simulated firearms training may have positively or negatively influenced the outcomes of recruits.

While this study focused on skill acquisition, future research will examine the extent to which firearms skills are retained one year after training and if they differ between training modalities. Previous research with RCMP cadets has found that requalification scores are in fact higher for those trained in a simulated environment versus those trained in a live fire range (Krätzig, 2011). Although requalification scores typically decrease in the years following graduation, cadets trained in the simulated environment actually scored higher during requalification compared to their scores achieved in the training academy. Data collection is currently underway to determine if similar long-term retention benefits will be replicated in a correctional environment with correctional officer recruits.

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