SUPPORTING THE ARMY TRANSFORMATION THROUGH COGNITIVE ENGINEERING: EVIDENCE FROM IMPROVED LANDMINE DETECTION CAPABILITY

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ABSTRACT

Improving soldier training will play a pivotal role in the Army Transformation. Cognitive Engineering Based on Expert Skill (CEBES) is a new approach to training design that can produce effective, efficient, and economical training. CEBES reverse-engineers the knowledge and skills used by experts in specific task-domains to develop cognitive models. The resulting models then serve as blueprints for training program development. CEBES has been applied to training operators of the currently fielded handheld landmine detection system (AN19/PSS-12) and the advanced technology HSTAMIDS. Both training programs produced substantial improvements in detection capability. These successful applications of CEBES in countermine training demonstrate the practical utility of this new technology and illustrate its potential as a method for improving training in other critical tasks.

1. INTRODUCTION

> "…Only through the synergy of parallel advances in doctrine, training, leader development, organizations, material, and Soldiers (DTLOMS) will the Objective Force achieve its full potential…"(U. S. Army, 2001)

Improving soldier training will play a pivotal role in the Army Transformation. Achieving the envisioned capabilities of the Objective Force and realizing the potential of its new technologies will require highly effective, efficient, and economical training. This paper describes a recent advance in training development methods with potential to support the Army Transformation by addressing its training needs. Here, we sketch a new scientifically-principled approach to training development called Cognitive Engineering Based on Expert Skill (CEBES), provide background on the threat-domain in which its practical utility was tested, the results observed, and their implications for broader application.

1.1 Cognitive Engineering Based on Expert Skill

CEBES applies the theory, principles, and methods of Cognitive Science -- rather than intuition -- to designing task-specific personnel training programs. This approach develops cognitive models of expert skill and then uses these models as blueprints for training. Reverse-engineering the knowledge and skills used by experts in performing important tasks produces such models. Just as microbiology's models of the genome support cloning organisms with desirable properties, the CEBES approach uses models of expertise as templates for replicating the knowledge and skills that are the foundation of exemplary human performance.

The advantage of the CEBES approach over conventional training design has been demonstrated in two recent landmine detection training projects carried out collaboratively by ARL and academic personnel under ARO, CECOM, and AMC-FAST sponsorship. Both efforts used the tools of Cognitive Science to literally *engineer* training programs for operators of the currently fielded (AN19/PSS-12) and forthcoming (HSTAMIDS) handheld mine detection systems.

2. APPLICATIONS OF CEBES TO COUNTERMINE

Hambric and Schenck's (1996) assessment of the landmine threat stated "Mines are a major threat in all types of combat and will be the major threat in Operations Other than War (OOTW) which are expected to be the most likely missions for US forces in the future…The widespread employment of landmines threatens to neutralize US advantages in firepower and mobility by severely limiting our ability to maneuver and disrupting our tactical synchronization." Subsequent observations in Operations Joint Endeavor (Schneck & Green, 1997) and Enduring Freedom (LaMoe & Read, 2002) have validated this assessment and suggest that its severity may have been underestimated. Ominously, the countermine problem seen in the contemporary operational environment is predicted to worsen (LaMoe & Read, 2002). Part of the challenge for the Objective Force will certainly involve developing new and better resources to counter this effective and growing threat.

2.1 CEBES Training Effects with Legacy Equipment

The CEBES approach has improved countermine capability with legacy technology, producing new operator training for the currently fielded handheld mine detector (AN19/PSS12) (Staszewski, 2001a, 2001b; Staszewski & Davison, 2000). Multiple tests using US Army personnel

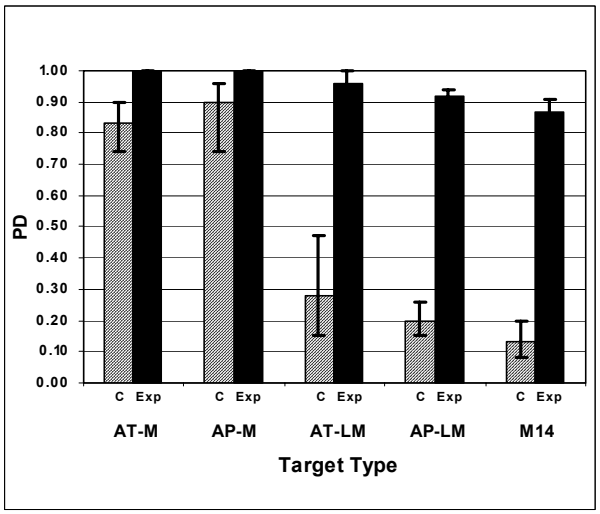

Figure 1

showed that a new training program, based on a model of PSS-12 expertise, (Staszewski, 1999) dramatically improved soldiers' detection capabilities (Staszewski & Davison, 2000). As seen in Figure 1, the greatest improvements in performance, relative to the performance of soldiers with standard training (striped bars), were against the most severe threat: small, anti-personnel land mines with low-metallic content. Review of these results by a U.S. Army Engineer School DTLOMS Board has led to force-wide adoption of the program's training and TTPS in February 2002. Mobile training teams are now disseminating the program to units worldwide.

2.2 CEBES Training Effects with HSTAMIDS

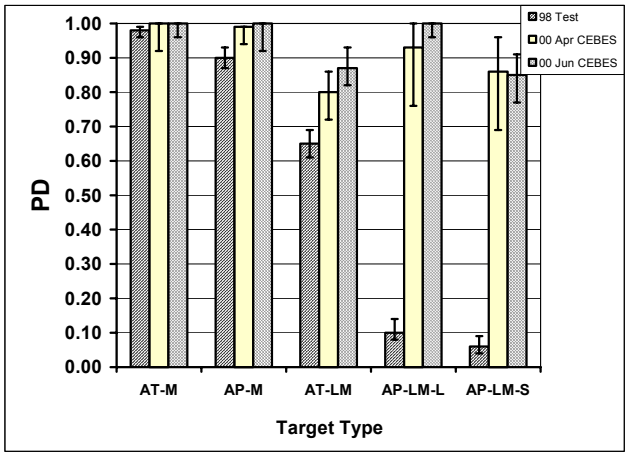

Figure 2

CEBES training for operators of the forthcoming Handheld Standoff Mine Detection System (HSTAMIDS) has also helped boost initially substandard developmental test performance (striped bars in Figure 2) to levels (white and hatched bars) that led to program continuation and guided further system development and improvement. A near-term deployment of the HSTAMIDS is planned. Significantly, these results showed that the CEBES approach could be applied successfully to developing training for advanced technologies still under development.

3. CONCLUSION

The results of these two mine detection training projects illustrate the gains producible with improved training for both fielded and emerging technologies. They also demonstrate the practical utility of the CEBES approach to training design. The findings suggest that application of CEBES to a wider range of military training tasks, particularly training soldiers on new warfighting and security technologies, offers a scientifically-principled, effective, and practical way to develop the capabilities needed by the Objective Force as effectively, efficiently, and as economically as possible.

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