Effectiveness Of Auditory Stressors In Military Training Environment

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Military training environments play a crucial role in preparing soldiers for protecting the homeland. These environments are designed to train and equip individuals with the proper skills and understanding to complete missions, execute orders, and safely return home. This study was designed to better understand the effectiveness of auditory stressors in a training environment in Air Force Reserve Officer Training Corps marching education. The study utilized Virtual Reality (VR) technology to study the utilization of virtual environments to train and educate college students on marching procedures. The research conducted will directly benefit the format of training resources utilized at Detachment 090 at Colorado State University. This research has the potential to help detachments across the United States better utilize resources and train more effectively with schools that are spread out over the state they reside in.

The methodology for this experiment included participants that were cadets and civilians undergoing a VR experiment that included a teaching and testing phase. They indicated their confidence in performing marching movements both before and after the experiment to test whether their knowledge increased. The data analysis revealed that participants not exposed to auditory stressors outperformed from a correct move standpoint and in their confidence after the experiment. The experiment showed great promise in utilizing virtual environments for educational purposes and little support for using auditory stressors for improved performance.

Overall, the analysis indicated that current practices of utilizing auditory stressors for increased performance in marching environments may be unnecessary. These findings support the idea that virtual or remote environments would be useful for those cadets that are separated by great distances from their host university. There also was an indication of broader use of VR technologies being applicable to training at the cadet and military levels. These insights provide a framework for reworking and optimizing training across the nation to better prepare cadets to enter active duty.

CCS Concepts: • **Computer systems organization** → **Embedded systems**; *Effectiveness*; Online Training; • **Military** → Leadership.

Additional Key Words and Phrases: Auditory Stress, Military Training, Effectiveness, Training

ACM Reference Format:
Laura S. Cook and Joshua J. Staut. 2018. Effectiveness Of Auditory Stressors In Military Training Environment. 1, 1 (May 2018), 10 pages. https://doi.org/XXXXXXX.XXXXXXX

1 INTRODUCTION

Military training environments have historically served to standardize, equip, and prepare fighting forces in the United States of America. In practice, it is important to provide well-equipped individuals in all branches of service, including the United States Air Force. At Colorado State University individuals training to earn a commission as an officer in the United States Air Force attend Detachment 090. Cadets are trained in various settings, but the most emphasized is in a high-stress environment with auditory stressors. In these environments cadets are tested on their ability to perform under pressure in knowledge recall, marching practices, and personal bearing. At Detachment 90 there are multiple

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Manuscript submitted to ACM

universities that are represented. One of these universities is over an hour drive from Colorado State University. Having an in-person training environment is not always possible for the individuals that attend the University of Northern Colorado. This study was designed to decide if auditory stressors are crucial to proper military training or if there is a potential for change in the design of curriculum at the Detachment.

The study aimed to test the effectiveness of auditory stressors in an online military learning environment. This will be beneficial for remote training practices in our Detachment and could be applicable to other Detachments across the nation that serve multiple schools in spread out communities. Conducting this research gave us a better perspective of the effectiveness of our current training practices and provided insights into areas of improvement. This research helped deduce whether online training is a proper substitute for in person training at the Air Force Reserve Officer Training Corps level and the role of auditory stressors in both virtual and in person environments.

2 RELATED WORKS

In other works, stressors have been shown in a virtual environment to simulate visual stressors and environments. For the purposes of our research, we are more interested in how loud noise and pressure effects the individual and their performance since this is directly applicable to the training practices used in person at Detachment 90. The results of this study could help create a virtual training environment in the future or allow for a new perspective on in person training environments in general.

2.1 Stress in Education

In other works, stressors have been researched in an educational setting. We began our research by trying to understand the effects of stress on performance and in relation to retention and task completion. In the article "Critical brain circuits at the intersection between stress and learning", the authors researched the psychological effects of stress on learning and retention. The study found that in many instances "stressful experience alters our ability to acquire or remember new information…" [2]. These findings support the idea that stress and intensity may not be beneficial for academic environments overall. The article "Learning under stress: how does it work?" also looked at the effects of stress on learning, but through the lens of hormones specifically. The study found that specifically if a stressor is presented during learning and recall in the same way that there is a positive correlation between stress and memory [9]. However, these conditions must be replicated in the same space and time to produce a positive response [9]. Since our training environment is not consistent in these conditions, the introduction of stressors may not be beneficial to our mission. Another source suggested that stress can be useful in some situations but can depend heavily on the novelty of the decision being made [15]. In relation to auditory stressors directly, a final article took a deep dive into the auditory cortex and how it is not just a sensor but can be linked to memory [18].

2.2 Reseacrh Forming

As we continued forming our research, we found that VR was the most effective educational platform for 3D learning [7]. In looking at other research we identified some areas of interest such as engagement, VR learning, and scalability [1]. We considered possible risk factors for our project and found constraints such as cybersickness and willingness to complete the project [12]. To combat these issues, we discovered the ability of individuals to be open and willing to change via the ABOS scale [6]. This gave us a unique look at different scales that could be used to gauge how willing future participants in this program might be to learn in this environment [6]. By developing this virtual environment, we needed to understand the importance of starting with VR as a medium. We found that it was beneficial to start

a student's education of marching practices in a VR environment instead of teaching something one way and then changing later [3]. The article promoted the idea of virtual environment as a teaching tool used in educational settings [3]. Another source studied cognitive behavior and reaction time of 57 personnel undergoing an 18-week training to see how stressors commonly found in military environment affected factors such as visual object tests [16]. In these tests the personnel were given quizzes after being put under stressors [16]. This is an example we followed to conduct our research.

2.3 Stress in military scenario

We decided to take a deeper dive into other research on stress as it relates to military scenarios which directly related to our research. Studies related to stress in military training environments vary from basic everyday stressors that impact forces to deploy specific stressors that are more intense than what is being researched for our purpose [4]. In some cases, virtual environments were implemented to simulate stressful environments such as deployment [4]. These scenarios were meant to produce a learning environment in which individuals can train responses and stay calm under extreme pressures [4]. Our research aimed to do this in the context of marching education but not live fire or anything of extreme nature. The report "Stress Training and the New Military Environment" looked at stress in military training environments and how they have evolved. The research conducted found that many individuals found high intensity training they endured to be necessary to handle the stress they were put under in combat situations [8]. However, many cadets that commission through the ROTC programs will not need such intense training for their day-to-day jobs. In fact, most special careers that demand this type of stress-based training will provide specific training before any kind of deployment or job-related incident.

2.4 Stress Training in a Military Environment

Studies related to stress in military training environments vary from basic everyday stressors that impact forces to deploy specific stressors that are more intense than what is being researched for our purposes. In a paper titled "Selection of Key Stressors to Develop Virtual for Practicing Stress Management Skills with Military Personnel Prior to Deployment" virtual environments were implemented to simulate stressful environments. This source introduces virtual environments to familiarize service members with stressors in a deployed environment. These can include deceased individuals, someone being injured in front of them, and returned fire. These scenarios are meant to produce a learning environment in which individuals can train responses and stay calm under extreme pressures. Additional elements in this study include trying to decrease stress and provide a safe place to desensitize military members to graphic incidents to decrease PTSD response on return. This study was used for both deployments in combat and peacekeeping missions as both environments can put military personnel in situations that could lead to traumatic experiences.

Some sources found that stress in military training had positive effects on results later in service. A source found that utilization of stress management techniques on screen in VR environments decreased stress levels and increased performance [5]. In a study on marching and marksmanship accuracy a 10-20% increase in marksmanship was indicated when completing rucks and marching exercises consistently [17]. Overall, it was seen that stress in training could be useful if implemented correctly. This led us to further question the ability for auditory stressors to positively impact marching performance in training versus live practice.

2.5 Military VR application

The application of VR technology in a military setting is diverse and paints a picture of immense innovation moving forwards. One source gave an overview of applications to include military training in otherwise dangerous conditions and how military members felt more prepared to handle live fire or non-routine conditions as a result [19]. Another article detailed simulator capabilities dating back to the 1950s and specifically discussed how night flying training was previously incredibly risky, and this mitigated a lot of the possible complications [10]. In further research an overview of applications of VR to help with PTSD and cognitive repair following combat was proven successful [14]. From basic field training to weapons manufacturing education, there is a breadth of possibilities for VR environments to change the landscape of military education and reform [11].

For the purposes of our research, we were more interested in how auditory stressors effect an individual and their performance as it directly applicable to the training practices used in person at Detachment 090. However, other sources looked at the application of tailoring virtual environments to specific job training for military purposes [20]. This provided a broader understanding of tools that could be used for ensuring military training is used for something such as tactical field training. Although not directly tied to military research, another article discussed land geography accuracy in a VR environment, and this could be useful for land navigation which we do at Detachment 090 [13]. These articles helped us understand that our environment could be manipulated and altered to serve greater purposes in the future.

3 METHODOLOGY

3.1 Surveys

Each participant began by answering a series of questions to include: How stressed do you feel on a scale of 1-10? How confident are you in your ability to perform a Right Facing movement on a scale of 1-10? How confident are you in your ability to perform a Left Facing movement on a scale of 1-10? How confident are you in your ability to perform a About Facing movement on a scale of 1-10? How confident are you in your ability to follow the command Present Arms on a scale of 1-10? How confident are you in your ability to follow the command Order Arms on a scale of 1-10?

3.2 Outline

Each participant then was led through an instructional period where they were taught how to do each movement utilizing the Virtual Reality system. During this time a video was shown to the participant for each movement in the sequence. Each video went over the movement being performed three times. After being shown the movements, the participants were encouraged to practice the movements with the video. At the end of the instructional period, they entered a testing period. The participants were placed in two groups randomly, one with auditory stressors and background noise and one with only the commands being presented. The testing period went through each movement two or three times and recorded how many movements were completed correctly and how many times. The results of whether the movement was done correctly was done by the testers. Each participant got a 1 or 0 if it was correct and this was recorded and graphed. The criteria used for testing were timeliness of move, whether the move was in cadence, and accuracy of move, if the move was preformed correctly.

3.3 Application

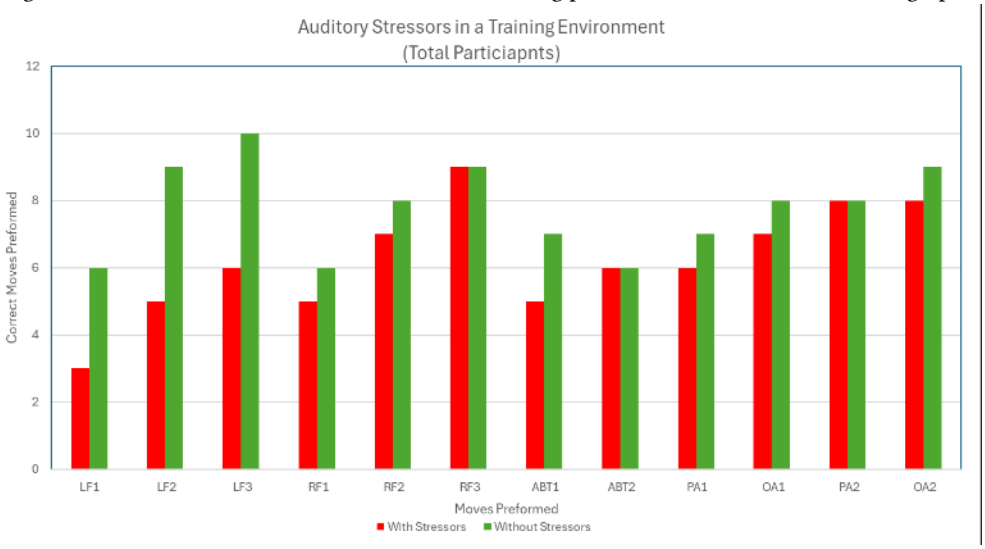
This coding was all done through Unity, a VR game development software. This was done to track movements to get an accurate and real-time reading of movements as the test was conducted. Through Unity we were able to get animated hands for the present/order arms movements and flawlessly play instructions through a made video. The Unity project was built and ran off a PC and through a quest Airlink was set up through an Oculus Rift 2. There were two major set up pieces for each participant. First, the PC was connected to a large monitor to watch the participants in real time as they completed the experiment. This was done so manual data tracking could be achieved. Second, the participants connected to the VR and made sure everything was set up before beginning the experiment.

3.4 Final Survey

Following the instructional and testing period the participants answered the same questions as before. Their answers were recorded and compared to their initial responses. This was to gain some knowledge on how effective the participant felt in their ability before the training and after. This was to get a subjective view into the study of the auditory stressor's effectiveness

4 RESULTS

As we did the experiment, we were testing mainly to find if the auditory stressor we used was effective in our VR training simulation. As we collected our data some interesting patterns came out of it. Below is a graph of data:

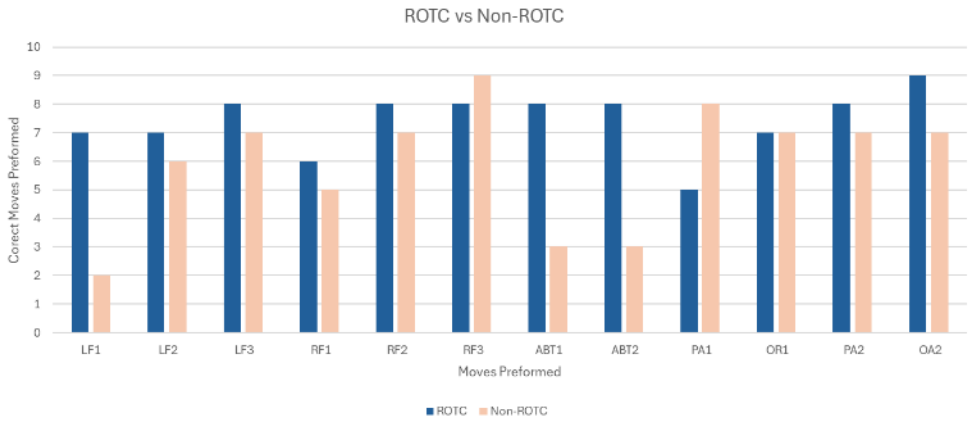


For almost every movement performed, the participants without the stressor in their test performed better than the participants with the stressor. We see that on average, all participants got better at the movement the more they performed it. This is a very common trend to see among experiments designed like ours. We had them performing three of the same movements, in some cases, and each of these three has an upward trend in the accurate completion rate. Again, however, those without the stressor had a significantly higher trend in almost every category. While some movements were relatively close, some (like left face) had almost a 50% increase in accurate moves performed. This was

an interesting piece of the data that was found, since as ROTC cadets we have been trained in a stressful environment for most of our careers.

On average, those without the stressor had 7.75 people perform that move correctly with a total accuracy average of 9.3 moves per person. This group had a standard deviation of 1.35 across the board. This showed that each participant had relatively equal experience and performed well on the testing portion of the experiment. The non-stressor group had a total of accurate moves performed of 93 moves. On the opposite side, those with the stressor had a lower average per move with only 6.3 people performing each move correctly, and a total accuracy average of 7.5 moves performed correctly per person. The stressor group had a standard deviation of 1.65 showing a more varied testing experience than those in the non-stressor group. This group had 75 total accurate moves performed. With an almost 30% increase in accurate moves, this data heavily suggests that those in the non-stressor group were much more confident in those moves and had an overall better understanding of the objectives asked of them.

One major bias we had in our data was also would we used as participants. Many of our testers were already in ROTC and have expereince with the moves we were looking to teach. This was one bias we were aware of going into the experiment and made sure to track to account for it. Below is a table graphing the difference between our non-ROTC testers and ROTC cadets.



This was data we felt necessary to track as it played a major role in the outcome of our data. We even split the ROTC cadets into the stressor and non-stressor groups to try and mitigate the bias in our overall data. This data is about what we expected with the ROTC cadets having a significant accuracy average over the participants who had never seen these moves before. The performance for the ROTC cadets remained relatively level, with slight increases after reputation of moves. The non-ROTC group shows a rise in accuracy through this reptation that was seen in the first graph. The ROTC group had 89 total moves performed correctly compared to the other group with 73.

Some of the reasons for this data may have been not only because the cadets had seen these moves before, but also because cadets are used to high pressure and stressful environments. As stated before, we are currently trained in these high-stress environments so every participant who is used to this had a clear advantage in the experiment. Though, by tracking this data, we learned something else about auditory stressors. The stressors did not have a significant role to play in training the ROTC cadets. It had a clear role in the civilians in the performance and overall accuracy, but not in the cadets themselves. This was fascinating to find, and it points to the conclusion that there is not a significant

difference in training on the military front. Couple this with the data found in the overall research, and it led us to believe that it may be more beneficial to train military personnel without the use of auditory stressors.

5 DISCUSSION(LIMITATIONS)

As the project unfolded, we ran into multiple limitations and standstills. We had originally planned to code the project in unity and create an automated game to record the movements of the participant. We found that this was incredibly challenging and due to our limited resources, we were unable to complete this on our personal computers. May weeks were spent trying to get the automated movement tracking working. However, this was the first time either of us had ever coded in C# and used a software like Unity. The experiment itself came out clean and ready to use, however, the main problem was the movement tracking and more importantly the exportation of this data. Any data collected from the game was unreadable or incredibly hard to use. This led to us having to manually collect the data based off personal understanding of the drill movements. It would have been much nicer and an overall cleaner project if we could have gotten this tracking system working. This would have allowed us to not only track the accuracy of each movement, but also the exact timing of the movements to track the cadence in which they were performed.

In the project both XR requirements and animations were completed so the user could interact with the experiment as they performed it. This allowed for a much more realistic feeling when the testers were inside. They could still interact with the system and this piece of the experiment came out great. This allowed for accurate (though limited) data collection. This part of the project went very well and turned out to allow the user to interact with the system.

6 CONCLUSION AND FUTURE WORK

The problem we initially set out to answer ended up being very complex in nature as our research unfolded and we became more educated on teaching practices and stressors in general. A seemingly easy decision to choose a VR platform for our project was discovered to be both more beneficial to education and more difficult in application than we imagined. As we formulated our process and techniques, we discovered how beneficial the technology could be to additional applications for teaching within our Detachment. Through experimentation, we saw our results come to life and taught individuals with no prior marching experience the techniques we had spent ten years collectively learning and perfecting.

We hope to present these findings to our leaders and decision makers in hopes that positive change could result in our education at Detachment 090. We believe that given our findings it is unnecessary to rely on auditory stressors in a training environment and a remote or virtual environment would be beneficial to supplement instruction time face to face. This would need to be further researched for applications such as warrior knowledge, land navigation, tactical exercises, and more. However, given our positive results and related works research, we believe that VR would be an excellent educational tool for multiple applications at Detachment 090 and beyond.

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Received 29 March 2024; revised 29 March 2024; accepted 6 May 2024