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# The Effects of Innovative Shotgun Shooting Methods on Collegiate Shotgun Shooters

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**Abstract:** Sporting activities are classified according to movement demands and can be categorized as either dynamic or static actions. Many events exist within the discipline of "shooting sports", and dynamic and static demands vary drastically among those events. However, consideration for differences in movement demands is frequently disregarded in shooting sports; common practice protocol encourages shooters to utilize static shooting techniques for all shooting sport events. In particular, shooting techniques for shotgun shooting, a dynamic sporting event, regularly align with rifle shooting (static activity) methods. Innovative dynamic shotgun shooting techniques have recently been developed, however, no previous studies have examined the outcomes of employing these dynamic techniques. Therefore, the current research investigated the effects of innovative shotgun shooting methods on collegiate shotgun shooters (n=38). Pre and post trap and skeet scores were collected at a certified International Shooting Sport Federation and USA Shooting competition field. Upon completion of pre-test shooting, subjects participated in an Optimum Shooting Performance (OSP) intervention that outlined innovative dynamic shooting and practice techniques. Post-test shooting scores were collected after 2-weeks of OSP practice. A paired sample t test identified statistically significant improvements for trap shooting scores (t[32] = 2.82, p = .008, 95% CI [0.431, 2.660], d = .49), skeet shooting scores (t[32] = 2.59, p = .01, 95% CI [0.436, 3.625], d = .45), and total shooting (sum score of trap and skeet tests) scores (t[32] = 3.37, p = .002, 95% CI [1.417, 5.734], d = .59). These results suggest that learning and utilizing the OSP methods significantly increased the shooting performance of college shotgun shooters.

***Key Words:*** Shooting Sports, Shotgun Shooting, Optimum Shooting Performance

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## 1 Introduction

Sporting activities possess challenges that require specific skill acquisition to accomplish the particular physical demands. Mitchell, Haskell, and Raven (1994) divided and defined sports into two categories: dynamic and static [1]. Dynamic sports involve rhythmic contraction that produce joint movement by lengthening and shorting muscles [2]. Static sports involve a constant contraction that produces little or no joint or muscle movement [1]. In conjunction with differing characteristics, dynamic and static sports require different practice strategies to improve performance.

Shooting sports are physical activities that include both dynamic and static demands. However, these opposing demands are rarely considered when current shooting sport practice techniques are prescribed. Rifle shooting is defined as a static sport based on the limited movement required during performance [1]. Rifle targets are set in a stationary or static position. The rifleman attempts to remain in a static position until the round is fired and the target is intercepted. In fact, less body and rifle barrel movement occurring during the shot contributes to higher accuracy, greater shot placement, and increased rifle shooting success [3]. In contrast to rifle shooting, shotgun shooting is a dynamic sport that requires precise rhythmic movement of the upper extremities, lower extremities, and torso to successfully intercept a moving/dynamic target [4]. Current shotgun shooting methods ignore the dynamic demands associated with the sport and rely on traditional rifle shooting methods to intercept a moving clay target. For example, Texas Parks and Wildlife educates shotgun shooters to point the barrel of the shotgun in the direction of the clay target by aligning the eye, singular, with the barrel of the gun [12]. In conjunction with closing one eye and pointing the shotgun, Texas Parks and Wildlife instructs shooters to point the barrel behind the target, increase the speed of the muzzle until the tip of the barrel passes the target, and then fire the gun [2]. This shooting technique is referred to as the "swing-through" method and is currently recognized and publicized as the best shotgun shooting technique. However, the results of Causer et al. [4] (2010) contradict the suggested method of Texas Parks and Wildlife [2] .

Causer et al. (2010) emphasized that clay targets travel at speeds up to 100 km·h-1 and conventional aiming methods are counterproductive; shooters should place more visual focus (both eyes open) on the moving target versus focusing on barrel direction [3]. Additionally, Causer et al. (2010) examined the gun kinematics of elite and subelite shotgun shooters and identified that elite shooters moved the barrel significantly less and slower than subelite shooters [3]. These results imply that subelite shooters utilize the swing-through method. Elite shooters mount the gun barrel ahead of the moving target and pull the trigger as the traveling speed of the barrel matches the traveling speed of the clay. The shooting method used by the elite shooters is documented as the "sustained lead" method [2].

Texas Parks and Wildlife (2014) briefly mentions the concept of sustained lead as pointing

the barrel at the estimated appropriate length of lead needed to intercept the target and maintaining the lead through the shot [2]. However, common questions among shotgun shooters are: what is the appropriate lead and how is it determined? Unlike the Texas Parks and Wildlife [2] sustained lead instructions, shooting methods developed by Ash 2006, recognized as the Optimum Shooting Performance (OSP) methods, advise shooters to disregard target lead and barrel placement[5]. Instead, sustained lead shooters are instructed to place the barrel in front of the target prior to the targets release. As the target is released, shooters are to visually focus on the front edge of the clay, with both eyes open, and initiate barrel movement as the clay approaches the barrel – seen in the peripheral vision [5]. With the barrel remaining ahead of the target and as gun movement speed matches the speed of the clay, the appropriate "sight picture" (displayed in figure 1) develops. When the sight picture is established, shooters are instructed to fire the shot [5].

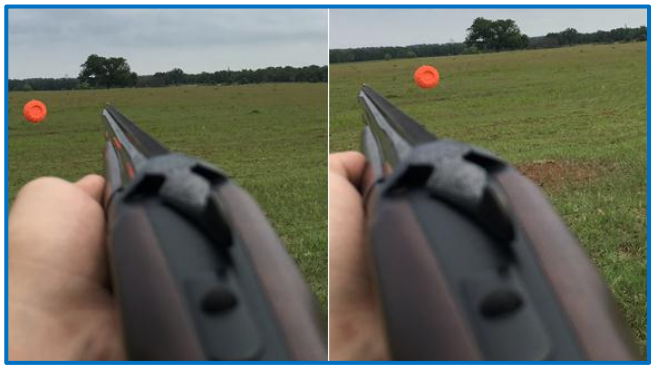

**Figure 1** Shotgun Shooting Sight Pictures for Left-to-Right Target Flight (L) and Right-to-Left Target Flight (R).

The literature displays a discrepancy in appropriate shotgun shooting techniques, and no empirical study has identified the effectiveness of OSP practice protocol on shotgun shooting performance. Therefore, the purpose of this investigation was to evaluate the shotgun shooting score (trap and skeet) of collegiate shooters upon completion of a 2 week OSP training program. Thus, identifying the effectiveness of the OSP methods.

## Osp deliberate practices

Deliberate practice consists of exercises that are specifically designed to increase the current performance level of participants [6]. Ash et al (2006) developed deliberate practice techniques (drills and simulation videos) that familiarize shooters with 3 specific aspects of sustained lead shooting: sight-picture (3-Bullet Drill), improve barrel control (Flash Light Drill), and enhance target trajectory recognition (Simulation Videos) [5].

The OSP 3-Bullet Drill (3BD) is utilized to enhance sight picture recognition. Three shotgun shells are aligned eight to ten inches apart on a flat surface approximately five yards from the practicing shotgun shooter. To create the appropriate sight picture for a target moving from left-to-right, shooters visually focus (both eyes) on the center shell and insert/mount the gun with the barrel pointing at the far right shell. To create the appropriate sight picture for a target moving from right-to-left, shooters visually focus (both eyes) on the center shell and insert/mount the gun with the barrel pointing at the far left shell. The mounted positions are held for 15 seconds, then released. This is repeated 15 time for left-to-right and right-to-left sight pictures.

The OSP Flash Light Drill (FLD) is practiced to improve gun mount and barrel control. A flashlight is turned on and inserted into the end of the shotgun barrel. The light from the flashlight is illuminated into the top corner of a room. Shooters attempt to keep the light steady and in the corner as they mount and unmount the gun (10 times). Following, the practicing shooter progresses to a moving mount. The projected light starts in the top corner of the room and as the shooter mounts the gun, they are instructed to move the light along the upper seam of the wall and ceiling. While mounting, the shooter's objective is to keep the light steady and in the seam of the wall. The move and mount progression is repeat 10 times to the left and 10 times to the right.

Three OSP shotgun sports (trap, skeet, and sporting clays) simulation videos provide visual

representation and repetitions of successfully hit targets for multiple flight variations. A red dot, representing the gun barrel, is centered and constant within the screen of the videos. The trap simulation (TRS) and skeet simulation (SKS) videos contain two repeated simulation shots of all potential target trajectories from each station. The sporting clays simulation (CLS) video contains two repeated simulation shots for typical target trajectories appearing in sporting clays courses. The simulation videos allow practicing shooters to cognitively process a correctly conducted sustained lead shooting method shot. Each simulation video is approximately 10 minutes long.

A realistic interaction component for the simulation videos is created by instructing practicing shooters to pause the video when the relationship of the red dot and the clay are of equal speed and the sight picture is formed. The pause simulates the pulling of the trigger. Additionally, this interaction component provides shooters with feedback. If the pause was clicked and the simulation target was broken simultaneously, the practicing shooter's shot time was correct. If the target remained unbroken when the video was paused, the practicing shooter's shot timing was early and incorrect. Likewise, if the target broke prior to pausing the simulation, the shot timing was late and incorrect.

Several studies have researched and reported the properties associated with shotgun shooting performance. However, a superior shooting method and practice protocol has yet to be empirically validated. The current researchers have recognized the divide in suggested shotgun shooting strategies and aimed to examine the effects of teaching, practicing, and utilizing the sustained lead methods and OSP practice protocol on college shotgun sports shooters.

## Materials & methods

### Participants

Formal written consent was obtained from thirty-eight (N=38) college students. Shooting subjects were enrolled in the Kinesiology Hunting and Fishing course (KINE 1246) or were members of the college shotgun sports team (age = 19.9 ± 1.9 yrs.). Shooters had no previous knowledge of the OSP practice protocol or had practiced OSP drills or viewed OSP videos. All subjects received a shotgun safety and shotgun range rules briefing prior to participating in the study.

Shooters were required to use 12 gauge automatic or over-under shotguns and wear appropriate ear and eye protection while shooting. Prior to the commencement of the study researchers received approval via the Institutional Review Board.

## Procedures

The current research will focus on and examine two shooting games: trap and skeet. As described by Causer et al. (2010), trap involves intercepting clay targets that fly away from the shooter [3]. Targets are released from a single bunker 15 m ahead of the shooting stations (5 stations). Targets are propelled in random trajectories ranging from 45˚ left and 45˚ right of a straightaway target. Shooters are allowed one shot per target, 5 targets per station, totaling a max score of 25 targets.

Skeet involves intercepting clay targets that fly horizontal to the shooter. Targets are released from two opposing towers (high & low). Eight station are dispersed in a half moon layout with the final station (station 8) centered between the two towers. Stations one, two, six, and seven consist of four targets: one single target from each tower and one double (double: two clays thrown simultaneously from each tower). Stations three, four, five, and eight consist of two targets per station: one single target from each tower. An optional or repeat shot is taken upon the shooter's first missed target or as an additional low house single from station eight if no misses are acquired throughout the round. Shooters are allowed one shot per target, with a max skeet score of 25 targets.

The current study investigated the effectiveness of OSP practice protocol. With limited shooting technique instructions or tips, other than safety shotgun firing protocol, shooters were instructed to shoot one round of trap (25 shots) and one round of skeet (25 shots), representing the baseline shooting test. Shooters attempted to intercept all targets within the trap and skeet rounds. Hit targets and missed targets were recorded on trap and skeet score cards. The sum of hit targets represented pre-trap and pre-skeet scores. The sum of pre-trap and pre-skeet scores represented a total pre-test shooting score.

Upon completion of pre-test shooting, participants received an OSP shooting intervention session. The session included a three hour classroom shooting lecture and an hour-and-one-half live shooting lesson. The lecture included: an articulation of the OSP shooting methods, an explanation of the OSP drills, the practicing of the OSP drills, and the watching of the OSP simulation videos. The live shooting lesson consisted three shooting scenarios: long range (approximately 30-50m) crossing targets, trap targets, and skeet targets (30-minute per scenario).

Following the OSP intervention, shooters began a two week OSP practice protocol. Participants were instructed to watch the OSP simulation videos and complete the OSP shooting drills once a day, five times per week, for two weeks. Participants were given a journal to record drills practiced and video watching over a 2 week period. The teaching session and practice were intended to improve the shotgun shooting performance of participating shooters.

Post-test shooting, facilitated and completed using identical processes as the pre-test, was conducted upon completion of the two week practice protocol. However, shooters were instructed to utilize the OSP/sustained lead methods during the post-trap and post-skeet rounds. Target hits were recorded for post-trap and post-skeet rounds and added to represent a post-test shooting score. Pre-trap, pre-skeet, and pre-test scores were compared to post-trap, post-skeet, and post-test scores to examine the effectiveness of OSP methods. Difference in treatment effects were calculated using a paired sample t test with the significant α level set at 0.05. Pearson's correlations coefficient ($p < .05$) was used to identify the relationship between recorded OSP practice protocol and the difference in pre- and post-test shooting scores – trap mean difference (TRD), skeet mean difference (SKD), and total mean difference (TD). It was expected that no statistically significant difference between pre-test and post-test shooting scores would be identified, and there would be no significant relationship between recorded OSP practice protocol and the difference in shooting scores.

## Results

Table 1 provides subject demographic information. Four participants were lost during follow-up/post testing. Pre-test shooting scores of lost participants were removed from the study. The remaining subjects (N=33) completed a trap shooting pre-test, trap shooting post-tests, skeet shooting pre-test, and skeet shooting post-test. The sum of pre- and post-test trap and skeet scores provided a total shooting score.

Table 2 shows descriptive statistics and outcome measures for pre- and post-test shooting results. Paired sample t test results identified that statistically significant improvements occurred from pre-test trap shooting scores to post-test trap shooting scores ($t[32] = 2.82$, $p = .008$, 95% CI [0.431, 2.660], $d = .49$), pre-test skeet shooting scores to post-test skeet shooting scores ($t[32] = 2.59$, $p = .01$, 95% CI [0.436, 3.625], $d = .45$), and pre-test total shooting scores to post-test total shooting scores ($t[32] = 3.37$, $p = .002$, 95% CI [1.417, 5.734], $d = .59$). These results suggest that learning and utilizing the OSP methods significantly increased the performance of college shotgun shooters.

**Table 1.** Subject Demographics

| | Age | Male, n (%) | Female, n (%) | Right Hand, n (%) | Left Hand, n (%) |
|---|---|---|---|---|---|
| Subjects (N=33) | 19.97±1.94 | 26 (78.8) | 7 (21.2) | 30 (90.9) | 3 (9.1) |

**Table 2.** Descriptive Statistics and t Test Results for Shotgun Shooting Pre- and Post-Tests

| Pre-test/Post-test | M | N | S | t | p |
|---|---|---|---|---|---|
| Post Total | 27.5455 | 33 | 9.98778 | 3.374 | .002* |
| Pre Total | 23.9697 | 33 | 11.98824 | | |
| Post Trap | 13.3939 | 33 | 5.01211 | 2.824 | .008* |
| Pre Trap | 11.8485 | 33 | 5.64647 | | |
| Post Skeet | 14.1515 | 33 | 5.75066 | 2.594 | .014* |
| Pre Skeet | 12.1212 | 33 | 7.04786 | | |
| Note: *p < .05 | | | | | |

**Table 3.** Description of Correlation Results, Amount Practice to Mean Shooting Score Difference

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| 1 3 Bullet Drill | 1.00 | | | | | | | |
| 2 Flashlight Drill | .919** | 1.00 | | | | | | |
| 3 Sporting Clays Simulator | .860** | .787** | 1.00 | | | | | |
| 4 Skeet Simulator | .851** | .819** | .980** | 1.00 | | | | |
| 5 Trap Simulator | .839** | .779** | .994** | .975** | 1.00 | | | |
| 6 Dif. in Total Scores | .122 | .015 | .185 | .148 | .178 | 1.00 | | |
| 7 Dif. in Trap Scores | .159 | .023 | .293 | .226 | .287 | .698** | 1.00 | |
| 8 Dif. in Skeet Scores | .054 | .005 | .045 | .042 | .041 | .866** | .246 | 1.00 |
| *M* | 5.18 | 4.45 | 6.76 | 6.70 | 6.52 | 3.58 | 1.55 | 2.03 |
| *SD* | 5.87 | 5.45 | 7.37 | 7.13 | 7.17 | 6.09 | 3.14 | 4.50 |
| Note: **Indicate significant correlation (p < .01). | | | | | | | | |

Table 3 provides detailed correlation statistics for recorded practice protocol and mean difference shooting scores. No significant (p<.05) correlation was found between total recorded OSP practice protocol and mean differences in shooting results. These correlation results suggest that the two week OSP practice protocol had no significant relationship to the increased shooting performance of participants.

## Discussion and Conclusion

The results of this study reject the null hypothesis concerning the difference between pre-test and post-test shooting scores, suggesting that OSP methods positively affect the shotgun shooting performance of college shooters. Although a statistically significant difference was identified between pre- and post-test scores, the researchers failed to reject the null hypothesis that there would be no significant difference between total recorded

OSP practice protocol and mean difference in shooting results. These results suggest that increased practice (OSP 3BD and FLD) and simulation views (CLS, SKS, TRS) across two weeks provided no contribution to the increase in post-test shooting scores. Therefore, it was assumed the initial OSP intervention, teaching shooters an alternative or improved method of shooting, affected the increase in post-test shooting scores. Although the two week OSP practice protocol displayed no significant relationship to increased shooting scores, the OSP drills and simulation videos may still possess value as they were integrated into the initial teaching session. A future longitudinal investigation exploring the effects of OSP methods and the relationship between total OSP practice and mean difference in shooting score may provide a better understanding of the long-term effects of OSP practice protocol. Regardless, these results validate the practical application and suggestions explained in the literature for improving shotgun shooting performance [2, 4, 5-7]. The OSP intervention provided student shooters with three essential shotgun shooting checkpoints: barrel in front, visual focus on the target, and same speed. Research investigating kinematics of shotgun shooters, proper visual target recognition strategies, hand-eye coordination associated with target interception, and predictive mechanisms of target interception have validated the effectiveness of OSP shooting checkpoints [4, 8-12]. Causer et al. (2010) identified that barrel movement of elite shooters was significantly less than subelite[4]. This suggests that elite shooters anticipate the future direction and trajectory of clay targets, and initially point the barrel where the target will be versus the released location of the clay (i.e. trap or skeet house) [4]. In doing so, the barrel begins and remains in front of the target. The 3BD and FLD simulate and reinforce the in front concept, potentially contributing to the improvement in shooting scores.

Placing visual focus on the target contains several components, purposes, and empirical justifications. Granrud et al. (1984) examined the difference in monocular and binocular visual abilities, and reported binocular vision as superior in perceiving distance and direction of objects [9]. Complimentary to the OSP shooting methods, students were instructed to utilize binocular vision while shooting to enhance the perceived distance and direction judgement of moving clay targets. Mroteck et al. (2007) investigated hand-eye coordination characteristics associated with intercepting targets [11]. Participants were instructed to watch a moving circular dot, displayed on a computer screen, and intercept the dot by touching the screen with their index finder. A smooth eye pursuit was constant for successful interceptions, however, the gaze of subjects typical lagged behind while tracking the dot/target. Mrotek et al. (2006) in an alternative study, reported similar lagging gaze during target tracking [10]. Additionally, finger kinematics analysis concluded that subjects displayed corrective movement patterns throughout the interception process [10-12]. These findings suggest two occurrences: a predictive element is involved when intercepting moving targets and the predictive mechanism provides a direction for the unseen interception tool (the hand). Ariff et al. (2002) and Reina and Schwartz (2003) confirmed the previous assumptions concerning predictive tracking and unseen interception tool directing, and refer to this phenomena as the activation of the anticipatory circuit [8-12]. Translated to OSP methods, these finding describe the advantages and purposes of visually neglecting barrel positioning and placing primary focus on the moving object or clay. Placing focus on the targets, with binocular vision, enables effective use of visual anticipatory circuits by relaying directional instructions to the musculoskeletal components utilized for barrel movement, barrel control, and appropriate target lead establishment.

The same speed checkpoint refers to matching barrel movement speed with target movement speed. As discussed, anticipation mechanisms provide the unseen interception tool a natural and appropriate directional guide ahead of

the target [8-12]. The same speed instruction is a visual cue to shooters that, once attained, will result in the appropriate sight picture. Within the OSP methods, the sight picture signifies that the appropriated anticipated direction and distance is achieved and it is the suitable time to fire the shotgun.

The research participants learned the OSP checkpoints during the in-class lecture portion of the OSP training session, and practiced the checkpoints during their live shooting session. Additionally, shooters were instructed to rely on the OSP checkpoints during post-test shooting rounds. Therefore, based on the significant increases in shooting scores, due to the initial OSP intervention and usage of the OSP checkpoints, it can be assumed that the OSP methods served as an effective tool in teaching an alternative method (sustained lead) for shotgun shooting, and is a successful strategy for increasing shotgun shooting performance.

## Practical application

The researchers encourage shooters to undergo an OSP intervention session if increased shotgun shooting is the desired outcome. Although the results of the study did not identify the 2-week OSP practice protocol as a statistically significant contributor to enhanced shooting performance, it is assumed that utilizing deliberate practice strategies geared towards enhancing sustained lead shooting techniques would elevate shotgun shooting abilities. Therefore, the researchers recommend shooter consistently utilize a comprehensive OSP practice routine that includes shotgun shooting drills (3BD and FLD) and simulation videos (TRS, SKS, CLS). The 3BD should be exercised 5 days per week, 1 set of 15 repetitions (15 second holds per repetition) per day for each sight picture (right-to-left and left-to-right). The 3BD improves shooter's recognition of appropriate sight pictures. The FLD should be exercised 5 days per week, 1 set of 10 repetitions (15 second hold per repetition) per day for steady corner mount, and 1 set of 10 repetition each (right-to-left and left-to-right) for mounted seam movement. The FLD improves shooter's gun mount and barrel control skills. Viewing and incorporating the interactive simulation components of the TRS, SKS, and CLS should be executed once a day, 5 days per week. The video simulators enhance cognitive processing of target flight patterns, correctly executed sustained lead shooting method, and immediate timing feedback. Consistent implementation of the strategic, comprehensive OSP practice protocol is suggested to enhance overall shotgun shooting performance.

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## Competing Interests

The authors declare that they have no competing interests.

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