You Cannot Hit What You Do Not Shoot

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ABSTRACT

A training system can only be effective if it is appropriately utilized, regardless of whether the training system is a sophisticated full-motion simulator or steel targets on a small-arms range. However, without understanding how trainees use a training system and without clear performance feedback, it is not likely that desired training outcomes will be met. A recent example of training-system underutilization impacting training performance comes from the U.S. Army Sniper School (USASS). In the USASS, sniper teams spend a considerable amount of time at the beginning of the course conducting “data confirmation.” Data confirmation is accomplished by engaging static targets at varying distances on an unknown distance range. So, in the case of data confirmation, the training system is very simple: a small arms range with static targets at varying distances. It was observed over several iterations of USASS that shooters rarely engaged targets at distances beyond 600 m during data confirmation and that, when engaged, the hit percentage of targets *over* 600 m was very low. The consequence of failing to shoot at far targets (i.e., over 600 m) during data confirmation was low hit percentages on far targets in the record fire event that was a graduation requirement. An intervention was introduced to increase engagements with far targets that required USASS instructors to record and analyze individual shot data. By requiring instructors to document data, the instructor was able to determine if the shooter was spending too much time at closer distances (i.e., not fully utilizing the training system) and to intervene if necessary. The result was increased record-fire performance on far targets. Even though the intervention and results may seem intuitive, the need for such an intervention highlights the importance of trainer engagement to ensure proper training-system utilization and the importance of providing performance feedback during training.

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INTRODUCTION

A training system can only be effective if it is appropriately utilized, regardless of whether the training system is a sophisticated full-motion simulator or steel targets on a small-arms range. Even though "utilization" may refer both to *how often* a training system is used and to *how well* the training system is used, utilization is determined by the interaction of the ease of use of the system (e.g., reliability and familiarization) and the training value of the system (e.g., skill transfer: Polzella, 1983). This paper addresses the later aspect of utilization, that is, the extent to which the features of a training system are fully exploited to achieve training outcomes. A recent example of training-system underutilization impacting training performance comes from the U.S. Army Sniper School (USASS). In the USASS, sniper teams spend a considerable amount of time at the beginning of the course conducting "data confirmation." Data confirmation is accomplished by engaging static targets at varying distances on an unknown distance range. So, in the case of data confirmation, the training system is very simple: a small arms range with static targets at varying distances. It was observed over several iterations of USASS that shooters rarely engaged targets at distances beyond 600 m. The consequence of failing to shoot at far targets (i.e., over 600 m) during data confirmation was low hit percentages on far targets in the record fire event that was a graduation requirement. An intervention was introduced to increase engagements with far targets and to provide additional feedback on all engagements.

Shooting is easy or so it seems. The shooter only needs to align the rifle sights with the target and squeeze the trigger without disturbing the sight alignment. Rifle marksmanship research over the years has shown that the simple task of shooting requires complex skill that involves a combination of fine and gross motor skills coupled with mental processes before, during, and after the shot (Chung, Nagashima, Espinosa, Berka, & Baker, 2009). Attaining and refining skills to consistently and accurately shoot a rifle, requires hours of deliberate practice. Deliberate practice requires the individual to practice both what is done well and what is deficient with the important factor of focused feedback (Ericsson, Prictula, & Cokeley, 2007).

In general, marksmanship training systems consist of a range (live or virtual) that allows shooters to engage targets at a variety of distances. Additional complexity can be added by the capability to shoot from alternate positions (e.g., loop hole or elevated position), to engage moving targets, to engage partially obscured targets or targets of varying size, and to provide combat situations (e.g., time pressure or distracting sounds). In a sense, deliberate practice requires individuals to reinforce existing skill and move beyond the comfort zone in order to expand skill application. Accordingly, a marksmanship training range must facilitate practice on both easier engagements (e.g., close targets) and more difficult engagements (e.g., far targets). The simplicity of a marksmanship range (i.e., an open range with targets at varying distance) does not inherently provide effective training. Rather, the value of the marksmanship range is in the deliberate-practice approach used on the range.

Initial observations of USASS students conducting data confirmation identified the application of *unguided* practice with limited feedback during training rather than deliberate practice. The primary purpose of data confirmation is to confirm or adjust the ballistic calculations for the weapon system at different distances, but data confirmation also provides an opportunity for shooters to practice static target engagements and to practice shooter-spotter teamwork. Shooters engage a target at a given distance until the target is consistently hit and then repeat the process with a target at a different distance. The typical pattern of target engagements observed during data confirmation was to start with close targets and frequent hits, move to far targets with *infrequent* hits, and then move back to close targets and shoot a lot more. This pattern resulted in spending too much time at closer distances without the ability to diagnose and remediate problems with shooting performance. In concert with USASS instructors, an intervention was developed that focused on skills required to engage long-range targets while at the same time providing a forcing function to promote interaction between the student sniper team (i.e., shooter and spotter) and the sniper instructor.

United States Army Sniper Course Data Confirmation

The USASS trains Soldiers to engage single stationary and moving targets from 300 to 1200 meters using both unknown and known distance ranges. Sniper training is team training. That is, students train as two-person teams and are trained in both shooter and spotter roles. Student sniper teams train on target acquisition, range determination, and engagements technique skills with an explanation of how to divide these responsibilities between team members while engaging a target. Both team members must be proficient on all tasks as they will alternate roles throughout the different training tasks. Teamwork skills are trained as a precursor to the live-fire training and practiced during data confirmation.

Data confirmation in the USASS is the process of engaging targets at unknown distances to verify firing data through proper utilization of the advanced ballistic calculator for future engagements. The data-confirmation process involves:

- Accurately recording cold barrel and confirmation shot placement, elevation and windage adjustments and holds.
- Properly identifying targets.
- Accurately determining range to targets.
- Accurately utilizing the advanced ballistic calculator.
- Accurately engaging targets with precision fire.

Data confirmation is conducted daily during the live-fire portion of the course and culminates with a record fire event that the Soldiers must pass to graduate USASS. Data confirmation is conducted on an unknown distance range with steel targets randomly placed between 300 and 1000 meters. Numbers and letters are painted on the targets to enable identification and are moved to a different location on the range prior to each training day. The sniper teams are taught a "shot process" to engage targets during data confirmation. Figure 1 depicts the shot process the team uses for each round fired. During the unguided practice, each sniper team picked the first and subsequent targets to engage.

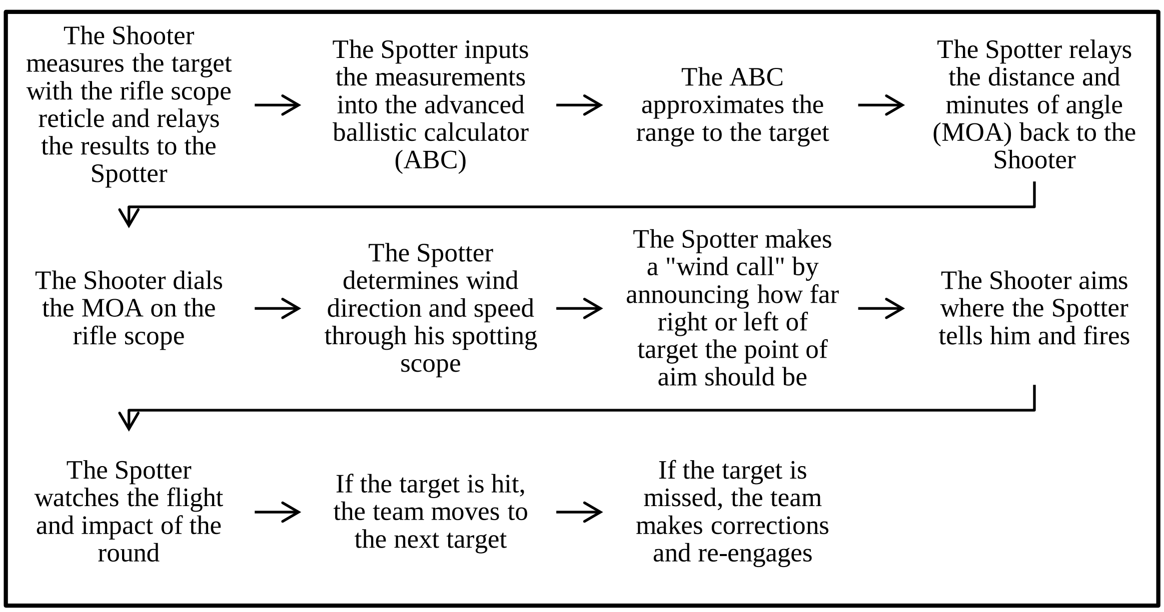

Figure 1. The shot process used by the sniper teams to engage each target during unguided practice.

THE UTILIZATION INTERVENTION

Again, the initial data-confirmation observations identified that, for the most part, the teams were conducting unguided practice with limited feedback from the USASS instructors. It was also observed that errors made in the range determination and engagement technique process were not mitigated between shots and that when teams missed at longer ranges, they tended to fall back into their comfort zone and *only* engage shorter range targets that would give them positive feedback (i.e., the "ding" of the round hitting steel). The utilization intervention required instructors to document students' shot data. By doing so, the instructor was able to determine if the shooter was spending too much time at closer distances (i.e., not fully utilizing the training system) and to intervene if necessary.

The utilization intervention was designed as an exercise in deliberate practice that focused on the skills required to engage long range targets. Implementing the intervention capitalized on a tool that was familiar to the USASS instructors and already available to USASS students. Shot data books are an analog tool used to record environmental conditions (e.g., temperature, humidity, etc.), range to targets, engagement techniques (i.e., hold-overs, dial, or rapid target engagement), wind direction and speed, wind hold, and location of hits and misses for each round fired during training. The purpose of the shot data book is to capture relevant historical shooting information that can be referred to for data on previous engagements and past performance gaps. All USASS students are provided hard copies of a shot data book as part of the student handouts at the beginning of the course. However, little emphasis was placed on using data books during data confirmation as more emphasis was placed on using the digital advanced ballistic calculator.

For the utilization intervention, a simplified shot data book was re-introduced. These modified shot data books included only range to target, engagement technique, and hit or miss. The purpose of the simplified data book was to enable both the student sniper team and the instructor to visualize shooting performance during and after the day's training. The data book was coupled with recommendations on how the sniper instructor should use the book while providing *focused feedback* during the shot process. As opposed to the unguided practice identified for typical data confirmation, the utilization intervention required the sniper instructor to facilitate deliberate practice by choosing all targets as well as providing feedback at critical points in the shot process (see Figure 2). After the completion of each successful engagement, the sniper instructor would select the next target for the student sniper team to insure that targets at all range bands – near and far – were engaged. The instructor also documented each shot in the team's data book in order to review performance and determine strengths and weaknesses to tailor the next day's training.

METHOD

Participants

Data were collected from six (6) USASS classes with a total of 224 Soldiers. The USASS students ranged in rank from Private First Class to Sergeant First Class. The classes were conducted from March through August during a recent training year. Two classes were simultaneously conducted in each of three cycles over this time period. At the outset of each class, USASS students were placed into two-man sniper teams. Existing sniper teams were kept intact, and Soldiers who arrived individually were partnered with another student. In the case of an uneven number of Soldiers in a class, three-man sniper teams were formed. USASS instructors were assigned mentor groups in each class with the goal of an instructor-student ratio of 1:4 (i.e., one instructor per two sniper teams).

Procedure

Each course was conducted in accordance with the training program of instruction with the exception of the utilization intervention during the second cycle of two classes. The utilization intervention previously described was only used during the firing events that led to the first record fire. After that, no modification of the course occurred. In order to provide a firm baseline and to further isolate the effect of the utilization intervention, the application of the intervention followed an ABA design. Data was collected from three consecutive cycles of two classes. The first cycle of two classes (i.e., Class 5 & 6) were not given the utilization intervention and merely allowed students to conduct data confirmation without instructor input (i.e., initial baseline). During the second cycle of two classes (i.e., Class 7 & 8), instructors applied the utilization intervention for all students. The final cycle of two classes (i.e., Class 9 & 10) received no intervention just as the first cycle (i.e., return to baseline).

USASS instructors were provided an introduction to the utilization intervention prior to Class 7 & 8. The modified shot data books were distributed to each instructor. A member of the research team was present during the first two days of data confirmation to ensure the intervention was properly applied and to answer questions from the instructors. Thereafter, the research team "spot checked" the intervention and retrieved data books every other day during data confirmation. The procedure for the application of the utilization intervention is given in Figure 2.

The static-target record fire event for all classes was conducted according to the course program of instruction, and data (i.e., record fire scores) were provided to the research team from USASS instructors. Record fire is a graded event. Each member of the student sniper teams engages five targets that vary in range from 350 m to 800 m. The members of the team alternate shooter and spotter positions during the event. A first-round hit on a target is scored as 10 points, a second-round hit on a target is scored as 5 points, and 0 points are scored for a second-round miss. Thus, each shooter can obtain a maximum score of 50 points on the record fire event.

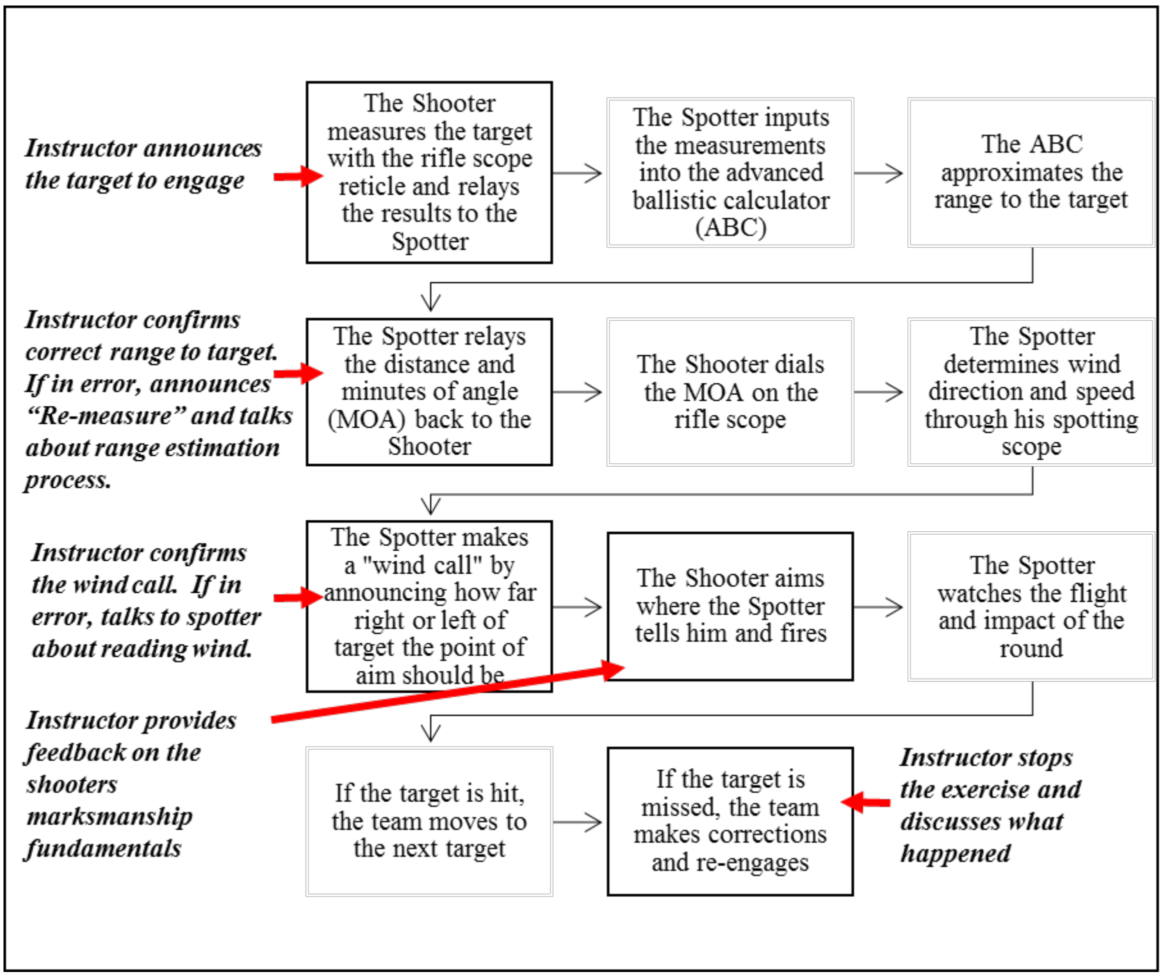

Figure 2. The shot process used by the sniper teams to engage each target during the utilization intervention.

RESULTS

The primary data consisted of proportion of shots and hits for near targets (i.e., less than 500 m) and far targets (i.e., greater than 600 m) during data confirmation and record fire. The data come from all rounds fired on all events from all students. Because data confirmation target engagements are self-determined, each student fired different number of rounds at different ranges at different times and in different orders. As such, there was no way of constructing viable *statistical* analyses for the shot data. Instead, graphical analyses were used to determine the pattern of results. If the utilization intervention produced the desired effect and if the effect was isolated to the intervention, then data values for Class 7 & 8 should be greater than both Class 5 & 6 and Class 9 & 10. The graphical analyses were used to determine if the utilization intervention resulted in (a) more engagements at far targets and (b) more accuracy (i.e., hits) on far targets than the self-guided training. In addition, scores from record fire were statistically analyzed to determine the impact of the utilization intervention on course performance. Finally, the proportion of shots and hits for targets greater than 700 m were graphically analyzed to determine if the training utilization intervention had an impact on the most difficult skill application.

The proportion of shots for near targets and far targets during data confirmation were combined into a ratio and plotted to determine if the intervention produced broader utilization of the available targets. The proportion of far-target shots was calculated as a function of the proportion of near-target shots. This ratio expresses the distribution of shots at the two range bands. Ratios closer to 1.00 indicate an even distribution of shots across the two range bands, ratios under 1.00 indicate that more shots were fired at near targets then at far targets, and ratios greater than 1.00 indicate that more shots were fired at far targets than at near targets. An inspection of the blue bars in Figure 3 clearly indicates that only students in Class 7 & 8 (.i.e., the students with the utilization intervention) had an even distribution of shots across far targets and near targets (i.e., ratio approximately equal to 1.00). Class 5 & 6 and Class 9 & 10 shot more rounds at near targets than at far targets (i.e., ratio substantially less than 1.00).

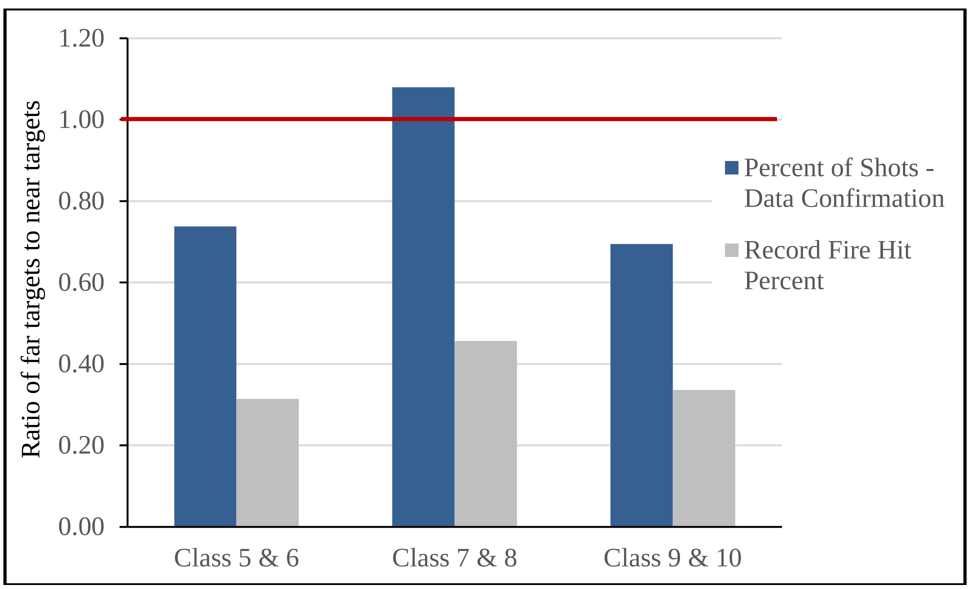

Figure 3. Ratio of far-target-to-near-target proportions for shots during data confirmation and for record fire hits.

The set of gray bars in Figure 3 shows the far-target-to-near-target ratios for the proportion of hits on record fire. As can be seen, all classes hit proportionately fewer far targets than near targets. However, Class 7 & 8 had a greater far-target-to-near-target ratio than either Class 5 & 6 or Class 9 & 10.

The mean individual record fire scores for all three USASS class groups were compared in a one-way analysis of variance. Student-Newman-Kuels *post-hoc* comparisons were used to determine the pattern of effects. The analysis was conducted at the 5-percent alpha-error rate. The mean record-fire scores for Class 7 & 8 (mean = 36.36, SE_m = 0.93) was statistically higher than the mean scores for Class 5 & 6 (mean = 29.76, SE_m = 1.01) and mean scores for Class 9 & 10 (mean = 27.15, SE_m = 1.14), F (2, 221) = 20.18, MS_e = 79.33, p < .01. This result indicated that the utilization intervention increased overall static-target performance.

The final set of analyses focused on performance for the most distant target range, i.e., greater than 700 m. Because hitting targets at this range is more difficult, this analysis provided a stricter test of the impact of the utilization intervention. This set of analyses again examined the proportion of shots during data confirmation and hits on record fire. In addition, the proportion of hits during data confirmation was added to determine if the intervention also impacted training performance. Because of the nature of the data, graphical analysis again was used to determine the pattern of effects. The left-hand set of bars in Figure 4 show the proportions of shots during data confirmation for each USASS class group. While all three bars of this set are nearly equivalent, the orange bar indicates that Class 7 & 8 (i.e., the utilization intervention) shot a higher proportion of data confirmation rounds at targets farther than 700 m than did Class 5 & 6 or Class 9 & 10. The middle set of bars in Figure 4 show that Class 7 & 8 also had a higher proportion of hits on targets farther than 700 m than did Class 5 & 6 or Class 9 & 10. Taken together, these two results indicated that the students who received the utilization intervention were more efficient at engaging targets farther than 700 m than students who were self-guided in these target engagements. The right-hand set of bars in Figure 4 show that the intervention resulted in a higher proportion of hits on targets farther than 700 m during record fire than did the other groups of students. This result again shows that the utilization intervention during training translated to higher performance on the graded event.

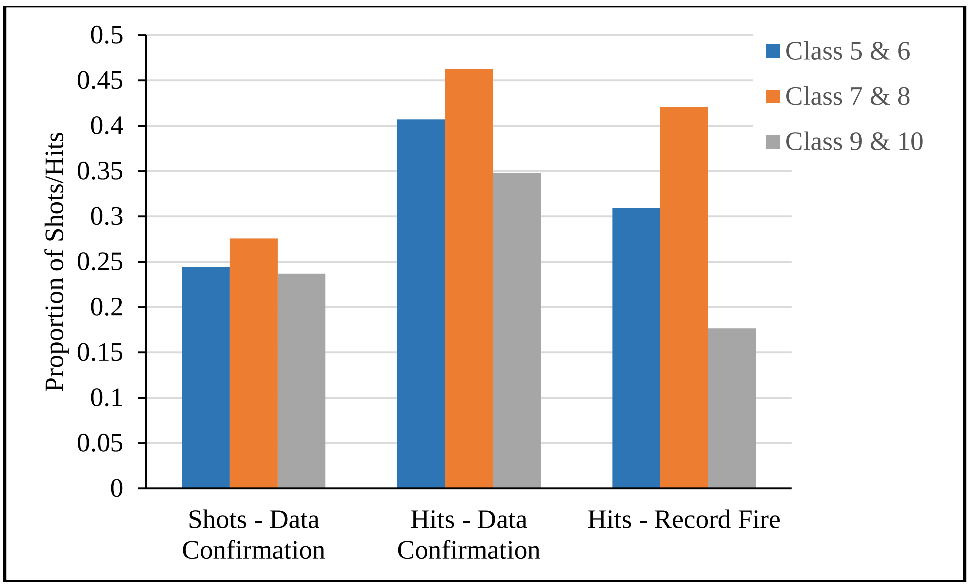

Figure 4. Proportions for shots and hits on targets farther than 700 m during data confirmation and record fire.

DISCUSSION

The purpose of the research was to increase the utilization, and thereby the effectiveness, of a very simple training system. The results converged on the conclusion that the intervention produced more efficient utilization of the training. USASS students who received the intervention (a) shot at more far targets during data confirmation, (b) had greater accuracy on far targets during data confirmation, and (c) obtained higher record fire scores than students who were not exposed to the intervention. The intervention focused on improving both how *much* of the training system was utilized (i.e., instructors announced the targets to engage) and how *well* the training system was utilized (i.e., instructors provided feedback and discussion on target engagements). Figure 4 provides a good illustration of how the intervention had its desired effect. Students who received the intervention proportionally shot a few more rounds at targets greater than 700 m. That small increase in number of rounds (i.e., "how much") was coupled with a slightly larger increase in accuracy (i.e., "how well"), which translated to about a 10% increase in record-fire hits (i.e., training effectiveness) at targets greater than 700 m. In other words, if USASS students did not effectively engage far targets in training, then students did not effectively hit far targets on the test (i.e., record fire). Even though the intervention and results may seem intuitive, the need for such an intervention highlights the importance of trainer engagement to ensure proper training-system utilization and the importance of providing performance feedback during training (Blaiwes, Puig, & Regan, 1973).

The utilization intervention was based on deliberate practice techniques. Deliberate practice requires effortful repetitions with formative feedback, is engaging, and leverages pre-existing knowledge to improve skill efficiency (i.e., speed and accuracy) and retention (Ericsson, Krampe, & Tesch-Romer, 1993). Implicit in this definition of deliberate practice is the notion that the role of practice is to continually progress skill performance. As such, practice must both exercise skills at the "edge of failure" as well as reinforce existing skills. Practicing skills at the edge of failure requires refinement and exploration of skill application, allows opportunities for formative feedback, and provides an engaging context without overwhelming the cognitive resources of the individual (Ali, Guckenberger, Rossi, & Williams, 2000; Hancock, 2009). Maintaining the edge of failure is achieved through the controlled progression of difficulty with performance support as difficulty increases (Hogan & Pressley, 1997). Of course, feedback is used to calibrate the difficulty of the learning task and to adjust the level of support (i.e., fading). In the case of the utilization intervention reported here, information from the shot data books and the expertise of the USASS instructors provided the basis for feedback and controlled progression.

Interestingly, the ABA research design not only provided additional experimental control for the data, but also allowed inferences about utilization challenges. The difference in far-target engagements and record-fire scores between baseline (i.e., Class 5 & 6) and intervention (i.e., Class 7 & 8) represented a training challenge. That is, there was a performance gap that was addressed with a training solution. In this case, an instructional intervention. The difference in far-target engagements and record-fire scores between intervention (i.e., Class 7 & 8) and return to baseline (i.e., Class 9 & 10) represented a Leadership challenge. According to the research design, instructors were *not required* to use the modified shot data books or to engage students during data confirmation. However, there were no controls to *prevent* instructors from using techniques or procedures during Class 9 & 10 that they previously learned from the utilization intervention. That is, it was expected that there would be some carryover effects of the intervention in the return to baseline phase, but the data clearly demonstrated that was not the case. The lack of carryover highlights the importance of Leaders, course mangers, and training-system operators emphasizing effective utilization techniques and preparing instructors and trainers to fully utilize the training systems.

Even though the current research addressed a simple training system, the findings may generalize to more complex training systems. There is a tendency to believe that training effectiveness improves as the training systems become more technologically sophisticated. There is also the belief that simply using a training system provides effective training. However, sophistication does not always yield effectiveness and training systems do not always replace training (e.g., Salas, Bowers, & Rhodenizer, 1998; Stewart, Johnson, and Howse, 2008). Instead, it is important to keep in mind that training systems are merely tools to enable effective and efficient training and that skill development is the result of the *process* of optimally applying training tools and training techniques.

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