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Does Mental and Visual Skills Training Improve High-Value Target Identification and Marksmanship Among Elite Soldiers?

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ABSTRACT

Background: The purpose of this preliminary investigation was to determine the impact of a mental and visual skills training (MVST) program on a high-value target identification and marksmanship (HVTM) task among Special Operations Forces (SOF) Soldiers. **Methods:** Deidentified archival data for 52 male SOF Operators (age: 31.06 ± 4.10 years) were assessed to determine if differences in performance existed between MVST program users (n = 15) and nonusers (n = 37) on a HVTM task performed immediately after a Special Forces Advanced Urban Combat (SFAUC) stress shoot. Independent-samples *t*-tests were utilized to determine if significant mean score differences existed between groups on specific shooting elements within the HVTM task. Effect size calculations were also performed to assess the magnitude of differences between groups in each measure of performance. **Results:** Statistically significant differences in performance were not discovered between MVST users and nonusers on overall score (Score) or any individual elements of the HVTM task. However, small to medium effect sizes (d = 0.305–0.493) were observed between groups in Score, Positive Identification Accuracy, Shot Accuracy, and Kill Shot Score. **Conclusion:** While inconclusive, these findings suggest the use of a MVST program administered by a trained cognitive performance specialist may have the potential to positively influence HVTM performance. More research using larger sample sizes is required to confirm this supposition.

KEYWORDS: *shooting; sport psychology; Special Operations Forces; cognition; military*

Introduction

Special Operations Forces (SOF) Operators are highly skilled military Soldiers who are required to perform their duties in high-risk environments, often under dire circumstances.[1] Consequently, Operators must be able to identify, engage, and eliminate critical threats through the use of firearms.[2] Failure to perform these tasks in an efficient and effective manner may jeopardize mission success, as well as put the Soldier, their team, and civilians in harm's way.[2] For these reasons, SOF Soldiers are provided specialized training exceeding that of most conventional military Soldiers.[1]

The ability to recognize and integrate complex patterns in a dynamic and ever-changing environment while allocating attentional resources to different key areas of the scene is essential for SOF Operators.[3] A crucial element to operational success is how an individual perceives and reacts to a wide variety of stimuli in these situations. As such, efficient information processing, sound decision-making, high visual capacity, and the ability to scan and process the scene in dynamic environments are critical to mission success.

Mental skills training (MST) focuses on the development and maintenance of several key skills and attributes, such as attention management, arousal control, and cognitive-perceptual abilities.[4,5] For these reasons, MST is frequently used by high-level athletes to enhance sport performance.[6,7] MST has also been used within tactical populations with the specific intent of enhancing operational performance.[8–11] Indeed, it seems reasonable to assume that the integration of MST into the SOF population may afford the Operator with a tactical advantage on the battlefield. However, more research on the impact of MST within the SOF population is of significance.

In addition to MST, visual skills training (VST) has also gained popularity within the SOF community in recent years.[12] VST operates under the logic that performing demanding visual, perceptual, and oculomotor tasks can improve an Operator's ability to process the information around them more efficiently.[13,14] Deliberate practice in the development of these skills may allow Operators to better discern between relevant and irrelevant environmental information (i.e., threats/non-threats), enhance visual search and scanning patterns (i.e., identify high-value targets), and improve speed of recognition while on the battlefield.[13,14]

The use of both MST and VT (i.e., MVST) may have significant value when incorporated into the training programs of SOF Soldiers. However, more research is needed to evaluate the effectiveness of such training programs within this community. Thus, the purpose of this study was to determine if differences exist between elite Soldiers that participate in an MVST program on HVTM task performance compared to those that did not use these services. For statistical purposes, the authors adopted the null hypothesis that no significant

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differences would exist between MVST users and nonusers on the HVTM task.

Methods

Experimental Approach

Deidentified archival data for 52 male SOF Operators of mean age 31.06 ± 4.10 years were provided to the investigators for secondary analysis. Performance variables for an HVT ID and marksmanship task were collected by the THOR3 Human Performance Program (HPP) staff after Soldiers performed the Special Forces Advanced Urban Combat (SFAUC) stress shoot (9 June 2017). These data were then provided to the primary investigators for analysis. Prior to the commencement of this analysis, a university institutional review board (IRB) approved this investigation (IRB #17–156). The Special Forces Group and the Army Human Research Protections Office also granted permission to conduct this research. Furthermore, this investigation followed procedures in accordance with the ethical standard of the Helsinki Declaration for human subjects.

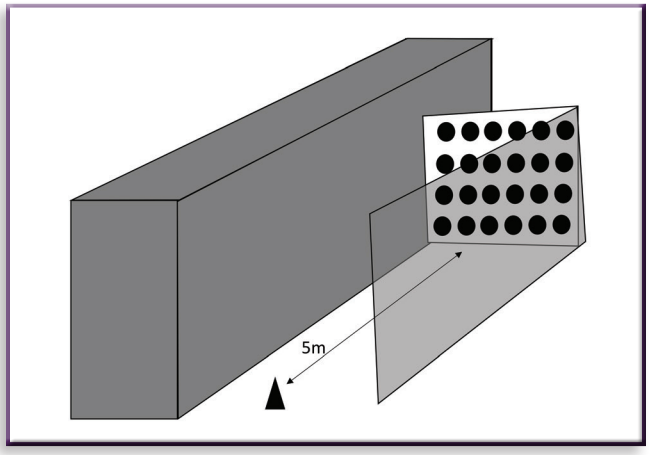
Procedures

The HVTM task was performed immediately after Operators performed an SFAUC stress shoot. The protocol utilized for the SFAUC stress shoot has been described in detail by Canada et al.[2] While Canada et al. also described the HVTM task utilized in this investigation, it has been described here for the reader's convenience.

HVT ID and Marksmanship Task (HVTM) Procedures and Scoring Criteria

Prior to the stress shoot, Soldiers were allowed up to 2 minutes to study the faces of two high-value targets. Each face was printed on a baseball card–sized piece of paper. At the conclusion of the SFAUC stress shoot, the Soldiers completed a positive identification (PID) recall and engagement task. This task required Soldiers to visually search and discriminate 24 faces, presented on a 4-in × 8-in sheet of plywood at a 5-meter distance (Figure 1). Only one of their target faces were available to engage, requiring exhibitory and inhibitory executive functioning for task success. Soldiers had 10 seconds to complete the task. Failure to engage the target within 10 seconds resulted in a failing score. Data were collected on positive identification (PID Accuracy), Shot Accuracy, and Kill Shot (i.e., shots within the head "A zone" by International Practical Shooting Confederation (IPSC) measurements), as well as time to complete this task.

FIGURE 1 *PID task layout.*



For the purpose of addressing the research question, an overall HVTM score (Score) was created using weighted scores (33.3% each) for each of the three main components (i.e., PID Accuracy, Shot Accuracy, and Kill Shot) of this drill. These scores were used to identify success as defined by accurately acquiring the target (i.e., recognition), shooting the correct target (i.e., accuracy), and shooting with precision to ensure mitigation of the threat (i.e., lethality).

Overview of Mental and Visual Skills Training (MVST) Services

A variety of MVST methods specific to marksmanship were utilized throughout the Soldiers' training. While we are unable to provide specific details due to security issues, typical forms of MST included target recognition and engagement contingent on visual and auditory information, concentration exercises, and PID simulation exercises (Figure 2). All MVST training sessions were designed by a Cognitive Performance Specialist and integrated into the Soldier's physical training sessions.

Common VT methods included Brock String training, transitional near/far and object identification exercises via saccades, and/or tracking. Soldiers engaged in such forms of training

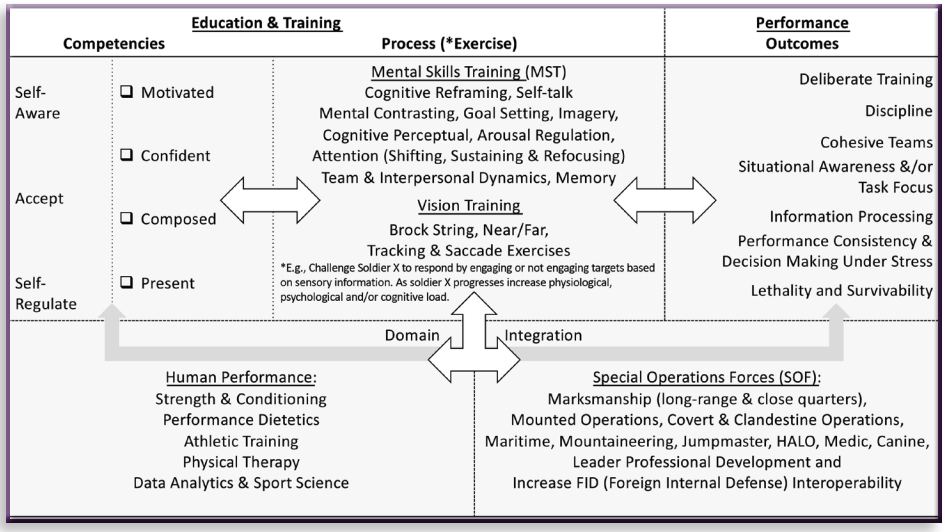


FIGURE 2 *Bartley MVST implementation model.*

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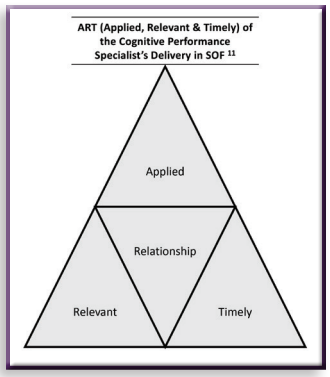

FIGURE 3 *Bartley MSVT implementation guidelines.*

daily for roughly 20–30 minutes within a 60–90-minute human performance training iteration, as MVST was integrated with their physical training program. This model was utilized in order to create an integrated approach and to optimize time. This approach has also been found to result in significant improvements on Army Physical Fitness Test (APFT) scores among conventional Soldiers.[15] Since Soldiers are encouraged to practice these skills independent of structured trainings, exact quantification of time devoted to MVST is difficult and for the purpose of this study was not measured. A practitioner model and guidelines for this form of training are displayed in Figure 3.

Statistical Analysis

The collected data were entered in a computer file suitable for statistical analysis using a free and open source graphical program for statistical analysis (JASP version 0.9.2, https://jasp-stats.org/). Prior to electronic transmission to the researchers, all data were rendered anonymous by the Tactical Human Optimization, Rapid Rehabilitation and Reconditioning 3 (THOR3) Human Performance Program (HPP) training. Each Soldier was given a unique identification number. Only members of the THOR3 HPP training staff had access to specific identifiers for the data analyzed. The THOR3 HPP training staff were responsible for ensuring compliance of all standard operating procedures to maintain the confidentiality of this information during data transmission were followed.

A descriptive statistical analysis was conducted to determine the mean scores and standard deviations for the total sample of Operators. The data were then subdivided by those that used MVST services provided by the THOR3 HPP (i.e., users [n = 15]) and those that did not use these services (i.e., nonusers [n = 37]). A series of independent samples t-tests were then conducted to determine if significant mean score differences existed between users and nonusers on age, Score, PID Accuracy, Shot Accuracy, Kill Shot Accuracy, and Shot Time. Significance for each test was set at the a priori $p \leq .05$ level. However, it has been suggested that this approach of reporting probability value alone can be highly influenced by sample size and may be inadequate for assessing the practical importance of research findings.[16] Instead it has been suggested that reporting the smallest worthwhile amount of change (i.e., d = 0.2) may be of more use for practitioners and clinicians when seeking to determine the value of an intervention. For these reasons a Cohen's d effect size calculation was also conducted to measure the magnitude of difference between groups on the HVTM task.[16] Subsequently, these results were then interpreted in line with the suggested scale by Hopkins et al., in which <0.2 = trivial; 0.2–0.6 = small; 0.6–1.2 = moderate; 1.2–2.0 = large; 2.0–4.0 = very large; and >4.0 = near perfect.[17]

Results

Descriptive statistics and mean score differences are displayed in Table 1. No significant differences ($p > .05$) were discovered between groups on any of the performance variables examined in the HVTM task. However, small to moderate effect sizes (d = 0.31–0.49) between users and nonusers were observed in Score, PID Accuracy, Shot Accuracy, and Kill Shot with performance favoring the user group in all categories. A trivial effect size (d = 0.193) was observed between groups in Shot Time with users performing this task 0.46 seconds faster on average compared to nonusers.

Discussion

The purpose of this study was to investigate the differences in an HVTM task performance between SOF Soldiers that participate in an MVST program compared to those that did not participate. The results of this study revealed no statistically significant differences in HVTM performance between groups. Therefore, the null hypothesis that significant difference in performance would not exist was accepted. However, small effect sizes were observed between groups in Score, PID Accuracy, Shot Accuracy, and Kill Shot Score with users outperforming nonusers in all categories. These findings may be particularly important in tactical populations in which small differences in performance may impact mission success, safety, and mortality.

TABLE 1 *Group Differences in HVT ID Performance*

	Group	Mean ± SD	p	Cohen's d
Age (y)	User	31.53 ± 4.2	.397	0.162
	Nonuser	30.87 ± 4.1		
Overall score (%)	User	66.7± 41.8	.152	0.447*
	Nonuser	47.8 ± 42.7		
PID accuracy (%)	User	80.0 ± 40	.222	.356*
	Nonuser	62.2 ± 50		
Shot accuracy (%)	User	66.7 ± 50	.323	.378*
	Nonuser	51.1 ± 50		
Kill shot score (%)	User	53.3 ± 50	.114	0.493*
	Nonuser	30.0 ± 50		
Shot time (s)	User	7.00 ± 2.4	.532	–0.193
	Nonuser	7.46 ± 2.4		

*Small-moderate effect size.

While statistically significant differences in the HVTM performance task were not discovered between groups, this does not necessarily mean that MVST is ineffective. Elite Soldiers may represent a relatively homogeneous group in terms of the skills assessed in the HVTM task. Due to the criticality of executing these tasks efficiently and effectively, even the smallest differences in performance may be worthwhile. According to Hopkins et al., an effect size of 0.20 would represent a small but potentially worthwhile difference in performance.[17] The findings of this study suggest users of MVST may have had a small advantage in such tasks compared to nonusers. Nonetheless, based on the dire consequences associated with the SOF Operator's military occupational specialty, even small advantages in performance may be of value and warrant further investigation into the use of MVST to improve occupational performance in this population.

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This is the first investigation to explore the use of MVST on an HVTM task among SOF Operators. Still, this study is not without limitations. Based on the constraints of the environment, there was no way to control for Operator actions prior to participation in the stress shoot and HVTM task. Furthermore, these Soldiers are encouraged to practice skills on their own, which make it challenging to quantify participation time in MVST. The use of self-report group identification as a "user" or "nonuser" is also not ideal. Physical activity and nutritional factors in the days leading up to and the day of the shoot were not controlled and may also have impacted performance. Future research should aim to reduce these confounding factors by implementing stricter controls. Finally, based on the archived nature of this data we were limited to the sample size provided. While the use of effect size calculations is less dependent on sample size, it certainly may affect statistical power. Thus, it is recommended that future studies utilize larger sample sizes, with a more even distribution between groups, to further explore differences in performance among users and nonusers of MVST statistical significance.

Conclusion

The present study has potential implications for both elite and conventional Soldiers, as well as other tactical occupations (i.e., law enforcement personnel). Though not statistically significant, the differences between users and nonusers of MVST were small but potentially worthwhile. Since gaining any small advantage in this population may mean the difference in success and the preservation of life, the use of MVST in these populations warrants further investigation.

Author Contributions

JD conceived the study concept, analyzed the data, and wrote the first draft. WT analyzed the data and wrote the first draft. NB conceived the study concept, recruited participants, coordinated and collected the data, and wrote the first draft. DB conceived the study concept, recruited participants, coordinated and collected the data, and wrote the first draft. KWB conceived the study concept, recruited participants, coordinated and collected the data. LB, CC, and PG conceived the study concept, and recruited participants. KP coordinated and collected the data and wrote the first draft. TF conceived the study concept and recruited participants. DB wrote the first draft. DC conceived the study concept, coordinated, and collected the data. All authors read and approved the final manuscript.

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