

Military Observation: Perceptual Skills Training Strategies

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ABSTRACT

Perceptual skills such as search and detection serve as a foundation for the development of situation awareness, and resultantly, have a range of applications across an array of military domains. From Infantry Patrol to Command and Control situations, warfighters must be able to use appropriate skills to extract information from their environment in order to detect stimuli ranging from a sniper rifle to a radar blip. To date, training strategies research has yet to fully address the complexities of operational perceptual skills learning (e.g., Observation Training). In complex military domains, advanced perceptual skills are an order of magnitude more complex than the simple laboratory perceptual skill tasks described in the literature. As such, there are relatively few strategies that can meaningfully support this type of learning and those that can have not been applied to the field.

In order to identify effective training strategies for the targeted perceptual skills, a Task Analysis was performed to decompose the target task (i.e. Observation) into Knowledge, Skills and Abilities (KSAs). From this, a literature review was conducted to identify training strategies key to perceptual skill sets that could be applied to the field. This paper discusses strategies related to Scanning, Detection and Recognition.

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Roberto Champney has had significant experience in systems design and evaluation having performed several system evaluations in industry and academia. His has worked on several multidisciplinary teams where he has developed an expertise in capturing the Voice Of the Customer (VOC) for transformation into design requirements

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INTRODUCTION

Troops fighting today are faced with vastly different challenges than in the past. Enemy use of Asymmetric/Irregular Warfare (AIW) techniques has motivated the military to explore new tactics and concepts such as Distributed Operations, a type of maneuver warfare in which small, highly capable units are spread across a large area of operations to provide spatial advantage (Ucko, 2007). A key tenet of this concept is training Warfighters who can exploit information at the lowest level of soldier to improve cognition and decision-making at the small unit level. Warfighters must have the ability to identify a range of threats, including snipers, Improvised Explosive Devices (IED), and suspicious activities and behaviors which could indicate the presence of such threats. The skills necessary to detect such threats are commonly referred to in the military as observation skills and in the science community as perceptual skills.

The preliminary findings of a 2007 study supported by the I Marine Expeditionary Force (I MEF), the Marine Corps Warfighting Lab (MCWL), and the Office of Naval Research (ONR) suggests that observational skills are critical to Situational Awareness (SA) and tactical decision making (Carroll, Milham, Champney, Eitelman, and Lockerd, 2007). The ability to detect static and dynamic environmental threats such as slight changes in movement, color, and texture aids in detection of threats such as IED's, snipers, and terrorist behavior patterns. A major challenge to the successful performance of threat detection, however, is that tactics are continually evolving. It is not sufficient to train troops to look for specific environmental and behavioral cues, given the adaptation of the enemy. Warfighters must be trained adaptive perceptual skill sets that enable troops to detect threats across any number of environmental, cultural, and situational conditions. To this end, it is necessary to first understand the basic perceptual skills necessary for successful threat detection and to identify effective means of training these perceptual skills.

A common misconception in training design is that practice equals training (Cannon-Bowers, Rhodenizer, Salas, & Bowers, 1998); however, effective training of any task relies on the integration of effective training strategies. Training strategies are training interventions that can be employed in practice environments that will optimize learning, transfer, and retention (Cannon-Bowers, et al., 1998). Four principles for effective training strategies require that they: 1) present relevant information and concepts, 2) demonstrate KSA competencies to be learned, 3) create opportunities for trainees to practice the skills, and 4) provide feedback to trainees regarding practice (Salas & Cannon-Bowers, 2001). Currently, perceptual skills training in the military strives to achieve the above principles, however, due to operational limitations there are many opportunities for improvement. One of these opportunities is the ability to enhance current training strategies used.

Common practice in current Marine Corps observation training is to provide feedback consisting of Knowledge of Correct Response (KCR) in the form of pointing out all threats in the scene/scenario or Knowledge of Results (KR) in the form of pointing out all threats missed. This form of purely outcome feedback has been shown successful in some domains (teacher in service training; (Leach & Conto, 1999); however, in other domains (Davis, Carson, Ammeter, & Treadway, 2005; Goodman, Wood, & Hendrickx, 2004) outcome feedback may not be at a granular enough level to facilitate trainees identifying and improving process level skills such as search and detection. This is because outcome level feedback typically gives little guidance on how performance needs to change in order to increase performance levels. What are needed are training strategies and feedback methods which can effectively target process level perceptual skills. As different types of learning tasks require different instructional strategies and methods (Mory, 2004), it is necessary to identify those strategies which are most effective at improving perceptual skill

learning, accelerating perceptual skill acquisition and hence improving Warfighter perceptual skill readiness.

Challenges to Training Perceptual Skills

There are several challenges associated with training perceptual skills, the first of which is the difficulty in demonstrating these skills. Perceptual skills such as search and detection are subtle or internal processes which are unobservable. As a result, traditional training strategies consisting of demonstration are infeasible and training typically consists of verbal description of skill performance, not actual demonstration. One difficulty with this approach, however, is that expert performers often operate on “autopilot” and are not always aware of the cues to which they are attending (Klein, 1998). It may be more appropriate (i.e., more efficient and accurate) to incorporate effective training strategies which allow experts to demonstrate their expertise rather than try to verbalize them (Sidani & Gonzalez, 1994). This leads to the second challenge which is that few training strategies have been proven to enhance perceptual skills and those that have rarely reach training practitioners. Instructors, particularly in the military, continue to utilize the strategies with which they were taught, despite the theoretical and empirical findings and advancements.

The goal of this effort was to leverage the theoretical and empirical findings in the training science literature to bring state of the art perceptual skills training strategies to the Warfighter to increase training and readiness levels by illustrating how these strategies could be applied to military training domains.

Target Domain

The Marine Corps Combat Hunter (CH) program is a new training program aimed to enhance the observation skills of the individual Marine. This research effort commenced with involvement in the CH Limited Objective Experiments (LOEs) in which the Marine Corps aimed to both identify key skills sets necessary for Marines to be “Always the Hunter, Never the Hunted” (US Marine Corps., 2008) and develop a curriculum which supported a Marine in quickly developing high levels of situation awareness and observation skills. Focus domains of the LOEs were Infantry Observation Post, Infantry Patrolling and Tracking. The target training task chosen for this research effort was static observation from an Observation Post (OP). An Observation Post (OP) is “a position from which military observations (visual, audible, or other means) are made” and reported in order to provide situation awareness for the

commanding force. “OPs are used during screening and reconnaissance operations. From the OP, the squad reports the enemy size, activity, location, and disposition to the commander, and, if directed, calls for indirect fires.” (US Army, 1992).

In short, the OP task entails static observation of a designated area for what can be extended periods of time. This task was selected as it provides an opportunity for critical Observation skills to be developed and practiced, creating a foundation to facilitate advanced Observation skills required in other operations (i.e., infantry patrolling).

APPROACH

The goal of this project was to bring cutting edge scientific findings in perceptual skills training to the Warfighter’s fingertips. To accomplish this it was first necessary to identify skills critical to the target domain. Next it was necessary to develop a perceptual Knowledge, Skills and Abilities (KSA) taxonomy to facilitate a mapping of operational skills to perceptual skill constructs in the training science literature. Utilizing this mapping, training strategies with theoretically and empirically proven training effectiveness were identified. In this type of domain, advanced perceptual skills are an order of magnitude more complex than the simple laboratory perceptual skill tasks described in the literature. As such, training strategies tested in the laboratory may not meaningfully support this type of learning. This effort aimed to fill these gaps by leveraging extant research, while attempting to illustrate how these training strategies could be used to target the perceptual KSAs critical for military observation tasks.

Task Analysis

First, a task analysis was conducted and the tasks and subtasks necessary to perform OP missions were identified. For instance, a primary task when conducting OP operations involves scanning the environment with the naked eye to identify anomalies or threats. These tasks were then decomposed into general skills required for successful performance and the knowledge and abilities which serve as a foundation for these skills. With respect to scanning a scene, Warfighters must possess effective scanning skills based on spatial orientation abilities, and the ability for sustained attention and short term memory for areas which they have already searched. Also required is knowledge of effective search strategies, including where they should be scanning (i.e., high

priority areas). Table 1 contains an excerpt from the task analysis relevant to the examples discussed above.

Table 1. Excerpt from OP Task Analysis

Task	Skills	Abilities	Knowledge
Scan assigned sector with naked eye	Scanning	Sustained Attention, Spatial Orientation, Search Memory	Where to scan, How to Scan
	Attentional Weighting		What cues are relevant, Perceptual Memory (what object looks like)

Perceptual KSA Taxonomy

Given that the majority of the critical training objectives identified focused on the perceptual portion of the task, the aim was to decompose and translate the perceptual KSAs into constructs commonly addressed in the training science literature, so that the review of training strategies could focus on specific, target perceptual KSAs. In order to facilitate this translation, a taxonomy of perceptual KSAs was developed and is discussed below.

The Human Information Processing (HIP) model (attention, sensation, perception, response selection, response execution; Wickens & Flach, 1988) served as the basis of the taxonomy (see Figure 1).

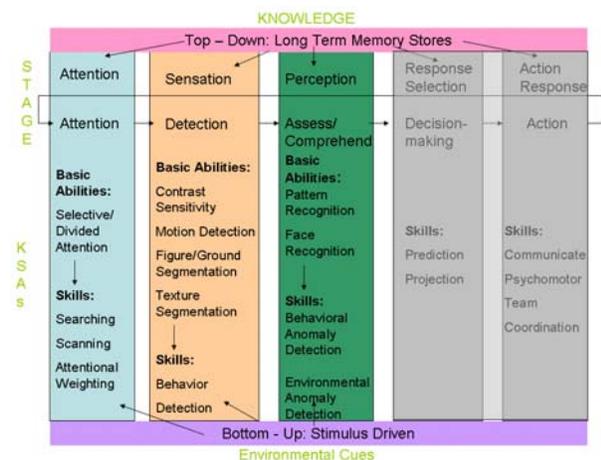


Figure 1. Perceptual KSA Taxonomy Conceptual Model

This model describes the process of bottom up and top down processing conducted by individuals to build

situation awareness (SA), conduct decision making (DM), and act upon the environment. The first three components (i.e. attention, sensation, perception) are considered key to Perceptual learning. Individuals progress through these three stages to perform a perceptual task and at any of these stages, an information processing breakdown could occur.

Given this, the goal was to map perceptual KSAs onto the first three stages of the HIP model to define the categories of Perceptual learning that are critical to situation awareness, decision making, and mission success. From this the notion is that training strategies to target these critical KSAs in each of the stages are triggered when metrics indicate failure in performing the target perceptual tasks. The following paragraphs discuss these three stages, how they interact and how they are relevant to a perceptual military observation task.

Attention

Attention is a top down and bottom up process which gives rise to conscious awareness by selecting between competing stimuli (Naish, 2005). From a top down point of view, attention is the first stage in a perceptual task as one directs their attention to relevant cues and regions of cues based on a priori knowledge of the environment or procedures. For example, in scanning the terrain during an OP task, a Warfighter will direct visual attention to different aspects of the terrain in looking for relevant cues which would indicate a threat (e.g. scanning left to right per procedure, scanning negative spaces). From a bottom up point of view, attention can result from a stimulus in the environment directing a person’s attention. For example, in scanning the terrain for a threat, a Warfighter may hear a rustle in the bushes or crack of a breaking branch which will cause attention to be shifted to the location from which the sound originated.

Sensation

Sensation is concerned with the first contact between the organism and the environment, the actual transfer of energy which occurs between the environment and a person (Coren et al., 2004). Sensation refers to initial detection of a stimulus (Pike and Edgar, 2005), be it a visual, auditory, haptic, olfactory or gustatory cue. Sensation can result from one directing their attention to a cue (top down). For example, a Warfighter scans negative spaces looking for indicators of a threat and detects an unnaturally dark and straight contour behind the brush (the barrel of a Dragunov sniper rifle). However, attention can often result from the sensation of a cue directing attention as well (bottom up) as illustrated in the section above.

Perception

Perception involves the analysis of sensory information, the process of constructing a description of the surrounding world (Pike and Edgar, 2005), the conscious experience of objects and object relationships (Coren et al., 2004). Once a cue is sensed, perception represents the resulting assessment and comprehension of what the cue means. To continue the example above, once the contour behind the brush is detected, perception describes the process of recognizing the contour as the barrel of a Dragunov sniper rifle and understanding that represents a threat that based on the distance from this threat it must be addressed.

KSA distinction

In addition to the HIP categorization, the taxonomy was further categorized based on the distinction between Knowledge (K), Skill (S) and Ability (A), to provide further definition and clarification with respect to the components of perceptual skills learning (see Table 2).

Table 2. Perceptual KSA Taxonomy

Stage 1: Attention	Knowledge: Knowing where key events are likely to occur
	Skill: Systematic scanning/refocusing to ensure relevant cues enter FOV & attended
	Ability: Ability to direct & divide attention
Stage 2: Sensation	Knowledge: Mental representation of what a stimulus looks, sounds, feels like (e.g. perceptual memory)
	Skill: Integration of piecemeal sensory information into a pattern or whole
	Ability: Ability to detect & discriminate basic multimodal cues e.g., color, shape, texture, movement, directional sound
Stage 3: Perception	Knowledge: Knowledge of what a mental representation / stimulus means for a situation (e.g. conceptual memory)
	Skill: Recognition of multimodal cues, object, patterns and comprehension of its meaning in a situation
	Ability: Spatial abilities which facilitate recognition

Knowledge refers to information stored in long term memory. Skill refers to a level of proficiency on a specific task or limited group of tasks (e.g. flying an airplane, etc.) In acquiring a skill, one acquires a sequence of responses required by a certain task. Hence, skills involved in complex activities can be

described in terms of more basic abilities. As such, skills are traditionally thought of as being trainable, whereas abilities are thought to be fairly resistant to change. Ability refers to a more general capacity of an individual, related and generalizable to performance in a variety of task that is fairly enduring and more difficult to change in an adult (Fleishman, 1967). Recent research on abilities has indicated that they may not be as resistant to training as once thought. Evidence suggests that perceptual learning (improvement in perceptual abilities), may result from neural plasticity, or the brain's ability to change structure and function (Kolb and Whishaw, 1998). Anatomical changes such as increase in dendritic length and synapse formation have been found to correlate with behavioral changes (Kolb and Whishaw, 1998). For abilities such as contrast sensitivity (Sowden, Rose, & Davies, 2002) and motion detection (Burns, et al, 2007), mere exposure to these stimuli have led to increased sensitivity/perceptual learning.

The general guidelines followed in the development of this taxonomy were as follows:

1. Knowledge refers to long term memory stores, including declarative/semantic knowledge (facts), episodic knowledge (past events) and procedural knowledge (how to). Knowledge can be specific to a task as with procedural knowledge or more global/abstract such as declarative knowledge. Knowledge is required for skill performance.

Example: Perceptual knowledge of physical representation of a sniper rifle

2. Skills are levels of proficiency reached on specific tasks. Abilities and knowledge facilitate performance of skills. Skills may or may not be generalizable across tasks as they are associated with performance of a specific task, however, tasks may be applicable to different domains.

Example: Search or Scanning

3. Abilities are basic building blocks of performance, low level processes which may be affected by training through perceptual learning caused by neural plasticity (Kolb and Whishaw, 1998).

Example: Contrast Sensitivity

Perceptual KSAs

Based on this taxonomy, KSAs within each category relevant to the military observation task were identified from review of both operational and scientific

literature. Approximately 50 relevant KSAs were identified. As there are countless perceptual KSAs, this taxonomy is not yet comprehensive and will continue to evolve over time. Table 3. contains an excerpt from the KSA list, including those deemed most critical and for which key training strategies were identified and will be discussed below.

Table 3. Excerpt from Perceptual KSAs

KSA	Description	Operationalized
Perceptual Knowledge/Memory	Veridical, largely non-verbalizable representation that develops via exposure to one stimuli; memory of what object looks like.	Perceptual representation in ones mind (e.g., gun barrel: two parallel contours, 2 feet long.)
Scanning/Search Skills	Where to scan/search while static (e.g., negative spaces) How to scan /search while static or moving (e.g. L to R)	Skills allowing integration of stimulus knowledge of where threats might be with environmental cues to know where to scan. Skills allowing proper scanning techniques while static or moving. (e.g. from left to right)
Figure/Ground or Shape Segmentation	Recognition of a shape in a cluttered environment	Ability to detect subtle anomaly such as shape of rifle against the leafy background of brush

Training Strategies

Once key perceptual KSAs were identified, a literature review was performed to identify training strategies, interventions and instructional methods that have proven successful in training these KSAs. From this list, a limited number of training strategies that were most relevant to the acceleration of target Perceptual KSAs were identified. These training strategies along with suggestions for how they can be applied in military observation training are discussed in the following section.

FINDINGS

Findings from the literature review resulted in over twenty five perceptual training strategies which were narrowed down to the seventeen perceptual training strategies most operationally and theoretically relevant, meaning, those training strategies which had the most scientific merit based on empirical and theoretical findings and which could be effectively integrated into military observation training. These strategies are presented along with the KSAs to which they are relevant and potential applications in operational training in Table 4. As the process for making significant changes to military training programs can be incredibly time consuming, the goal is for military instructors to be able to easily integrate these training interventions into their current Program of Instruction (POI). As such, the below table describes examples of simple instantiations of these strategies which may provide increased training value for military observation training.

Table 4. Perceptual Training Strategies, Associated KSAs and Potential Operational Training Applications

Training Strategy	KSAs	Application
Exogenous Orienting/Highlighting: Highlighting can be used to orient visual attention (Hagemann, Strauss, Cañal-Bruland, 2006) and enhance performance of visual search/scanning (De Koning et al., 2007; Chapmen, 2002 cited by Underwood, 2007).	Attentional Weighting, Scanning/Search Skills	Highlighting could be used within During Action Review (DAR) and After Action Review (AAR) feedback to draw trainees attention to critical cues in the scenario/environment which could potentially indicate a threat, such as a partially occluded gun barrel.
Feed-forward Training of expert scan patterns: Presentation of expert scans can increase search and detection performance (Nalanagula et al, 2006; Sadasivan, et al., 2005).	Scanning/Search Skills	Expert scan data could be presented as an overlay to training scenarios, both as feedforward or feedback to demonstrate how to scan an environment including critical areas to scan and scanning strategies to enhance threat detection.

Training Strategy	KSAs	Application
Scaffolding: Decomposition of task steps used as scaffolding can improve search skills (Guerlain et al., 2005).	Scanning/ Search Skills	Pre-training tutorials could provide a breakdown of the search steps necessary to ensure successful threat detection, including guidance on: 1) Where to look first (high priority areas), 2) How a scan should unfold (scanning strategies or patterns) from initial point, 3) How long to dwell on certain areas and when to move on, and 4) what key features should be attended.
Confidence Metacognition Feedback: Mentor-guided feedback with instructions encouraging trainees to monitor and use confidence levels to drive search strategies may improve search and assessment skills. (Nodine, et al., 2002)	Scanning/ Search Skills	During scenario performance, when trainees dwell for significant amounts of time on certain scenario features, trainees could be queried regarding their confidence in whether the cue indicates a threat and based on a predefined threshold, encouraged to act on threat or move on.
Use Low Conspicuity: Training on difficult to discriminate stimulus (i.e. closer to threshold) leads to development of more effective and global search strategies, hence better transfer than easy to discriminate stimulus (Doane et al., 1996)	Scanning/ Search Skills	Training scenarios should include well hidden targets difficult to discriminate from the background to ensure trainees are adequately challenged and have opportunity to develop more effective scanning strategies.
Computer Assisted Visual Search: Findings indicate that 70% of lesions not reported in mammogram reading attract visual attention, implying that such misses are covert negative decisions (Melo-Thoms et al., 2002). Feed back regions of interest that receive prolonged visual dwell so these regions can be re-evaluated. (Nodine, 2001)	Scanning/ Search Skills Pattern Recognition	Due to high probability of threat in the area, either within DAR or AAR, trainees attention could be drawn to areas on which they spent a significant amount of time visually interrogating, however, did not indicate as a target. Encouragement to re-evaluate may lead to increased target detection. This may also be a promising strategy to increase not only training performance but also operational performance.
Field of View (FOV) Control: Change viewer position to demonstrate significant features by bringing into FOV target features (Crowley et al, 2003).	Scanning/ Search Skills	Pre training tutorials or actual training scenarios could incorporate a forced Field of View (FOV) scan in which trainees FOV is forced into desired scan patterns, pausing for significant amounts of time on key features in the scene to encourage trainees to visually interrogate.
Expert Attention Models: Use expert models of attention allocation to show trainees how to allocate attention (Eccles et al, 2006).	Divided Attention	For tasks such as patrolling in which trainees must learn to efficiently allocate attention between scanning different aspects of the environment, checking team members, and utilizing tools such as binoculars, strategies for allocating attention between these different tasks could be prescribed based on how experts rotate their attention between these different aspects of the tasks. Trainees could be taught this sequence and timing as a model of performance.
Training Variation: Manipulate training content and aspects of the training environment (e.g., quantity/complexity of distracters, complexity of target).	Stimulus, Perceptual & Conceptual Knowledge	Training scenario difficulty should fluctuate, for example, by varying the location and orientation of the target, the level of occlusion and camouflage (contrast) of the target, the amount of clutter in the environment, and the visual similarity of clutter to target.
Massed Exposure: Massed exposure to stimuli leads to perceptual learning (Anna Schubo, Cristina Meinecke, 2007; Yi, Olson, & Chun, 2006; Burns, Nettelbeck, McPherson, 2007; Sowden, Rose, & Davies, 2002; Fahle, Edelman, & Poggio, 1995). This improvement in perceptual abilities results from mere exposure to stimulus over as little as 100 trials (Sowden, Rose, & Davies, 2002; Burns, et al, 2007; Ivanchenko & Jacobs, 2007).	Texture & Shape Segment, Contrast Sensitivity, Visual Acuity	Training curriculum could include a massed practice with feedback component in which trainees are quickly presented with numerous training stimuli and must detect a target across a broad range of situations. This exposure will quickly build their repertoire of experiences from which they can draw in future situations, a promising alternative to merely presenting specific exemplars of target feature categories and how to distinguish them (Sowden, et al., 2002).

Training Strategy	KSAs	Application
Negative Feedback: Perceptual abilities can be affected by reward/punishment; Figure ground segmentation was enforced by unpleasant audio cue associations (Hochberg & Brook, 1957).	Figure/ Ground or Shape Segmentation	Audio, both pleasant and unpleasant, could be used as a feedback mechanism to enforce search skills. Pleasant/positive audio played when trainees scan critical cues in scene could reinforce good scan strategies and unpleasant/negative audio played when trainee dwells on low priority areas could serve to discourage allocation of attention to non critical cues.
Practice with Knowledge of Results (KR) feedback: Practice with knowledge of results feedback has been shown to positively impact training performance (Jastorff, Kourtzi, & Giese, 2006; Wright and Fitzgerald, 2001).	Complex Motion Pattern Discrimination, Sound Localization	It is necessary to ensure trainees receive feedback with respect to good and poor aspects of their performance so they are aware of areas in need of improvement. Trainees could be given post performance feedback on the percentage of critical areas scanned, percentage of targets detected as well as locations of targets missed.
Minimum Stimulus: Pattern recognition skills are best developed in a minimum-stimulus environment because it provides the greatest degree of cue saliency for cues necessary for pattern identification skill development (Kass et al., 1991)	Objective/ Pattern Recognition	In training that attempts to both familiarize trainees with critical cues associated with targets such as IEDs and allow trainees to discriminate from non targets, the targets could first be presented out of context to allow trainees to explore the features of the IED without environmental distractions. Once trainees are familiar with the threat features, distracters in the training could be increased by embedding the targets in a competitive stimulus environment (e.g., cluttered scene).
SAGAT: Use a scenario based training task and freeze at random points and query 3 levels of SA (a la Endsley); encourage self-reflection on performance (Saus, Johnsen, Eid, and Thayer, 2006)	Situation Awareness	While searching a scene for threats such as IEDs and snipers, the screen could be blanked out and trainees could be asked to 1) describe what they saw in the scene, including high priority or suspicious objects or behaviors, 2) assign levels of threats to each object and 3) predict how the scenario would unfold next. The trainees could then watch the remainder of the scene unfold, acting on threats appropriately.
Multiple Representations. Learning activities must provide multiple representations of content from multiple perspectives (Spiro, Feltovitch, & Coulson, 1996).	Cognitive Flexibility	Training should include threats from an array of different perspectives (i.e., orientations, levels of occlusion and camouflage/contrast) to allow trainees to build viewpoint invariant representations of the threats, increasing their ability to recognize threats in novel positions.
Structured Variation. Revisiting same material, at different times, in rearranged contexts, for different purposes, from different conceptual perspectives is essential for advanced knowledge acquisition (Spiro, Feltovich, Jacobson, Coulson, 1991).	Cognitive Flexibility	Trainees should be presented with training scenarios which include situations which play out in a variety of ways. For example, a group of men gathered in the street in a Middle Eastern town could in some cases peacefully disperse, in some cases lead an ambush and in some cases collect intelligence which leads to a much later attack.
Attribute Isolation: Highlight central attributes of target concepts to improve general understanding of phenomenon. (Mason & Bruning, 2001).	Object & Pattern Recognition	Feedback aimed at correcting recognition errors could physically highlight key visual components and provide information that elaborates on the conceptual background knowledge associated with the physical cue (e.g., shimmer of light in a window may indicate the reflection off a sniper scope). This marries the perceptual knowledge with the conceptual knowledge necessary to recognize critical cues in the environment, improving trainees' ability to recognize threats in both similar and novel situations.

Application to Other Domains

Observations skills such as search and detection are foundational for almost any military task. These training strategies can be used across a range of training domains, not only Infantry Observation Post (OP). For instance, in the aviation domain, scanning and detection are critical for pilots (i.e., scanning instruments, detecting out of tolerance gauges; scanning windscreen, detecting other aircraft) as well as air traffic controllers (i.e., scanning radar, detecting incoming aircraft). Within the Combined Arms domain, a major portion of the Forward Observer and Forward Air Controller's task entails scanning the terrain and detecting enemy entities and incoming indirect fires and scanning the airspace to detect incoming aircraft. Similarly with Military Operations in Urban Terrain (MOUT) Room Clearing, it is necessary to ensure all building and rooms sectors are scanned and properly cleared of enemy combatants. Employing training interventions which support trainees in learning effective search strategies and gaining the ability to detect and recognize threats across of range of situations can lead to improved perceptual skill performance, resulting in increased levels of situation awareness and decision making in the field.

CONCLUSION

The goal of this effort was to leverage the theoretical and empirical findings in the training science literature to bring state of the art perceptual training strategies to the Warfighters to increase training and readiness levels. By marrying top-down theoretical and empirical findings with bottom-up domain knowledge, operational tasks and skills were mapped to scientific constructs to identify several scientifically validated training strategies which could be leveraged to train the Warfighter. From this, suggestions for how these training strategies could be used to target key observations skills such as search/scanning, detection and recognition were presented. The potential impact of incorporating these scientifically validated training interventions into current training programs is acceleration of skill development, resulting in "Training More" and "Training Faster. With the perpetual crunch to get Warfighters trained in key skills before deployment, the utilization of training strategies scientifically proven to improve skill performance can lead to 1) higher levels of proficiency within the same amount of time, 2) increased throughput as it takes fewer trials to get to criterion, and 3) preparation for

deployment in a shorter time period, hence leaving time to train other key skills which may not be trained previously due to time limitations.

Future work aims to validate the training effectiveness of a limited number of these strategies instantiated within a military observation domain. Those most theoretically and operationally relevant will be evaluated, resulting in the integration of effective perceptual training strategies into a Virtual Environment (VE) training system targeted to transition to the field.

ACKNOWLEDGEMENTS

The authors would like to acknowledge the support of the Office of Naval Research (ONR) and its Human Performance and Education program and the Combat Hunter instructors and organizers at the Marine Corp Warfighting Lab (MCWL) and the Marine Corp Training and Education Command (TECOM) who made this work possible.

This material is based upon work supported in part by ONR under Contract No. W911QY-07-C-0084. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views or the endorsement of ONR.

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