A "THIN-SLICING" APPROACH TO UNDERSTANDING COGNITIVE CHALLENGES IN REAL-TIME COMMAND AND CONTROL

Jill L. Drury and Erika Darling[1]

Abstract. Before modernizing any information-intensive system, it is important to understand how people are performing their jobs using that system. This understanding is built not simply by observing what people are doing, but by digging into how people think about their jobs, what coordination they need to do, and the dependencies among subtasks that together dictate a workflow. Building a thorough understanding of complex tasks takes weeks or months rather than days, but we needed to get as much of an understanding as possible in three days of a real-time command and control centre for military unmanned vehicles. To help structure our investigation, we used a technique called Applied Cognitive Task Analysis (ACTA) [14]. To the best of our knowledge, ours is the first use of ACTA to study a military command and control centre in such a time-compressed fashion. We describe our application of ACTA and the types of recommendations we were able to generate from our analysis, and provide reflections on the study process. Another contribution of this paper is based on the fact that we were able to gain access to a facility that is not usually open to researchers; hence the ACTA results may be of interest to those who would benefit from knowing about the major cognitive challenges facing members of the Predator Unmanned Aircraft System community.

INTRODUCTION

Background

The Predator Unmanned Aircraft Systems (UASs) are becoming increasingly useful to US and coalition military operations. The number and complexity of Predator missions is rising as requests for Predators' services pour in. To ease coordinating and supporting Predator missions, the Predator Operations Center (POC) was opened at Nellis Air Force Base (AFB).

The POC is rapidly evolving as new technologies and operational procedures are tried, evaluated, and kept or discarded. What is unusual in the world of military acquisition and command and control center design is just how rapidly the POC is changing. Instead of months or years, some POC changes are happening in days or weeks.

We are convinced that understanding and documenting POC operators' cognitive demands is key to designing better technology for them: in particular, better visualization of information for decision-making and better means of facilitating collaboration. Understanding cognition is difficult, however, because the POC operations tempo leaves little time for operators to work with analysts. Also, analysis methods that attempt to document how operators do their jobs at a detailed level will likely result in studies that are obsolete before they are completed.

We concluded that we needed a type of cognitive task analysis (CTA) that could be performed extremely rapidly. The traditional task analysis technique often used as the starting point for CTA is Hierarchical Task Analysis, in which "tasks are represented in terms of a hierarchy of goals and subgoals, using the idea of plans to show when the subgoals need to be carried out" [19, p. 1]. CTA is an appropriate means of understanding cognitive challenges because such techniques were designed to be "the extension of traditional task analysis techniques to yield information about the knowledge, thought processes, and goal structures that underlie observable task performance" [1, p. 3].

We needed to gather all data, with the possible exception of later sending email messages with a few follow-up questions, during a three-day period. Because of the need to form almost instant—yet correct—impressions of operators' cognitive challenges, we were reminded of the phrase "the power of thin-slicing" from psychology: "as human beings we are capable of making sense of situations based on the thinnest slice of experience" [6, pp. 43-44].

Choosing a CTA Technique

Unfortunately, CTA has not matured to the point where there is consensus regarding which CTA technique should be used in which situation. There are many CTA techniques: in fact, whole books full of them [17]. We examined some of the most frequently cited variants of CTA before determining the one that would be most appropriate for our analysis needs. We considered each technique based on whether it would allow us to accurately capture as many major cognitive challenges as possible within a three day period, be as non-disruptive as possible, not require recording and/or instrumentation, and take into account a dynamic, team-based environment. By "non-disruptive," we mean that gathering the data could not adversely impact POC operations, which proceed for 24 hours per day, seven days per week.

Specifically, we considered six methods:

- Goal Directed Task Analysis (GDTA) [4].
- Team CTA [12].
- Task-Knowledge Structures (TKS) [10].
- Critical Decision Method (CDM) [11].
- Simplified Precursor, Action, Result, and Interpretation (Simplified PARI) [18].
- Applied Cognitive Task Analysis (ACTA) [13,14].

GDTA and Team CTA

GDTA [4] is an interview and observation-based technique that decomposes tasks at a fine-grained level and then examines the situation awareness needed for each part of the tasks. Team CTA [12] extends task analysis techniques designed for individuals to accommodate phenomena such as team members' interdependence and cooperation. Note that both GDTA and Team CTA build on traditional task analysis techniques that normally require analysts to examine each work unit (the lowest-level standalone task) in great detail.

[1] The MITRE Corporation, 202 Burlington Rd., Bedford, MA 01730 USA.