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Effectiveness of Video Simulation Training on Coincidence Anticipation Timing for Law Enforcement Officers

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Abstract

Objectives: To examine the coincidence anticipation timing performance of law enforcement officers before and after four consecutive weeks of completing a video simulation intervention. Design: A one group pre/post study design (n =15) was selected for this investigation. Methods: 15 healthy police officers (13 men, 2 women; age 39±1.7 years; height 175.28±12.72 cm; weight 88±25.4 kg) from a Midwest law enforcement agency were selected for the study. The Bassin anticipation timer was used in this investigation. The object stimulus speed was set at 3.0 mph in accordance with prior studies. Participants were allowed a single practice trial on the anticipation timer before the 3 trial attempts, both pre and post. The anticipation timer was placed approximately two feet in front of the participant on a table with the target light marked, and in view of each subject. The Virtra, a 300° video simulator was selected as the intervention. Each participant performed a new video simulation two times per week for 4 consecutive weeks. Results: A dependent t-test (SPSS ver. 26) determined a significant relationship (p = 0.035) between pre and post test scores after 4 weeks. Conclusion: Coincidence anticipation timing improved with police officers within 4 weeks when training with a VirTra video system twice a week, for 4 consecutive weeks. This could potentially improve decision-making for police officers.

Keywords: Police, VirTra, Coincidence Anticipation Timing, Video Simulation, Target Tracking

Introduction

Law enforcement officers can be faced with fast-paced, high stress situations when on duty. Working in law enforcement can be a high-risk job due to the level of violence that each officer faces each day which results in a higher rate of injuries and death compared to other professions (Orr et al., 2023; Thompson et al., 2017; Tiesman et al., 2018). Since the first recorded fatality of a police officer in 1786, there has been over 22,000 officers killed in the line of duty (Bennell & Jones, 2004). Police officers can be tasked with the act of having to respond quickly, with little to no warning in response to offenders or other environmental stimuli. The period from the unanticipated, unexpected stimulus to the onset of the movement is known as reaction time (Ross et al., 2022). Reaction time is an important skill for police officers to have, for the protection of themselves, their colleagues, and the public. When an object is being tracked or intercepted, this is known as coincidence anticipation timing (Le et al., 2022; Ross et al., 2022). Coincidence anticipation timing (CAT) is a skill that allows an officer to be able to think, react, and perform a proper response within a period that is conducive towards one's safety.

The ability to make quick decisions that are perceived as threatening are known as neurological and physiological processing (LeDoux & Pine, 2016). Decision-making is a critical part of activities of daily living, including police officers. This action comes from the portion of the brain known as the cerebellum (Poldrack & Farah, 2015). By optimizing how the brain perceives and responds to stimuli, we can become better decision-makers, problem solvers, and overall, more safety conscious (Andersen et al., 2020; Le Doux et al., 2016). Improving the ability to make quick decisions and be able to act on those decisions with accuracy requires specific training. In law enforcement, it is critically important to read the scenario and recognize what actions need to happen in any given scene which could result in injury or even death. Improving CAT in police officers could result in an increase in longevity and a decrease in the injury rate of police officers. In a previous study performed by Duncan et al. (2015), video simulation training demonstrated an increase in shooting accuracy skill but suggested that there is a still a need for future research to develop officer training and decision training.

Video simulators have been used since 1992 for military and law enforcement agencies, however, past literature is limited (Bennell & Jones, 2004; Latham et al., 2013). The Canadian government developed a manual dictating about the advantage of how simulators can be useful for decreasing court cases. These videos create the ability to make better decisions on possible violent outcomes by police officers and military personnel. The scenes are created to promote cognitive awareness and provide different outcomes, based on the choices that have led to lawsuits and court hearings. Video simulators have also demonstrated improvement in making better decisions that result in healthier outcomes (Tailby & Haslam, 2003). It has been proven that engaging students with hands-on instructional practice is more effective than exposing them to the content with static visual aids (Tailby & Haslam, 2003). Due to these past studies, video simulation may play an effective role in improving cognitive skill development and accuracy for anticipation timing.

Therefore, the purpose of this study was to determine if video simulations performed on a moving video system could improve CAD in law enforcement officers.

Material and Methods

A one group, based on convenience, pre- and post-test experimental design was selected for the study. Fifteen volunteers (13 men, 2 women; age: 39±1.7 years; height: 175.28±12.72 cm; body mass: 88±25.4 kg) police cadets from a Midwest law enforcement agency voluntarily served as the participants. All participants were healthy subjects based on their recruit applications and completed an informed consent form. This study proposal was approved by the Midwest institution's Institutional Review Board (IRB approval number: CSM 2013).

After the participants agreed to take part in the study, the data collection began with recording of subject demographic information such as weight, height, age, and BMI. A pre-test for CAT, using a Bassin Anticipation Timer (Model 35575 Lafayette Instruments, Lafayette, IN) was conducted before the video intervention. Participants began with verbal instructions on how to properly use the Bassin Anticipation Timer. This device had the participants watching a moving light on a runway. The subject was instructed to anticipate when the moving light would land on the indicated target spot by pressing the toggle push button. This valid and reliable device accurately measures a participant's anticipation time to one 1000th of a second (Coker, 2006) may they be early or late. This assessment was selected as the method for measuring CAT based on visual feedback that is necessary in making decisions on moving objects. Each participant was given one practice attempt with the timer to become familiar with the motion of the light moving down the runway. The timer had a speed setting of 3.0 miles per hour based on previous studies performed on adults (Coker, 2006; Duncan et al., 2015; Le et al., 2022). All participants were given three trials, attempting to perform as precisely as possible to hit the target. Three attempts were recorded and calculated to determine the average of the three scores.

After the pre-test scores were recorded, participants completed a video simulation intervention for 4 consecutive weeks, twice per week. The VirTra (V-100 model, Tempe, AZ), is a 300° video simulator, that allows real-life video siuations as well as animated object target shooting by using a standard Glock 9 mm handgun loaded with gas powered lasers. The simulator allows movement of the participant in a standing enclosure and provides accurate feedback of where a shot landed. With certain features, the live scenes change each scenario, so although similar, it is different and unexpected each time. The given simulation was chosen by the indoor gun range officer based upon scenarios that had movement of objects, therefore promoting movement interception. The participants did not know the type of video simulation beforehand to eliminate any maturation from previous experience. Each participant had no previous knowledge with the type of video shooting simulations before their participation in this study. The accuracy score of each VirTra simulation score was recorded after each attempt. The CAT post-test was administered after the four consecutive weeks of the VirTra video intervention. After the data was recorded, the post-test scores were compared to the pre-test scores.

A dependent t-test using SPSS (SPSS ver. 26), a data analysis software, was used to observe the difference in mean scores between the group, the pre-test scores, and the post-test scores from the Bassin Anticipation Timer. An alpha $p < 0.05$ was set, allowing the confidence level to be at 95%. Effect size interpretation was set as small for ≤ 0.2, medium for 0.5, and large for ≥ 0.8 (Cohen, 1988; Larner, 2014).

Table 1. Group Pre and post test means along with effect size

Table 1. Pre/Post CAT

Bassin Anticipation Timer Trials	CAD Pretest		CAD Posttest				
	M	*SD*	*M*	*SD*	*t(13)*	*p*	*Cohen's d*
CAT 1	0.057	0.050	0.041	0.044	1.36	.099	0.36
CAT 2	0.059	0.046	0.036	0.026	1.83	.046	0.49
CAT 3	0.050	0.038	0.034	0.031	1.21	.124	0.32
Average CAT	**0.056**	**0.035**	**0.037**	**0.025**	**1.93**	**.038***	**0.52**

Findings

The six shooting intervention scores had a lowest mean of 62.7 and a highest score of 96.3. The average standard deviation for shooting scores was 8.27. By observing trial 1 of the CAD pretest (Table 1) there is a mean of 0.057 seconds. The third attempt had an improved mean of 0.050 seconds. The average between the three pretest scores was 0.056. By observing trial 1 of the CAD posttest, the mean was 0.041. The third attempt also had an improved mean of 0.034 seconds. The average between the three posttest scores was 0.035 seconds. Cohen's d demonstrated a moderate effect size, (0.52) among the sample population.

Discussion

This novel investigation was one of the very first to be conducted worldwide, assessing CAT with police officers. This study examined using a video intervention of objects or scenes and attempted to determine if this 4-week intervention could allow police officers to improve on CAT scores. In a study with a similar sample size of nineteen subjects, Alen (2015) proved that consistent exposure to video games improves a person's anticipation of a coincidence task. Video games have been used as an intervention since the mid-1980s for improving cognition, memory, and decision-making (Young, 2008). Alen's use of video games supports the results from our current study based on the pre to post CAT scores after the 4-week video intervention. Alen's results were promising because it supported the idea that video games could improve information processing speed and require the participant to track objects visually throughout a process of continual movements. This improved their ability to effectively shift their attention from a stationary stimulus to a moving target, such as the VirTra video system. Latham, Patston & Tippett (2013), also supported the idea that playing video games consistently improves visual attention, executive control, and reaction times. Kuhlman and Bierel (1991) also purported similar findings of video game players who were able to anticipate stimulus onset very accurately over several weeks. Their ability to track with their eyes gave them the benefit of having a more accurate response to the correct stimulus in a sequence. As a result, this allows them to anticipate the arrival of the light stimulus successfully. Alen (2015) noted how the improvements in visual attention, anticipation timing and control remained to at least five months past the time the participants were studied. This could provide some explanation as to the improvements in CAT performance for the current studies' participants.

Helsen & Starkes (1999) used a larger sample size (n = 24) when assessing police officers with shooting efficiency. Their study used a slide and a projector screen of pre-recorded video scenarios, much more archaic than the video intervention our study used. Their investigation was extremely important at the time, setting the standard towards using video interventions to improve proper responses among police officers. Their use of multiple screens that rotate scenarios throughout the intervention was considered state of the art and the beginning of using video interventions with law enforcement. Since this inaugural revelation twenty years ago, newer electronic versions, such as the VirTra have created more life-like situations and can distribute important data. VirTra uses real-life scenarios as well as moving targets that allow a participant to track an object and be able to make good decisions on when to fire their gun. Our intervention allowed for object interception, whereas the older screen versions did not. Helsen & Starkes' study also used an initial signal to prepare them for a stimulus, allowing them to anticipate the scenario that was about to occur. This was much different than our study, where a preparatory signal did not occur, however, each police officer was given a visual three second countdown as to when the scenario was going to start. Another point to consider that differentiated this study from ours would be the use of actual weapons provided by each participant. A Glock 9 mm, outfitted with a laser and interfaced to the computer software system provides more real-life environments. Comparatively, the investigators for our study used the same exact handgun for each participant, each day the scenarios were run. Helsen & Starkes (1999) used a ten-point scale to rank each result subjectively. This probably caused interrater reliability errors since their scores were assessed by a different person. This is unlike our current study where all measures were objective and not ranked. With the improved development of new technology, the VirTra system provided shooting scores to assess shooting performance. The equipment used along with the video system allowed the scores to be more objective and congruent throughout the four-week intervention. Our study also differentiated from other previous studies by not looking at accuracy scores but observing if the intervention improved anticipation timing specifically (Boyd, 1992). The CAT pre-test and post-test scores showed drastic improvement, Table 1, supporting the idea that learning from videos with moving targets can be most effective towards improving the decision-making process.

The skill of mastering motor and cognitive skills can be accomplished with repetitions (Bennell & Jones, 2004). Handling a firearm and making split second decisions allows for no room for error. To achieve this skill, the officers must repeat the task multiple times. In our study the officers performed the intervention of the shooting scenarios, twice a week for four consecutive weeks. The time of exposure and variety of scenarios were sufficient to improve CAT over the 4-week intervention. It demonstrates that mastery of skill is required to make safe and could possibly result in providing better decisions when in a high stress situation, leading to improved officer safety. Future video intervention studies with increased sample sizes as well as improving gender ratios and including older police officers could potentially offer more insight towards the benefits that our study has demonstrated.

Coker (2006) examined and demonstrated how efficient anticipation timing can be achieved by conducting a study on a variety of methods to track a target light. Coker's study is similar in such that it examines variables related to CAT, using an identical instrument, the Bassin Anticipation Timer. However, our study used a VirTra video system in addition to the timer, which is relatively new and used for military and law enforcement officers, but has limited data, therefore allowing our study results to demonstrate possible officer safety and improve judgement.

Conclusion

The current study gives support to previous studies showing that video could be an efficient method for enforcement personnel to improve CAT scores. CAT scores improved with police officers when training with the VirTra video system twice a week, for 4 consecutive weeks. These findings may eventually change training protocols across the nation for law enforcement officers. A video simulation system like VirTra system should be considered for assisting in improving anticipation timing in law enforcement officers or departments. Limitations of our study include the sample size, the lack of female officers available at the time, and the time of day (early morning) that was selected due to the availability of staff and personnel to run the video system at the police department.

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REFERENCES

Alen, H. (2015). Differences in anticipation of coincidence between action video game players and non-gamers. Unpublished master's thesis, University of Helsinki.

Andersen JP, Arble EP, Collins PI. Editorial: De-escalating Threat: The Psychophysiology of Police Decision Making. Front Psychol. 2020 May 26;11:1112. doi: 10.3389/fpsyg.2020.01112. PMID: 32528393; PMCID: PMC7264256.

Bennell, C, Jones, N. (2004). The effectiveness of use of force simulation training: final report, Carleton University, Ottawa, viewed 09 May 2021, http://web.archive.org/web/20060509171 035/http://www.cprc.org/tr/tr-2005-01.pdf.

Boyd, S. (1992). Training effectiveness of interactive video systems for the use of lethal force decision making. Unpublished doctoral dissertation, University of San Francisco, CA

Cohen J. Statistical power analysis for the behavioral sciences. 2nd ed. Lawrence Erlbaum; 1988.

Coker, C. A. (2006). Influence of Target Location on Coincidence Timing Performance. Perceptual and Motor Skills, 102(1), 231–238. https://doi.org/10.2466/pms.102.1.231-238

Duncan M, Stanley M, Smith M. (2015). Coincidence anticipation timing performance during an acute bout of brisk walking in older adults: Effect of stimulus speed. Neural Plasticity. 2015;2015;1-8

Duncan MJ, Fowler N, George O, Joyce S, Hankey J. Mental fatigue negatively influences manual dexterity and anticipation timing but not repeated high-intensity exercise performance in trained adults. Res Sports Med. 2015;23(1):1-13. doi: 10.1080/15438627.2014.975811. PMID: 25630242.

Helsen WF, Starkes JL. (1999). A new training approach to complex decision making for police officers in potentially dangerous interventions. J Criminal Justice. 27:395-410.

Kuhlman, J. S., & Beitel, P. A. (1991). Videogame Experience: A Possible Explanation for Differences in Anticipation of Coincidence. Perceptual and Motor Skills, 72(2), 483–488. https://doi.org/10.2466/pms.1991.72.2.483

Larner AJ. (2014). Effect Size (Cohen's d) of Cognitive Screening Instruments Examined in Pragmatic Diagnostic Accuracy Studies. Dement Geriatr Cogn Dis Extra. 2014 Jul 3;4(2):236-41. doi: 10.1159/000363735. PMID: 25177332; PMCID: PMC4132220

Latham, A. J., Patston, L. L., & Tippett, L. J. (2013). The virtual brain: 30 years of video-game play and cognitive abilities. Frontiers in Psychology, 4. https://doi.org/10.3389/fpsyg.2013.00629

LeDoux, J. E., and Pine, D. S. (2016). Using neuroscience to help understand fear and anxiety: a two system framework. Am J of Psychiatry, 173, 1083-1093, https://doi.org/10.1176/appi.ajp.2016.16030353

Le T, Shim AL, Newman D. (2022). Does a relationship between handgrip strength and coincidence anticipation timing exist among young adults: a pilot study. Int J Occup Saf Ergon. Dec;28(4):2546-2550. doi: 10.1080/10803548.2021.2010377. Epub 2021 Dec 24. PMID: 34823437.

Orr R, Canetti EFD, Pope R, Lockie RG, Dawes JJ, Schram B. (2023). Characterization of Injuries Suffered by Mounted and Non-Mounted Police Officers. Int J Environ Res Public Health. Jan 9;20(2):1144. doi: 10.3390/ijerph20021144. PMID: 36673926; PMCID: PMC9858804.

Poldrack, R.A., Farah, M.J. (2015) Progress and challenges in probing the human brain. Nature 526, 371–379.

Ross E, Kinney M, Fogt N. (2022). Coincidence Anticipation Timing Responses with Head Tracking and Eye Tracking. Aerosp Med Hum Perform. Feb 1;93(2):79-88. doi: 10.3357/AMHP.5904.2022. PMID: 35105424; PMCID: PMC8903079.

Tailby, R., & Haslam, C. (2003). An investigation of errorless learning in memory impaired patients: Improving the technique and clarifying theory. Neuropsychologia, 41(9), 1230-1240.

Thompson M, Hartman T, Sztajnkrycer M. (2017). A descriptive analysis of occupational fatalities due to felonious assault among U.S. law enforcement officers during tactical incidents. J Special Ops Med. 2017;17;69-73.

Tiesman HM, Gwilliam M, Konda S, Rojek J, Marsh S. (2018). Nonfatal Injuries to Law Enforcement Officers: A Rise in Assaults. Am J Prev Med. Apr;54(4):503-509. doi: 10.1016/j.amepre.2017.12.005. Epub 2018 Feb 1. PMID: 29395571.

Young, G. (2008). Anticipation Timing as a Function of Expertise and Effector-Specific Training. Master's Thesis, University of Tennessee, 2008. https://trace.tennessee.edu/utk_gradthes/448