Warrior Resilience Training through Cognitive Self-Regulation

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Abstract - *Developing "Warrior Resiliency" has been a focus of armies since the dawn of time. There has been much research over the last decades to understand and provide systems and methodologies to develop and enhance cognitive resiliency in soldiers. The ability to adapt to adversity and overcome barriers in all walks of life is critical to a soldier's overall mental health and strength. And while physical resilience is very important, lack of psychological resilience can cripple a soldier just as easily as physical impairments. In addition to peak physical performance, each soldier must be well-balanced psychologically and socially in order to sustain the intense rigors of military life, especially when it must be balanced with home, family, and community life.*

Keywords: Cognitive Self-Regulation,

1. Introduction

What is described here is an automated, interactive, cognitive system, called the Cognitive, Interactive Training Environment (CITE, pronounced "KITE") that will provide the necessary cognitive psychological training to provide the warfighter with the ability to maintain mission readiness and psychological self-regulation before, during, and after stressful situations, whether in combat or at home. The CITE system utilizes advances in Artificial Cognitive Systems developed by Raytheon combined with Linguistic Ontological Technologies developed by Purdue University to create an interactive environment capable of providing training to and adapting to individual soldier's needs and requirements. CITE will provide automated, interactive training and capture and report metacognitive indicators and metrics that allow complete assessment of psychological resilience. CITE will gather and assess metacognitive indicators like:

- Problem solving skills
- Social skills
- Relationship Skills
- Self-awareness
- Emotional self-regulation
- Cognitive self-regulation

CITE will provide the soldier with training to assist in development of the self-monitoring and self-assessment skills needed for psychological self-regulation. Figure 1 illustrates the block diagram of the CITE system.

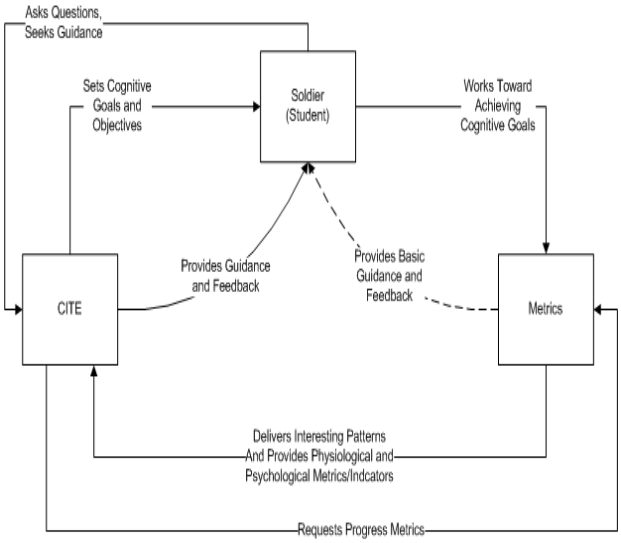

Figure 1 – Block Diagram of the CITE System

2. Warrior Resilience

The Office of Naval Research (ONR) website describes Warrior Resilience[1] as:

> "...improving the cognitive agility, flexibility and capacity of expeditionary warfighters by making them mentally tough, resilient to stress and well-adapted to chaotic, irregular environments"

In order to affect cognitive resiliency among warfighters, that must deal with a host of complex environments, both on and off the battlefield, an interactive training system must have a comprehensive understanding of the psychological, physical, and social elements and their interrelationships with warfighter performance. What we describe here is a comprehensive, Cognitive Interactive Training Environment (CITE, pronounces "kite") that will provide extensive, interactive, cognitive training and evaluation to provide warfighters with psychological self-evaluation, and self-awareness, and self-regulation skills to improve their cognitive performance throughout deployment as well as off the battlefield. We describe advanced instructional methods, based on Dr. Peter Levines [Levine 1997], autonomic nervous system states, that will provide cognitive behaviour training, metrics, and biomarkers that include environmental, contextual, and social components to affect real cognitive resiliency. The CITE system will provide the cognitive training tools to develop cognitive self-regulation and mitigation strategies to reduce cognitive dissonance among warfighters.

[1] http://www.onr.navy.mil/en/Media-Center/Fact-Sheets/Mental-Resilience-Cognitive-Agility.aspx

3. Cognitive Resiliency and Memory Development

Cognitive Resiliency develops in the brain through training that results in the learned ability to respond or self-regulate to severe psychological changes which may result from many forms of trauma and/or change; physical, emotional, environmental, or social. These learned abilities, then, get stored as memories within the human brain. Memories, in general, are divided according to the functions they serve [Newell 2003]. To qualify as a "memory" a cognitive input must cause both enduring changes within the nervous system (affect the autonomous nervous system states) and must also affect emotional and motivational responses and goals [LeDoux 1996]. A memory must induce some change that affects the nervous system and drives some physical change, in addition to modifying the human conceptual ontology, brought about by the memory being in the class of things that are affected by input, and therefore, affect other forms of behaviour. There are no memories that are neutral from a behavioural standpoint (Crowder and Friess 2010a].

4. Procedural Memory Development and Resiliency

One of the main divisions of human memory is "Procedural Memory." Procedural memory is a form of implicit memory that includes classical conditioning and the acquisition of skills. Procedural memory creation contains central pattern generators that form as a result of teaching or practice and are formed independently of conscious or declarative memory. In his work on Procedural Memory and contextual Representation, Kahana showed that retrieval of implicit procedural memories is a cue-dependent process that contains both semantic and temporal components (Kahana, Howard, and Plyn 2008)].

Creation of Procedural Memories is tied to not only repetition of tasks, but also to the richness of the semantic association structure (Landauer and Dumais 1997). In order to provide cognitive resilience, the CITE system provides interactive training that allows warfighters to create procedural memories, or "scripts" that have emotional, social, and psychological triggers and provide the skills required at the time for cognitive self-evaluation, self-awareness, and self-regulation to present or reduce psychological disorders, or problems, caused by trauma, either physical, psychological, or environmental [Crowder and Friess 2011a].

The CITE interactive training will provide a cognitive system that will interact and learn from the warfighter, developing strategies and training scenarios specific to that warfighter, thus allowing the warfighter to develop procedural memory strategies, i.e., implicit procedural memories, that will "kick in" under specific emotional memory queues, based on physical, emotional, psychological, and/or environmental events that the warfighter encounters. CITE will develop a model, or picture, or the warfighter's prefrontal cortex, based on the cognitive interactions with the system. This prefrontal cortex, or mediator, model (see Figure 2) allows CITE to understand the warfighters particular cognitive processes and what drives changes between emotional and cognitive states [Crowder and Friess 2011b] for that warfighter.

Based on these derived cognitive models, cognitive interactions between CITE and the warfigher will affect procedural memory creation, which will allow self-assessment, self-awareness, and self-regulation, driving cognitive self-soothing procedures to be initiated, greatly reducing mental stress and thus the possibilities of mental disorders [Crowder and Friess 2010b].

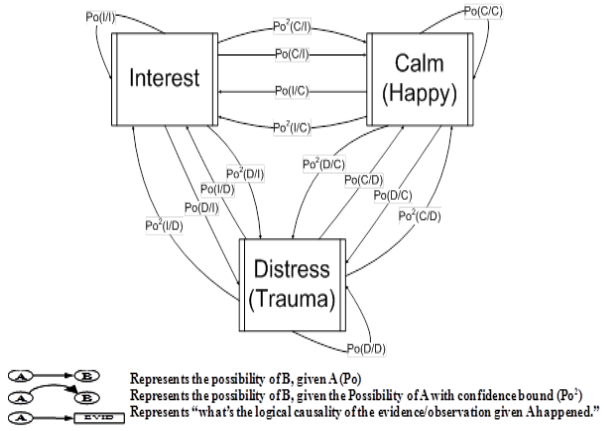

Figure 2 – Derived Warfighter Prefrontal Cortex Model, based on CITE interactions

5. The CITE Artificial Cognitive Neural Framework

The CITE warfighter cognitive models are derived through human-machine interactions and stored within the CITE Artificial Cognitive Neural Framework[2] (see Figure 3). In order to understand the world we live in, humans synthesize models that enable us to reason about what we perceive. Situations warfighters find themselves in, as well as the information they receive comes from a variety of sources, rendering it fuzzy. These diverse sources often do not have consistent contextual bases and this introduces ambiguity into the correlation and inferences the warfighter applies to the combined information. We have the ability to perceive the world we see and form our own concepts to describe and make decisions. To do this, we use language fuzzily and we communicate fuzzily, adapting and evolving our communication and processing to best fit the needs of our personal and conceptual views, along with our goals and vision for where we need to grow and evolve to [Zadeh 2004]. In order to understand and provide individualized resiliency training for

[2] Patent Pending

each warfighter, CITE must be able to organize information from the warfighter semantically into meaningful fuzzy concepts and models that provide a conceptual ontology [Raskin, Taylor, and Hempelmann 2010, and Taylor and Raskin 2010] of the individual warfighters cognitive abilities.

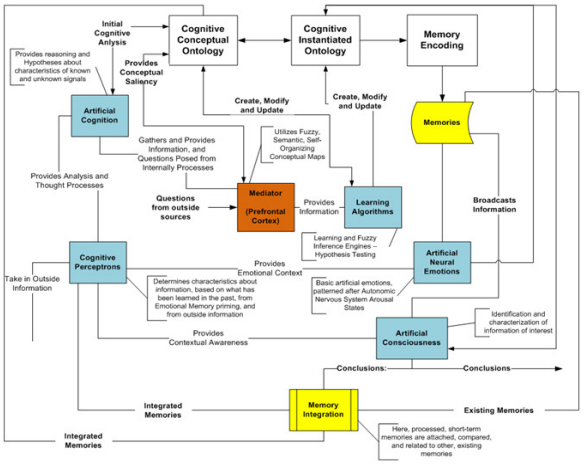

Figure 3 – The Artificial Cognitive Neural Framework

The purpose of these warfighter cognitive models is to provide cognitive knowledge products that reflect the state of being for the individual warfighter that includes metrics to measure cognitive resiliency for all aspects of life, to include battlefield, family and community.

6. Summary

What we have described is a cognitively interactive training system, CITE, that will allow warfighters to develop cognitive resiliency and provide knowledge products that reflects state of the art cognitive conditioning that minimizes injury, maximizes home station performance gains, and enables peak cognitive performance throughout deployment, and in garrison. This includes cognitive procedural memory development that will allow improvement in attitudes and knowledge about the value of proper nutrition, factors and fatigue, and the limits of sleep deprivation, through the use of cognitive self-awareness, self-evaluation, and self-regulation.

7. References

1. Crowder, J., and Friess, S. 2010a. Artificial Emotions and Emotional Memory. *Proceedings of the 11th Annual International Conference on Artificial Intelligence*, Las Vegas, Nevada.
2. Crowder, J. A., and Friess, S. 2010b. Artificial Neural Diagnostics and Prognostics: Self-Soothing in Cognitive Systems. *Proceedings of the 11th Annual International Conference on Artificial Intelligence*, Las Vegas, Nevada.
3. Crowder, J. and Friess, S. 2011a. Metacognition and Metamemory Concepts for AI Systems. *Proceedings of the 12th Annual International Conference on Artificial Intelligence*, Las Vegas, Nevada.
4. Crowder, J. and Friess, S. 2011b. The Artificial Prefrontal Cortex: Artificial Consciousness. *Proceedings of the 12th Annual International Conference on Artificial Intelligence*, Las Vegas, Nevada.
5. Crowder J., and Friess, S. 2012. Artificial Psychology: The Psychology of AI. *Proceedings of the International Multi-Conference on Information and Cybernetics*, Pasadena, CA.
6. Kahana, M. J., Howard, M. W., and Polyn, S. M. 2008. Associative retrieval processes in episodic memory. In H. L. Roediger III (Ed.), *Cognitive psychology of memory. Vol. 2 of Learning and memory: A comprehensive reference, 4 vols. (J. Byrne, Editor)*. Oxford: Elsevier.
7. LaBar KS and Cabeza. 2006. Cognitive Neuroscience of Emotional Memory. *Nat Rev Neurosci 7: 54-64*.
8. LeDoux JE. 1996. The Emotional Brain. *Simon and Schuster*, New York, NY.

9. Marsella, S., and Gratch J., "*A Step Towards Irrationality: Using Emotion to Change Belief*." 1st International Joint Conference on Autonomous Agents and Multi-Agent Systems, Bologna, Italy (July 2002).
10. Levine, P. 1997. Walking the Tiger: Healing Trauma. *North Atlantic Books*, Berkeley, CA.
11. Newell, A. 2003. Unified Theories of Cognition. *Harvard University Press*, Cambridge, MA.
12. Raskin, V., Taylor, J. M., & Hempelmann, C. F. 2010. Ontological semantic technology for detecting insider threat and social engineering. *New Security Paradigms Workshop*, Concord, MA.
13. Taylor, J. M., & Raskin, V. 2010. Fuzzy ontology for natural language. *29th International Conference of the North American Fuzzy Information Processing Society,* Toronto, Ontario, Canada.
14. Zadeh, L. 2004. A note of Web Intelligence, World Knowledge, and Fuzzy Logic. *Data and Knowledge Engineering, vol. 50, pp. 291-304*.