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LEND ME YOUR EAAR: ENHANCING THE AFTER ACTION REVIEW TO INCREASE TACTICAL LEARNING

Adams, Dominic F.; Bulson, Jason M.; Feterl, Zachary S.; Salisbury, William C., II; Warren, William T.

Monterey, CA; Naval Postgraduate School

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SYSTEMS ENGINEERING CAPSTONE REPORT

LEND ME YOUR EAAR: ENHANCING THE AFTER ACTION REVIEW TO INCREASE TACTICAL LEARNING

by

Dominic F. Adams, Jason M. Bulson, Zachary S. Feterl,
William C. Salisbury II, and William T. Warren

December 2021

Advisor: Robert Semmens

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13. ABSTRACT (maximum 200 words)

Leaders need more opportunities to train with their units to hone their skills. Leaders use After Action Reviews to improve themselves and their units. The After Action Review has existed since the 1970s and has not substantially changed in that time. New technological advancements in the last several years offer the opportunity to enhance the efficacy of the After Action Review for future leaders and units. One of these new technologies is virtual reality. Virtual reality presents trainers the ability to control all aspects of the training environment. It also enables thorough data collection and the ability to rapidly run through a scenario again.

This project sought to identify the information gaps in live training and determine whether virtual reality enables tactical learning at the individual level. Using surveys and experimentation, the team concluded that virtual reality scenarios in concert with After Action Reviews can be used for tactical learning at the individual level. Through the course of the experiment, the team also discovered that servicemembers take advantage of opportunities to improve themselves regardless of their performance.

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MAJ Dominic F. Adams (USA), MAJ Jason M. Bulson (USA),
CPT Zachary S. Feterl (USA), MAJ William C. Salisbury II (USA), and
MAJ William T. Warren (USA)

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Lead Editor: Jason M. Bulson

Reviewed by:
Robert Semmens
Advisor

Accepted by:
Oleg A. Yakimenko
Chair, Department of Systems Engineering

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ABSTRACT

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LIST OF ACRONYMS AND ABBREVIATIONS

AAR	After Action Review
CALL	Center for Army Lessons Learned
CGSC	U.S. Army Command and General Staff College
GTK	Group Tacit Knowledge
IDF	Israeli Defense Forces
KO	Knowledge Officer
MDMP	Military Decision-Making Process
NTC	National Training Center
OC/T	Observer Coach Trainer
PEO-STRI	Program Executive Office-Simulations, Training, and Instrumentation
T&EO	Task and Evaluation Outline
TAFF	Training and Analysis Feedback Facility
TRADOC	Training and Doctrine Command
VR	Virtual Reality

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EXECUTIVE SUMMARY

The After Action Review (AAR) has been a foundational part of learning in the U.S. Army for decades. However, over this time, the effectiveness of these AARs has seemed to stagnate in turning the lessons learned to observed improvements in mission execution.

The research group sought out opportunities to enhance the AAR. After a review of the applicable literature, the group decided to get direct feedback from current Observer Coach Trainers at the National Training Center, one of the preeminent learning environments for the Army in the country, and to test the ability of virtual reality as an emerging technology to translate lessons learned into verifiable results.

Results from the experiment showed that some participants used the opportunity for low-cost learning to attempt different methods to improve their performance. This research suggests that leaders and units can not only improve their performance using virtual reality to achieve proficiency but also that the rapid iterations and easy access to performance metrics allows them to explore other methods, thereby improving their tactical judgment.

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We would like to acknowledge the efforts of Jonathon Lussier in getting the virtual reality system to work and allow us to conduct our experiments. We would also like to acknowledge the support of our families as we worked to complete our data collection.

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I. INTRODUCTION

The After Action Review (AAR) is the cornerstone of how the Army learns and improves over time. The AAR has withstood the test of time, as shown by its continued use and relatively unchanged approach to how it is conducted over the decades since it was formally implemented. However, the lessons learned through the AAR process do not always translate into action across the Army in the rapid way needed to counter our adversaries.

Our capstone group evaluated using virtual reality to potentially increase the speed from lessons learned to updated training and the application of those lessons learned. Virtual reality is a maturing technology that requires few resources, such as space and equipment, and can be quickly updated through software updates in scenarios.

A. PROBLEM STATEMENT

Trends from Combat Training Center (CTC) rotations indicate the lack of implementation of lessons learned using the current method of AAR. This causes units, leaders, and Soldiers to repeat mistakes from previous rotations that may have otherwise been avoided.

B. RESEARCH QUESTIONS

The central question that we are trying to answer is: Can virtual reality scenarios and additional performance data improve a leader's tactical judgment?

There are supporting questions that we are trying to answer that are:

- What information, and in what form, influences a leader's performance in training?
- How do people learn and implement tactics in a novel simplified contested environment?

C. STAKEHOLDERS

The CTC directorate is the sponsor and primary stakeholder as they have a vested interest in improving the AAR process and an interest in the available tools to better train and equip warfighters. Other stakeholders include the Naval Postgraduate School (NPS), United States Military Academy (USMA), the Program Executive Office Simulations, Training, and Instrumentation (PEO-STRI), and the Training and Doctrine Command (TRADOC).

D. PROJECT OVERVIEW

The focus of this project is to evaluate a new method of training that may help share lessons learned before encountering similar scenarios to increase tactical learning. We aim to do this by utilizing virtual reality tools to enhance the Army's AAR process. The scope of this project is to utilize a virtual environment with a first-person perspective to collect data on the level of tactical learning that can be achieved through augmentation. The purpose is to assess the viability of using virtual reality tools in concert with the Army's AAR process to build on live training.

II. LITERATURE REVIEW

The learning science literature on feedback indicates that it leads to better learning. However, most of those studies have been conducted on well-structured problems where it is easy for the researcher to assess good performance. Military operations do not lend themselves to this form of assessment, yet VR can provide more quantifiable data than traditional live training. What we don't know, however, is the utility and benefit of this data. The only way that Combat Training Centers can create a requirement to provide data to trainees is to demonstrate that learning is improved with data, and this study is a proof of concept in support of that aim.

A. FOG OF WAR

The "fog of war" pervades the battlefield. The need for AARs stems from warfare. In preparation for and during war, individuals and units must learn from what has occurred to perform better in the future. However, there is always an amount of uncertainty in training and war. The fog of war is a phrase that refers to this uncertainty.

To start, our team divided this topic into three areas. First, we identified how current research discussed the fog of war concept. Second, we discussed the various methods used to address uncertainty within warfare. Third, we touched on our research findings and how our project fits within the existing body of knowledge.

Applicable to the concepts of linear planning processes and the non-linear is further research by MAJ Matthew Smith (2014) while attending the U.S. Army Command and General Staff College (CGSC). His research touched on the importance of avoiding a principle he referenced as categorization. He indicated leaders must be cognizant of not using past experiences as the common catalyst to solve a problem. While useful, it is unwise to assume such an approach will be successful, especially when confronting wicked problems. As referenced by Smith (2014), "Bryan Lawson, author of *How Designers Think*, identifies categorization as a cognitive trap. Lawson attributes this trapping to inexperience designers who 'transfer solutions previously seen….and may not even notice the difference or be aware of the parts of the problem which have not been addressed'"

(Smith 2014, 42). Smith's research focused on the concept of framing a problem set with open discourse and expectations for assumptions made to be proven incorrect.

Our second area focuses on methods used to address uncertainty within warfare, otherwise known as the "fog." While the U.S. Army uses the Military Decision Making Process (MDMP) to plan and reduce uncertainty, there are many other examples of how data is used to enable learning and subsequently diminish uncertainty. For example, Steven Mains describes how the Israeli Defense Forces (IDF) came into its own during the early 2002 conflict in Lebanon. Their evolution of the IDF's use of knowledge management and a replication of the U.S. Army's Center for Army Lessons Learned (CALL) concept to capture lessons learned across multiple regions in Israel. He described their effort, initially small in the IDF, through the cross-loading of officers between organizations to disseminate tactical and operational knowledge gained through firsthand experience. He continued to describe how the IDF created a knowledge officer, or KO, branch whose sole job was to facilitate learning exchanges between units entering the theater as well as the general cataloging of operational data that would eventually feed an IDF wide body of knowledge based on the U.S. Army's CALL concept. While these repositories were not new to the U.S. Army, they were used far more extensively by the IDF and at multiple echelons. Mains (2011) describes efforts such as "adjoining battalions met in structured learning synchronization sessions, personally led by their brigade commanders, whenever fighting lasted just a few days" (170). While this was extremely time intensive and resource heavy, the IDF's heavy implementation of this at both the battalion and company level of instruction garnered valued information from those who had firsthand experience that could readily be shared.

The third area covers what assumptions current research provides. The primary assumption identified across all research supported a general belief that the more data gathered, the less uncertainty existed within a given environment. Our team concluded that this is only accurate to a degree, as it indicates there is an eventual path to eliminate uncertainty. The second common assumption found indicated that when confronting wicked problem sets, a best-effort approach was feasible. Simply put, there will be unknowns, and leaders must be proactive to identify those challenges before they manifest.

So, how do you enable what Harper (2017) described as the "best managers," who can predict what will be the future issue before it manifests?

B. LEARNING IN THE AAR

To know what type of learning is happening in an After Action Review (AAR), we must start with the definition.

> The AAR is a professional discussion that requires the active participation of those being trained. AARs enable units or Soldiers to discover for themselves what happened and then develop a plan for improving performance. These reviews provide candid insights into strengths and weaknesses from various perspectives and feedback, and focus directly on the commander's guidance, training objectives, and standards. Leaders know and enforce standards for collective and individual tasks. Task standards are performance measures found in the respective [Training and Evaluation Outlines (T&EOs)]. (Department of the Army [DA], 2016)

The type of learning that occurs in an AAR is guided discovery learning. "Leaders avoid creating the environment of a critique during AARs. A critique only gives one viewpoint and frequently provides little opportunity for discussion of events by participants. The climate of the critique, focusing only on what is wrong, prevents candid and open discussions of training events and stifles learning and team building. Since Soldiers and leaders participating in an AAR actively self-discover what happened and why, they learn and remember more than they would from a critique alone." (DA, 2016)

C. ORGANIZATIONAL LEARNING

Beyond individual learning and group knowledge, is where organizational learning comes into play. It is more complicated than just combining the lessons from each. The literature related to organizational learning does not reach a consensus, as there is no universally accepted understanding or even agreement on what organizational learning is or means.

Some, such as Kim (1993) in "The Link Between Individual and Organizational Learning," contend that organizational learning happens because of individual learning. Others, like Levitt and March (1988) in "Organizational Learning" focus on the aspects of how an organization, as a whole, learns from history and how that translates into routines.

Furthermore, there is no consensus among the academic community of where group learning belongs. Is it part of the chain of the individual to organizational learning or is it a separate concept on its own? Organizational learning ideals are both vast and vary greatly and this section seeks to understand the current principles of organizational learning.

D. GROUP TACIT KNOWLEDGE

To understand what "Group Tacit Knowledge" (GTK) is, we must first ensure we clarify what makes up a group and then understand the different types of knowledge. According to Weick and Roberts (1993) "A group refers to a collection of people in a close relationship taking part in an interrelated activity with the aim of performing a task or achieving a common target." Using the Weick and Roberts definition, we can make the correlation that a "group" is closely related to what the military defines as a team. According to ATP 6-22.6, a team is any group that functions together to accomplish a mission or perform a collective task. Additionally, a team or group can range in size from two or more people (DA 2015, 7). For this report, we will utilize "group" as the standard context.

E. TRANSLATING AAR INTO ACTION

To begin we searched for different studies that gave perspectives on how best to conduct the AAR process to lead to better performances. One 4-year study resulted in the group settling on three main lessons about how best to use the AAR process to their benefit: 1) Ensure that all team members participate, because everyone's experience and viewpoints are valid, 2) Keep a time limit or schedule to discuss specific items of interest, and 3) Set ground rules and discuss the rules at the beginning of the AAR to allow all members the ability to confidently discuss the event openly (Bray et al. 2013).

F. SUMMARY

The Army operates in a fog of war that affects Soldiers' and Leaders' ability to most effectively train and fight wars. To combat this fog of war, the Army conducts AARs to learn from what went well and what went poorly. The effectiveness of the AARs is dependent on how individuals learn, how groups maintain knowledge, how organizations learn, and how effectively organizations take what they have learned and apply it to future events.

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III. METHOD

The method for answering our research questions is composed of two main parts: 1) observations at the National Training Center, and 2) conducting an experiment with virtual reality tools.

Our team adopted a tailored systems engineering approach to our capstone. Due to the exploratory nature of the research question, our tailored approach consisted of a layered approach to data research, conceptual framework, experiment design, data collection, data analysis and findings, and finally recommended future research. The software programming provided to our team by our USMA stakeholders was limited in nature, thus requiring us to limit what data we believed could be accurately captured to generate the most value to our identified research questions.

A. OBSERVATIONS AT THE NATIONAL TRAINING CENTER (NTC)

The Principal Investigator and two Researchers traveled to the National Training Center at Fort Irwin in California to observe how the Observer Coach Trainers (OC/Ts) conduct AARs. The National Training Center is one of the premier training institutions in the United States Army and is a leader in the conduct of AARs. OC/Ts are the people that guide and support the conduct of the AARs at the NTC.

Additionally, PEO-STRI (external stakeholder) primarily conducts its next-generation concepts of training devices at NTC. The future environment, often called the "Synthetic Training Environment" or STE, has and continues to evaluate the use of altered reality systems to enhance the quality of training currently being performed, thus it was of vital importance to our team to observe the user community and how they interpret the needed evolution within current training environments

1. OC/T PROCESSES

The three members of the research team shadowed three separate OC/T teams at NTC to observe rotational unit training and observe the conduct of AARs. The research team members were able to discuss current trends and issues with the AAR processes with members of the OC/T teams. NTC retains multiple teams that are employed during each rotation, specific to their assigned battlefield functions. The research team members discussed the types of information that is collected and how that information was presented to support the AAR process. Additionally, OC/Ts were asked about our research inputs, hypothesis, and any common trends that they have witnessed as common traits between a wide range of units. The research team members were able to observe what information could be requested by OC/Ts to benefit and enhance the AAR process and improve learning. This information included multiple systems that captured a very broad data set, to include, GPS tracking, simulated engagements, kills, wounded, and sustainment materiel tracking.

2. AAR OBSERVATIONS

The three team members jointly observed three separate battalion level AARs and various AARs at the company level. The level of detail and resources that the OC/Ts are able to display and discuss is dictated by the level at which the AAR is conducted. Company and below level AARs are typically "green book" with the OC/Ts providing recent feedback to units on how to maintain successes and improve in necessary areas. Battalion level AAR's are better able to leverage the various data collected and display it during the AAR on screens at more permanent AAR sites. A challenge of this process is the short time frame and great distances that must be covered to organize the data and take it to the AAR sites. This was a consistent observation by all research team members. The type of data that is important is not consistent across all AARs as different branches and different levels leverage different data to provide learning. The research team observed that because only battalion level leaders were at the formal battalion AARs, many leaders at the company and below levels were not receiving those lesson learned, which could impact the overall unit performance. Another common factor noticed by all three researchers was the consistent reliance upon written AAR comments across all unit levels. Due to the time constraints between the end of the exercise and the conduct of the AAR, many products are left to basic texts or bullets, despite volumes of data and recorded engagement data being available to the Training and Analysis Feedback Facility (TAFF) and OC/T teams.

B. EXPERIMENT IN VIRTUAL REALITY

The main effort for our research is conducting an experiment to see how participants perform in a capture the flag game utilizing virtual reality. This game allows control over "bot" teammates and easy tracking of metrics. This experiment was tactically focused using simple metrics to best measure each participant's performance and control group impacts. Our team saw the true value of the simple environment as it provided an easy means to capture accurate gameplay metrics that could be monitored for change—which in this case meant learning. Adding to these qualities, our team chose virtual reality due to its ease of use, simplicity, and commonality to concurrent Army efforts to redesign training devices and software.

1. PARTICIPANTS

The participants for this experiment were recruited from the Naval Postgraduate School student population. There were ultimately eight participants in total who were screened prior to experiment execution for motion sickness and familiarity with virtual reality systems. All eight participants were United States military officers.

2. EQUIPMENT AND TOOLS

The equipment and tools included an approved lab space, a computer with the required software to support the capture the flag game and virtual reality outputs, Valve Index virtual reality hardware, and a separate computer to run the participants through the experiment and allow them to fill out the surveys and note taking materials to record the number of scores and tags. All performance information was captured manually using audio cues generated by the program, as well log files that were captured containing the recorded performance for each participant's run for future research.

3. PROCEDURE

Participants were asked to perform the following actions during their scheduled time in the ENDER Lab, located in Bullard Hall, 201L. Subjects performed the experiment one at a time and were accompanied by at least two Researchers to run the computer and record information. Before the arrival of any subjects, all VR equipment, desks, and computers were sanitized. Upon completion of the experiment, all equipment and lab surfaces were again sanitized between each subject's arrival.

Subjects initially had to review and agree to a consent form and respond to Pre-Arrival questions both conducted via Qualtrics, in accordance with an approved IRB protocol. Participants were organized into two control groups: Group A conducted an AAR review using written lessons learned. Group B conducted a visual AAR using pre-recorded gameplay video. Both control groups received this data before beginning to plan their gameplay strategy. All even-numbered participants received written AAR inputs, while all odd-numbered participants reviewed the pre-recorded gameplay.

The researchers oriented the participants to the experiment including reviewing the actions that would take place during the experiment and familiarizing the participants with the VR system. This review included a gameplay overview, basic environment and game rules, bot control procedures, and auditory and visual data the game would provide. Once the participant was oriented to the experiment and the system the researchers initiated the experiment.

As described, each participant had five minutes to review either a prepared written review or a visual review (pre-recorded gameplay) of a game. They then had five minutes to prepare a plan of how they were going to play their first game and record it in Qualtrics. They then played their first game repetition. Following the first game, the participants were told the number of scores and tags for both their team and the opposing team, and then completed a survey of how their plan played out and if the comments or video were useful. They were then given the opportunity to adjust their strategy and played a second game again for six minutes. Following the second game, the participants again received the score and tag stats and conducted a review via a survey in Qualtrics. The last part for the participants was to complete an exit survey with questions that addressed the overall experiment.

All surveys for this experiment were conducted through Qualtrics. This included the Pre-Game Consent Survey which specifically screened out participants who were prone to motion sickness and the In-Game Survey which sought to capture participant's strategy, understanding of gameplay metrics, and the evolution of strategy between game iterations. All participants will be kept anonymous, with the only common factor being that all eight participants were military officers from the NPS student body.

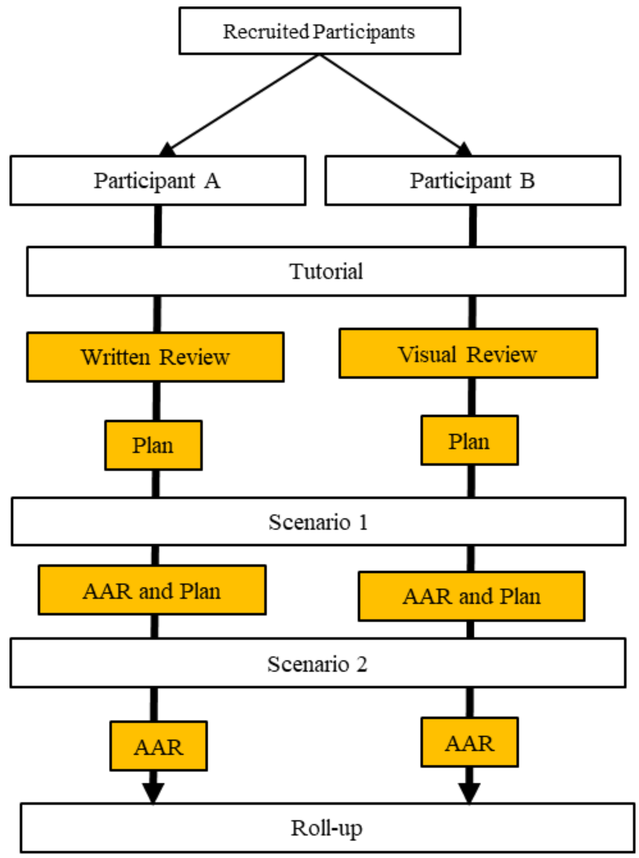

Figure 1. Experiment Process Flow Diagram

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IV. RESULTS

Using the methodology described in Chapter III, interviews, surveys, and game stats elicited data from the OC/Ts and participants.

A. FINDINGS FOR RESEARCH QUESTION 1

What information, and in what form, influences a leader's performance in training?

We found that scenarios in VR along with the additional performance data can improve a leader's tactical learning. VR systems, which are predominately software, can be easily modified to display the requested information to the user to improve their awareness and decision making. Additionally, having access to performance metrics correlates to a leader wanting to improve their strategy.

We analyzed participant performance using our Measures of Performance, the number of flags captured and tags, and Measures of Effectiveness, the difference in the number of flags captured and tags, and we found that 63% of the participants improved from the first game to the second game. We defined improvement as a better relative score, meaning the number of scores the participant's team had beyond the number of scores the opposing team had followed by getting more tags relative to the opposing team. There was one participant that did not pull away from the opposing team in both flags captured or tags, but we classified the participant as improved because they scored more times than in the first game.

We took some data from the Qualtrics surveys to determine if those that improved from game 1 to game 2 and changed their strategy performed significantly better than those that improved from game 1 to game 2 and did not change their strategy. However, the data were not conclusive in indicating that better performance was due to a different, arguably better, strategy.

We found that participants decided to change their strategy regardless of whether they thought their strategy was successful or not. Even more interesting is that 40% of the participants who thought their strategy was successful decided to change their strategy anyway to perform better and take advantage of the low-cost opportunity for tactical learning. This is the greatest takeaway from our experiment.

Table 1. Comparison between Strategy Success and Strategy Change

	Changed their strategy from Game 1 to Game 2	Did not change their strategy from Game 1 to Game 2
Thought their strategy was successful.	2	3
Were unsure about their strategy's success.	1	
Thought their strategy was unsuccessful.	2	

The numbers represent the number of participants that fall in the respective categories.

We evaluated other qualitative data from our survey, and we found that participants rated game metrics over other visual and auditory data as the additional data that they needed most to improve their gameplay. Therefore, we concluded that the reason that participants wanted to improve their strategy, regardless of success, was that they thought they could do better than their previous game and improve their performance metrics.

A leader's ability to improve their tactical judgement is based on their knowledge of what happened during a scenario. VR provides a tool where scenarios can be created and changed relatively rapidly and the system that supports the VR can produce all of the information that corresponds to each iteration of a scenario. This record of information in turn provides a leader the clarity of what transpired so they can improve their tactical judgment.

B. FINDINGS FOR RESEARCH QUESTION 2

How do people learn and implement tactics in a novel simplified contested environment?

Leaders must consume and process significant amounts of information in training to not only perform in the moment, but also to recall later when they review their actions as part of an AAR. There are various types of information that can be communicated to an individual and a couple different mediums for that information to be conveyed. We asked the participants both questions as part of the survey that took place during experimentation.

When it came to what information a leader thought influenced their performance in gameplay, we derived the answer from our findings for the first research question as the game metrics. This finding was reinforced by another survey question. When asked what additional information would have been useful during the game, the most frequent comments were about being able to see the performance metrics.

With respect to the medium for the information, information presented visually is preferred. When asked what form of information affected their gameplay the most, participants responded that they preferred visual information over auditory inputs. The reason we think that participants responded this way is because visual information allows a participant to easily see a summary of the information instead of having to mentally track the data received from auditory inputs.

Game metrics presented visually influenced a leader's performance in training the most. The most relevant information displayed in a way that is easily consumed and processed allows a leader to adjust as needed and get back into the scenario. This finding reinforces our finding for the first research question. Performance metrics are critical to influencing performance in training and leaders needed to receive that information visually to speed up the processing time and reduce the cognitive burden.

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V. CONCLUSION AND RECOMMENDATIONS FOR FURTHER RESEARCH

The purpose of the research was to inform the Army if there is a way to enhance the efficacy of AARs.

A. CONCLUSION

We concluded that VR provides users with the ability to achieve a faster rate of tactical learning due to the rapid feedback loops and availability of performance metrics. We also found that these qualities encouraged participants to attempt alternative methods, expanding their knowledge of potential tactics and techniques. While the Capture the Flag program is limited in its variables, it provides a similar yet simplified contested environment to that of NTC or other virtual engagements. Therefore, we believe that with the appropriately identified performance metrics and observed desire to expand strategy, this concept can be replicated in more complex operations-based scenarios to further prove its true potential.

B. THE RELATION OF VIRTUAL REALITY TRAINING AND GAMING ENVIRONMENTS TO LIVE AND CONSTRUCTIVE ENVIRONMENTS

Learning and implementing novel methods requires varying amounts and types of resources in different training environments. Live and Constructive training environments require significantly more resources than Virtual and Gaming environments. However, the training in Live and Constructive environments are significantly more realistic than Virtual and Gaming environments. The relative advantages and disadvantages are only part of what impacts people's ability to learn.

In Live and Constructive environments, we have limited control over varying situations that allow opportunities to implement novel methods and conduct AARs to evaluate the novel methods used. At the NTC, people and units train in whatever conditions exist without the ability to shift the timing of their training. Due to the nature of information flow and the number of people involved, leaders at the company level and below must rely on the notes of the OC/Ts that move with them during their training. There is also a very limited time to try novel methods because of the resource coordination. The nature of these circumstances reduces the leaders' ability to improve their tactical judgement.

In Virtual and Gaming environments, we control everything about the scenarios that leaders will face and can change it relatively quickly. This control can prompt leaders to try different methods in different scenarios, receive detailed near real time feedback, and still have time for more iterations so that they can try something new.

Virtual and Gaming environments allow rapid situation changes to force a user to try novel things and makes the information easily accessible to modify their methods. The Virtual and Gaming environments cannot match the unpredictable environment of Live and Constructive training, but it does offer the opportunity to implement and learn from novel methods in much faster succession.

C. RECOMMENDATIONS FOR FURTHER RESEARCH

To build on the foundation that we established with this project, there are several things to do moving forward.

The first is to continue experimentation in VR to further prove its benefits. The experiment we conducted at its core is the right method to get after proving the benefits of VR in tactical learning. The simplified contested environment in the game allows researchers to evaluate results and make determinations on whether participants are experiencing tactical learning more easily.

Second, having more participants will allow future researchers to make claims that can be supported statistically.

The third is to improve the testbed so data and information are more easily accessible for evaluation. The game, in its current form, allowed us to make some overarching observations and findings. That said, we had to focus on collecting basic data because the system did not auto-calculate it. This does not qualify as Future Research because the system generates the requisite data, but the computer program to turn the generated data into the needed information was beyond our resources to write.

Moving on to Future Research, we envision further research going in three directions that will culminate in a fourth.

The first, called Iteration analysis to achieve unit proficiency, is to study how many iterations it would take to get enough personnel trained for a unit or team to be considered proficient. Our experiment only had enough time to conduct two games so knowing how many games it would take to get 95%+ of the individuals to improve would be beneficial in determining applicability.

Second, changing variables to prove adaptive learning, gets after proving if and how long it takes for a participant to learn to interpret the actions of the opposing force and adjust their gameplay accordingly.

Third, identifying metrics synthesized with CTC environment/challenges, would build on the simple metrics of scores and tags, which can be likened to objectives and deaths, to better mirror the vast amounts of data that is collected by the Combat Training Centers.

Fourth, proving tactical learning in moderately complex contested environments would be the compilation of the other future research efforts where the basic principles that we applied in a simplified environment are then complexified to basic battle drills such as squad attack. If the findings from this project continue to hold true as the size and complexity increase, then we have proved that VR is a tactical learning multiplier that can enhance the efficacy of live training.

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SUPPLEMENTAL: DATA

The raw data and calculations and the survey results can be accessed here: https://calhoun.nps.edu/handle/10945/68664.

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