

Microgames for Training Perceptual Skills

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ABSTRACT

A common challenge in military training lies in motivating personnel to practice and retain lessons in the limited time they have available. A training methodology that can exploit the moments of “micro-boredom” that lie between missions and other duties can help to address this challenge. However, exploiting those moments requires training methods that are self-motivating, can be completed in isolation (e.g., without trainer interaction or forcing factors), and of a duration that can easily fit in these available time slices. To address this need, we are exploring the application of microgame-based training tools—casual games that provide critical lessons in periods lasting no more than a few minutes—across a number of domains. Here, we describe our ongoing effort with the Office of Naval Research (ONR) to adapt microgames to augment perceptual training. Specifically, in this work we adapted microgames to support training objectives for the Marines’ Combat Hunter program, a program that focuses on training perceptual skills needed to recognize threats in urban environments. Designed to augment existing training, our engaging microgames assist Marines to prepare for in-classroom training, provide practice lessons during class, and rehearse lessons learnt after training is complete. In this paper, we describe our work designing these games, and some of the lessons we learned in adapting microgames to perceptual training objectives. In future work, we plan to further evaluate and test these games, and to extend our game library to address other Combat Hunter training objectives.

ABOUT THE AUTHORS

Mr. Sean Guarino is a Senior Scientist at Charles River Analytics, and was the Principal Investigator for this effort. His primary research focus is on game-based training applications, where he has explored microgame and immersive simulation based approaches to training, as well as the application of human behavior models to drive entities in training systems. He has worked on efforts sponsored by the Navy, USAF, DARPA, and Marine Corps.

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INTRODUCTION

Throughout their history, Marines have been targeted—or hunted—by snipers, terrorists, and other adversaries using veiled or stealthy forms of attack. To better counter these tactics, the USMC implemented the Combat Hunter Program where Marines are taught to be the hunter rather than the hunted (Gideons et al., 2008). The Combat Hunter program trains perceptual pillars that are critical to combat awareness and survivability, including observation theory (i.e., analysis of anomalies using available senses and equipment) and combat profiling (i.e., analysis of the human terrain and its impacts on threats (Fautua et al., 2010)). Underlying these topics is a set of perceptual skills that rely on establishing cognitive baselines, or *schemas*, that identify what to expect in a given environment. Using these schemas, Marines identify what *is* in the environment that *should not be*, and what *is not* there that *should be* (Michaels, 2008).

While extremely effective for those who have been able to complete it, the Combat Hunter Program is limited in terms of its throughput and accessibility (Gideons et al., 2008). Live training is clearly essential for perceptual skills, however, it can be time-consuming and expensive (due to the need for expert trainers and actors), and prone to decay (as it lacks support for effective skill maintenance). In response to these issues, the Office of Naval Research (ONR) is currently executing the Perceptual Training Systems and Tools (PercepTS) program, which provides both computer-based training tools that enable remote introductory training and remedial review, and portable physical exercises that allow small unit leaders to bring live exercises to their squads (Alston & Schatz, 2013; Vogel-Walcott et al., 2013). However, while these tools do begin to address the accessibility and throughput issues, the current methods are not always highly motivating for individual Marines. In addition, current Combat Hunter training also tends to focus on the context of actual deployment settings, including Middle East combat environments (e.g., desert terrain; Afghan and Iraqi culture; towns and villages reflective of those societies) (Fautua et al., 2010; Schatz et al., 2010). Therefore, contextual changes, such as moving to a different urban environment in Africa or Pacific islands, require Marines to adapt these concepts to the norms of the new operational context. So, rather than focus on training specific context, the Combat Hunter program needs to be augmented with *meta-cognitive* training that enables Marines to learn new contexts, to rapidly adapt new cognitive schemas to fit the new environment, and to identify anomalies based on those new schemas. Augmenting live training with self-motivated and independently accessible training options will allow Marines to enhance the benefits of live training, keep skills refreshed over time, and adapt these skills to their new settings, all with low cost and time commitment

Microgames provide a powerful platform to deliver meta-cognitive training. Microgames are lightweight, short duration (less than 5 minutes), multi-platform games that can be designed to support skill assessment, acquisition, and maintenance. They are designed to be engaging and easy to use, which both improves assessment and training transfer (Prensky, 2001), and encourages more frequent rehearsal. Furthermore, whereas more detailed immersive games will inevitably represent a specific combat setting, microgames can easily be designed to incorporate abstract relationships and information to support meta-cognitive training that focuses on perceptual schemas in a variety of contexts. In this paper, we describe our development of an initial suite of microgames for training high-level cognitive schemas, with a focus on the proxemics element of combat profiling (i.e., analyze the spatial relationships and orientations observed amongst groups in an abstract setting). We describe the curriculum we developed to guide microgame training objectives, the suite of microgames that we developed to address those objectives, and some of the lessons learned for microgame-based perceptual training. We then describe our initial assessment of these games with subject matter experts (SMEs), and our plans for an upcoming formal assessment of the games. We conclude with recommendations for future microgame-based training tools drawn from our progress.

BACKGROUND

Microgame-Based Training

Microgames (also referred to as casual games) provide a powerful training solution that can effectively provide and augment training across a wide range of domains. These games are designed to be short-duration, portable games playable in virtually any setting and within the moments of micro-boredom that people commonly experience. Because of the short duration of these games, they are ideally suited for task repetition, enabling trainees to repeat numerous trials with different presentations to better learn new concepts and schemas. This kind of repetition would be difficult and time-consuming to achieve in the more detailed scenarios commonly used in immersive simulation-based games. This has led to a number of effective educational microgames that range across many different domains. For example, Miller Brewing Company has developed several microgames to help, among other things, bartenders pour beer correctly (Aldrich, 2007), while the Canadian Standards Association has developed microgames to identify hazards and emergency response procedures. Cisco Systems has developed game-based training to assist in certification learning for network professionals, including games focused on IP communications, binary calculations, and network security. Our own work in microgame-based training has included tools for improving cognitive development in students (Connell & Stevens, 2002; Stevens et al., 2003), training mnemonic tools for remembering essential medical procedures in the battlefield (Kilgore & Godwin, 2010), and providing extensible information assurance training (Guarino et al., 2012).

Microgames are particularly effective when they are designed to complement other learning mechanisms, such as classroom learning or field exercises (Aldrich, 2007). Used as preparation for other training methods, microgames can provide trainees with an initial understanding of critical background skills needed to prepare them for a class or training exercise. This can make classroom training more efficient, as instructors can move more quickly to exercises that require mentoring. Within an ongoing class, microgames can provide useful testing exercises, helping instructors to quickly assess whether trainees have learned the critical material covered in a given session. Finally, after deployment, microgames can provide a consistent remedial training tool, enabling the practice of key skills in the moments of micro-boredom that are available throughout the day. It should be noted that microgames do not replace the need for classroom and field training, particularly when training perceptual skills. Marines need to directly experience environmental sights, sounds, and other indicators firsthand to fully enhance their perceptual skills; microgames can then augment this training by providing reminders of the training experience and helping Marines to adapt those lessons to new environments.

Previous Perceptual Training

The Combat Hunter training program has been highly successful in training Marines to be the hunter rather than the hunted, providing them with the critical perceptual skills needed to observe threats in both combat and peaceful settings (Gideons et al., 2008). Similar training tools have also been applied elsewhere in the military and in other types of security agencies. For example, the US Army provides a perceptual training program focused specifically on human terrain analysis as part of its Advanced Situation Awareness Training (ASAT) course, while the US Border Patrol has duplicated Combat Hunter training in their CODIAC Border Hunter training program for officers patrolling the border between the US and Mexico (Fautua et al., 2010). In addition, the FBI, TSA, and other justice agencies train similar perceptual skills to teach agents and security personnel to recognize threats in city environments, airports, and other public areas.

Combat Hunter training specifically focuses on three key perceptual capabilities: (1) observation theory (i.e., the analysis of anomalies using available sense and equipment); (2) combat tracking (i.e., the analysis of the physical terrain to determine events that have transpired); and (3) combat profiling (i.e., the analysis of the human terrain and its impacts on threats) (Fautua et al., 2010). Underlying each of these pillars is a set of perceptual skills (e.g., combat profiling includes skills for observing, amongst other things, the *geographics* that define how people move in an environment and the *proxemics* that define aspects of social density and distance and orientation between people). These skills rely on establishing cognitive baselines, or schemas, that identify what to expect in a given environment. Using these schemas, Marines identify what *is* in the environment that *should not be*, and what *is not* there that *should be* (Michaels, 2008). The current training suffers from two critical issues. First, it teaches cognitive schema elements within the context of current deployment settings (e.g., observed human behaviors in Iraq and Afghanistan) (Fautua et al., 2010; Schatz et al., 2010); therefore, contextual changes—such as moving to a different

urban environment—require the Marine to adapt schemas to address the norms of the new operational context. This transfer can be difficult if the training does not focus on teaching the meta-cognitive skills needed to rapidly *construct* and *adapt* cognitive schemas to these new environments.

A second key issue in current training—and perhaps the biggest limitation—is the need for scarce expert personnel to provide the training. The need for such experts limits the throughput of the course, preventing it from reaching all Marines. Instead, squads will often send one or two members to the course (including small unit leaders), who will attempt to bring the training back to the unit. With only the training manuals as guidance, this approach does not provide a very effective means to update the perceptual skill set of other squad members. Recent work in the ONR PercepTS program has been augmenting Combat Hunter training with a number of computer and paper based tools that can be used by Marines outside of the Combat Hunter course. These include web-based training aids that cover the materials provided in the training manuals, immersive simulation-based trainers that allow users to use observational skills and combat profiling skills to evaluate activities within a small village (Alston & Schatz, 2013), and home exercises that small unit leaders can use to guide their squads through live training (Vogel-Walcutt et al., 2013). Our work extends these PercepTS training materials with microgames that focus on specific combat profiling skills, providing lessons in an abstract setting that can transfer to future combat environments.

PROTOTYPE DEVELOPMENT PROGRESS

Our prototype development has focused on several guiding goals. First and foremost, we focused on a microgame-based training approach because it addresses some of the key gaps found in existing Combat Hunter training methods, as discussed in Table 1. Microgames provide a novel method for perceptual training that includes several critical advantages in this domain. The short duration of these games enable repetition of difficult skills across a wide range of contexts, allowing trainees to gain significant experience with the different situations portrayed by those skills in a manner that would be impossible in live exercises, simulation-based training, and even online training materials. The focus on engagement and portable design enables the use of microgames outside of standard training environments. Specifically, Marines can use these games both before training to prime themselves for more efficient learning in the Combat Hunter course, and after training to review materials while deployed. Furthermore, these games can be provided to other squad members to assist in the distribution of learning back to the unit. For these reasons, in addition to the general engagement value of these games, we believe microgames provide a strong advancement over previous training methods.

Table 1: Training approaches used in Combat Hunter training and microgame advantages

Approach	Strength	Microgame Advantage
Classroom Training	<ul style="list-style-type: none"> • Captures attention, provides direct interaction with expert instructors 	<ul style="list-style-type: none"> • Microgames provide low-cost, short-duration adjuncts that can help prepare students for training and enable more efficient instructor review
Field Exercises	<ul style="list-style-type: none"> • Provides first-hand motivating experiences with expert instructor review 	<ul style="list-style-type: none"> • Microgames provide low-cost, short-duration adjuncts that can help prepare students for training and review lessons
Game-Based Simulation	<ul style="list-style-type: none"> • Provides realistic computer-based scenarios without need for instructor, motivating game mechanics 	<ul style="list-style-type: none"> • Microgames are easier to use, support rapid repetition of a variety of cases in each area, and can address more operational settings
Written Course Material	<ul style="list-style-type: none"> • Summarizes content of training in succinct book, provides examples of key concepts, prepares trainees for class 	<ul style="list-style-type: none"> • Microgames provide an engaging method of accessing similar material; microgames can be readily accessible on portable devices carried by Marines

Second, we focused on meta-cognitive training rather than focused contextual training. Previous perceptual training research shows that skill transfer can be difficult to achieve (Ahissar, 1999; Cholett et al., 2005; Tanaka & Taylor, 1991), largely because much of this training relies on perceiving attributes in a particular domain (Goldstone, 1998). Combining a meta-cognitive training approach—one that teaches Marines to effectively build cognitive schemas for perception—with existing live and computer-based training will facilitate better understanding and transfer of Combat Hunter skills to other deployment settings or situations. This parallels the use of linguistic skills (e.g., semantics, syntax, and pragmatics) in training languages and mathematical theory in training advanced mathematics. While research suggests that languages are most effectively learned through immersion (Archibald et al., 2006), a solid foundation in linguistic skills can enable such learning to occur more quickly (Bartels, 2004). Similarly, students who are taught to think mathematically (e.g., to seek solutions, explore patterns, and formulate new patterns) gain a more resilient capability to solve novel mathematical problems (Schoenfield, 1992). Extrapolating

on this research, a similar approach can apply to perceptual skills, where a strong understanding of the underlying concepts will enable individuals to more rapidly adapt those concepts to the specifics of new combat settings or environments.

Finally, because our focus is on augmenting existing training, we were able to focus our training on a subset of essential skills rather than attempting to address the full Combat Hunter curriculum. To determine our initial focus, we interviewed Marines who had participated in Combat Hunter training to identify potential gaps in the training. The Marines we spoke to identified difficulties in following many of the skills related to Combat Profiling (reading the human terrain), including skills surrounding proxemics, geographics, and atmospherics. Ultimately, we focused on proxemics skills for understanding relationships between distances and orientations of people, and associated leadership and focus point indicators. We made this choice in part because of the feedback from the Marines we interviewed, and because of the potential for these skills to be readily represented in a microgame format. In the sections below, we describe the development of our prototype proxemics curriculum and our initial suite of microgames for training proxemics. In future work, we will extend this curriculum and microgame suite to address other combat profiling capabilities, including geographics and kinesics, using other styles of games.

Curriculum Design and Development

In designing our curriculums, we first focused on developing a Cognitive Schema Model that provides the *semantics* defining the meta-cognitive skills that are addressed within the Combat Hunter training program. These semantic models hierarchically define categories of concepts that must be addressed in a full training program, providing a guideline for the development of a full-scope curriculum. Figure 1 provides an example of a cognitive schema model for proxemics skills. In interpreting the proxemics in a crowd, trainees must learn to recognize differences in average distance and orientation, combine these skills to identify groups in the crowd, and observe the behaviors of those groups to identify potential leaders. Other proxemics skills are more focused on specific behaviors, such as the movement taken to bring someone into a conversation or box someone out (proxemics push and pull) and the reciprocation taken to show agreement or disagreement. In our initial microgame suite, we focused on developing games that use an overhead view of the environment, addressing the critical skills highlighted in blue in Figure 1 (distance, orientation, group analysis, and leader analysis). We selected an overhead view because it readily addresses many of the key skills in proxemics (and, later, geographics), while enabling straightforward and automated generation of a wide range of different representative scenarios for the repetition-based training that we target in microgames.

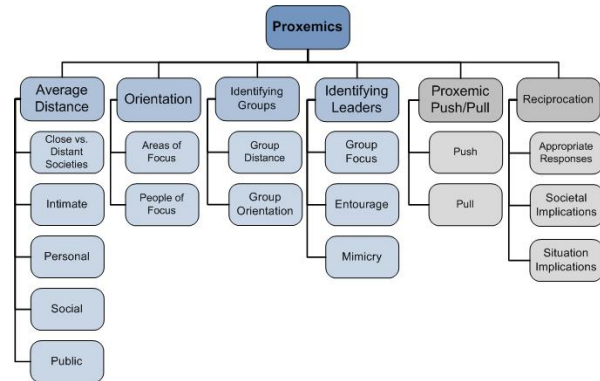


Figure 1. Proxemics cognitive schema model, with targeted training objectives in blue

Using this model, we next developed a curriculum to effectively organize microgame-based training objectives for Marines. We used an incremental training approach that starts with basic skills (e.g., recognizing baseline distances and orientations), and builds on those skills to provide more complex analytical skills (e.g., identifying anomalies and threats based on those baselines) to more complex skills. As shown in Table 2, the curriculum begins by training perceptual skills to recognize distances in a crowd. The games first teach Marines to build a baseline in a new environment, recognizing that different environments and cultures will have different customs for both distance and orientation behaviors. Once the trainee knows how to construct a baseline, they build on that knowledge to detect key anomalies such as personal and social groups for distance, and potential anomalous threats and focus points for orientation. We can then proceed to a more complex combination of cues, such as the recognition of leadership based on the combination of group distance, orientation, and mimicry. Finally, we combine all of these skills in a challenge level in which Marines must identify potential threats based on a combination of proxemics skills. We next describe the microgames that we developed to support each of these training units.

Microgames Design and Development

Early in the effort, we assessed a variety of different microgame approaches that could be used to address training objectives in the Combat Hunter program. One of microgames most exploitable strengths is the ability to play a series of trials that each exhibit different elements of the task, thereby allowing players to experience a wide variety of contexts that cannot be easily achieved in immersive simulation. We first explored tasks that show pictures of an environment, requiring the trainees to identify critical perceptual elements. However, while imagery can be effective for a wide variety of perceptual tasks, including recognizing facial cues and body language (i.e., kinesics), recognizing environmental cues (i.e., atmospherics), and recognizing symbols and icons (i.e., iconography), such imagery would be inherently limited to the content integrated into the game, which would likely be focused on a specific culture or cultures. Extending these lessons to other cultures would require extensions to a realistic image library.


Table 2: Proxemics curriculum for microgame training suite





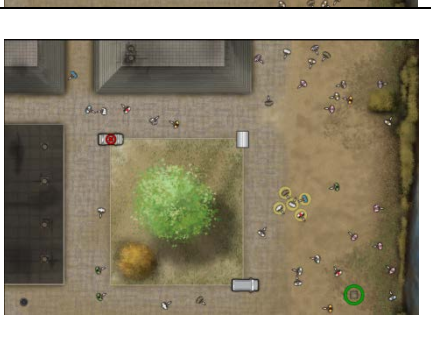
Training Unit	Training Objectives
1: Distance I	<ul style="list-style-type: none"> Identify baseline public distance in a new setting Recognize that different environments and cultures will have different average distances
2: Distance II	<ul style="list-style-type: none"> Differentiate distance indicators (i.e., intimate, personal, and social distance) Assess distance indicators of groups
3: Orientation I	<ul style="list-style-type: none"> Identify baseline focus of a crowd (i.e., area that crowd is focused on, or lack of focus) Recognize that orientation behaviors are different in different environments and cultures
4: Orientation II	<ul style="list-style-type: none"> Identify anomalous group orientation focus (i.e., groups that are focused differently from the rest of the crowd) Assess orientation indicators of groups
5: Orientation III	<ul style="list-style-type: none"> Identify combination of distance and orientation indicators of group leadership, including group focus and entourage behaviors
6: Challenge	<ul style="list-style-type: none"> Use combination of group, leader, and anomaly indicators to identify potential environmental threats/anomalies based on group proxemics

Instead, after analyzing the training requirements for proxemics and geographics, we decided to pursue 2D overhead games that show crowds of individuals moving around in an environment, as one might view from an unmanned aerial vehicle feed. This view allows us to capture lessons associated with distance between people, orientation, and movement in an urban setting, all while allowing the random generation of a wide variety of scenes, both with different backgrounds and with different configurations and baselines in proxemics and geographics. Using this approach, we are able to produce a wide variety of puzzles to enable a higher degree of replayability (ensuring that players are tested on the training objectives, not on their familiarity with a particular image), and to address a variety of baseline states. As we move forward with other games, we will continue to identify approaches that can exploit reusable graphics in this way. For example, to address kinesics cues, we will use representative facial and body features, akin to the avatars used in Wii Miis.

Once we had settled on overhead view games, we addressed the specific objectives of our proxemics curriculum with a suite of six microgames, each focused on a particular unit. Below, in Table 3, we describe details these six microgames; the full suite will be available for demonstration at IITSEC 2014.

Table 3: Proxemics microgame suite

<p>Distance I: Trainee must observe the crowd, and identify the line that is most representative of the average distance in that crowd, identifying the baseline public distance for the crowd. This is one of the first things that should be done upon entering a new environment to apply proxemics skills. Each environment and culture will have a different public distance from which observers can derive other distance indicators, such as intimate, personal, and social distances needed to recognize different types of groups.</p>	
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<p>Distance II: Trainees must observe the crowd and identify either social or personal groups within that crowd. Importantly, these distances are not static; rather, each new setting in a puzzle will have a different baseline public distance, from which the trainee must derive what the social or personal distance would be expected to be. Only after doing this analysis can the player correctly identify social and personal groups within the given environment. In addition, in doing this task, players learn how to use distances between individuals to identify potential groups; in later units, they will learn to incorporate orientation into this analysis as well.</p>	
<p>Orientation I: Trainees must observe the baseline focus for a crowd (or determine that the crowd is not focusing on anything). At low difficulty, trainees are provided with a static scene; at high difficulty, the crowd moves and only occasionally glances at the object of interest (the example on the right shows a high difficulty scene where movement results in only a handful of crowd members focusing on the target at any instant). Understanding a crowd's baseline focus can be useful in both identifying critical threats that the crowd may be aware of, and in identifying anomalous crowd members who are attending to other focus points.</p>	
<p>Orientation II: Trainees must identify the anomalous individuals who are focusing on something different from the primary focus of the crowd. To do this, players must first identify the baseline focus of the crowd, and then determine which individuals are different. Again, at low difficulty, trainees are provided with a static scene and at high difficulty, the crowd moves. Understanding anomalous focus points for crowd members can be useful in identifying those individuals who are acting suspiciously within the crowd. Furthermore, if those individuals can be correctly identified, their focus point may provide a greater indication of potential threats.</p>	
<p>Orientation III: Trainees must identify potential group leaders based on the proxemics of the scene. Here, trainees combine several different cues, including distance cues to determine members of a group and orientation cues to determine the focus point of each group. For the purposes of this game, the individual at that focus point is considered the group leader. Importantly, this proxemics skill could then be combined with other skills (e.g., kinesics skills observing the micro-behaviors of that individual) to determine if that individual is actually following the leadership of another actual leader.</p>	
<p>Proxemics Challenge: This final game combines the above cues to use proxemics to identify potential threats in a given environment. Trainees must use a combination of orientation and distance to identify group leaders, and then observe the leader's focus to determine which group is focusing in a manner that is different to the rest of the crowd. Upon performing this assessment, the trainee must identify the object of that focus as a potential threat. By combining distance, orientation, group, and leadership recognition skills, the game illustrates how trainees can use proxemics to identify potential threats in an environment. Later games in the curriculum would then combine these proxemics skills with other combat profiling skills to combine indicators of higher threat possibilities.</p>	

Finally, we assessed several approaches to managing the presentation of these exercises. Each game unit is divided into three difficulty levels that the trainee is expected to achieve, incrementally extending the complexity of the puzzles both through larger and denser crowds and through movement within the crowd. Initially, we developed our games to be played as a single exercise to practice each particular skill. Later, to make the games more engaging, we adapted this to a series of one-minute exercises, trying to correctly answer as many puzzles as possible in this time frame. In the current version of this software, we use the single exercise mode as a *practice* mode, in which feedback is provided as to why the player got the problem correct or incorrect, providing scaffolding to help the player learn the task. We then use the series of tasks as a *challenge* or *test* mode in which the player is expected to

achieve a minimum number of exercises with a minimum level of performance to prove that the skill has been effectively learned. A unit is considered complete when the player successfully completes the challenge mode through all three difficulty levels of the unit.

We believe that these games provide a strong augmentation for training proxemics skills that can be used in combination with current and future Combat Hunter training. Using the practice mode, trainees who are preparing for the Combat Hunter course (or for initial training with a small unit leader) can play through each of the game units to learn the basic concepts in as little as 5-10 minutes. Using the testing mode, trainees can evaluate their learning after a Combat Hunter course unit is covered, verifying that they are able to apply the concepts effectively. Finally, after this initial training, trainees who are deployed can practice these skills using the highest difficulty of the testing mode. As we integrate more advanced scoring and reward mechanisms into these games, the engagement value of these microgames will be on par or better than that of other computer-based training methods.

EVALUATION

After developing our initial microgames, we performed a formative evaluation of our microgames with SMEs at DCSI's MESH Solutions (partners in the overall PercepTS program that this effort supports) to assess the playability and training value of our games, and recommend improvements. In general, the feedback was positive, identifying the games as simple to use and effective in its feedback. However, these early versions of games had a number of issues that we have since addressed. The original games did not include a testing mode and were deemed unengaging for a number of reasons, primarily they failed to adequately challenge the user (the original games were designed to be too simple), and inconsistent in linking training goals to actual proxemics cues. We improved on both of these aspects of our games, refining our training objectives to focus more on understanding the nuances of pragmatic elements of a scene, and helping trainees to integrate information from several pragmatic elements to reach conclusions about potential threats and anomalies. We also integrated a more advanced scoring mechanism that integrates into the testing mode; the results included a greater challenge to the player, better evaluation of user performance, and ultimately improved rewards – all of which generate increased engagement within the games.

We are currently working with ONR and the Marine Corps Training and Education Command (TECOM) to perform further analysis of these games. In the near future, we plan to demonstrate the games to TECOM course designers in a second formative evaluation that will ensure that the games are suitable for integration with the Combat Hunter program, and to refine the games based on feedback provided by TECOM. After those refinements, we hope to evaluate the effectiveness, transfer, and engagement value of the games with a population of Marines who have experienced Combat Hunter training, working with TECOM to gain access to such a population. This formal evaluation will set the stage for further refinement of our existing microgames, and future development of microgames to address other Combat Hunter training objectives. We hope to complete both of these assessments over the summer of 2014, and present results at the IITSEC conference.

CONCLUSIONS AND FUTURE RESEARCH

In conclusion, we have demonstrated how microgames can be applied to address perceptual training objectives. One of the critical challenges that must be addressed in such an application is identifying automated and reproducible methods for generating scenes that capture the essential baseline and anomalous elements of a perceptual scene. In the work described in this paper, for proxemics and geographics, we focused on an overhead view of crowds and environments. Similar approaches can be effective for other environmental cues as well (e.g., atmospheric cues). For more human-centered elements, such as facial expressions, body language, and biometrics, it is necessary to capture more detailed features of the environment. However, even in these cases, there are a variety of low fidelity representations that can be used to support automated generation of a variety of scenes, using computer-generated features rather than the imagery that is common to most perceptual training tasks. Finding effective methods for illustrating these cues without complex and realistic imagery is an essential task to address in applying repetition-based microgames to any perceptual training task.

Overall, microgames provide several critical advantages for augmenting Combat Hunter training. They are particularly well suited to upcoming generations of Marines, who are used to playing games on their portable devices (Prensky & Berry, 2001; Kirkle et al., 2005). The more microgames can exploit familiar game mechanics and feedback mechanisms, the more they can engage our future warfighters. Furthermore, as they are portable

training tools, they allow Marines to be trained at home or while deployed, as Marines can use their personal devices to perform the training exercises. Finally, effectively designed microgames can achieve training in short time periods, particularly when addressing review tasks.

While our current work has not yet proven the effectiveness of these microgames, we are positioned to evaluate these games over the next several months. We hope to present results of this evaluation at IITSEC 2014. In addition, we will continue to extend our suite of games to address other training objectives. We are currently developing a second suite of games to address geographics skills (the analysis of human movement within an environment to identify habitual paths and areas, paths of least resistance, channeling effects, and anchor points). After that, we will explore more detailed games to address facial expressions and body language.

Finally, we recommend a more focused integration effort to align these microgames with evolving perceptual training methods. Specifically, evolving training approaches (Vogel-Walcutt, Fiorella, Malone et al., 2013) focus on a training taxonomy that combines combat profiling cues based on temporal scales and cognitive-perceptual complexity. By aligning our microgames with those training objectives, they will be able to more effectively augment future Combat Hunter training exercises.

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