Team Cognition in Intelligence Analysis

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While intelligence analysis has become the focus of much recent research, there has been a shortage of research in team cognition for analytical tasks and effective training strategies for analysis. This study investigates the effectiveness of teams of analysts in a training exercise. In order to capture the dynamics and nuances of multiple large teams of practitioners concurrently struggling with a realistic scenario, we used a unique adaptation of established ethnographic methods. The goal of this qualitative research was to determine persistent analytical strategies and study the interplay between the critical support functions of macrocognition for teams of novice analysts. Findings from this study suggest strategies for improving performance and training for intelligence analysts.

INTRODUCTION

Since the terrorist attacks of September 11, 2001, intelligence analysis has become the focus of much research. Given the technical nature of intelligence collection and the distributed nature of intelligence analysis, it stands to reason that much of this research would focus on technology and representational aiding to support the analyst. There has, however, been a shortage of research in team cognition for analytical tasks and effective training strategies for analysis. This study investigates the effectiveness of teams of analysts in a training exercise. In order to capture the dynamics and nuances of multiple large teams of practitioners concurrently struggling with a realistic scenario, we used a unique adaptation of established ethnographic methods. The goal of this qualitative research was to determine persistent analytical strategies and study the interplay between the critical support functions of macrocognition for teams of novice analysts. Findings from this study suggest strategies for improving performance and training for intelligence analysts.

METHODS

In this study, an interdisciplinary team of observers used a federated approach to observe a five-day training exercise at the U.S. Army Intelligence Center at Fort Huachuca, Arizona. (For a complete description of the methods see Trent, et al., 2007) The training exercise, which was designed and supervised by instructors at the Intelligence Center, was a fictitious military operation in 1940’s Great Britain. Germany had occupied England and was combating British insurgents. Trainees were given the assignment to serve as the intelligence section for a German infantry brigade. Their fictitious predecessors had been destroyed by a British attack and they were responsible for assembling the remnants of the last team’s analysis. This data and new reports would be required to determine the disposition, modus operandi, and likely targets for the British insurgency. The goals of this training exercise were to teach analysis of insurgent methods, presentation of analytical assessments to a military commander, and Analysis of Competing Hypothesis (cf. Heuer, 1999).

The participants in this study were military intelligence captains who were mid-way through their mandatory 20-week Captains Career Course. As military intelligence captains, they are analysts and analyst supervisors with a bachelors degree and an average of four years of military service in either combat arms or military intelligence. The class of 40 captains was randomly divided by the instructors into four independent squads at the beginning of the course. These teams simultaneously executed the same scenario under the supervision of the training cadre. Each team was assigned to a separate room equipped with dry erase boards, maps, overlay materials, and four computers with standard desktop applications.

Prior to the exercise, all teams were provided the same briefing and background material which included an intelligence assessment from their higher headquarters. Throughout the exercise at approximately two hour intervals, teams received hand delivered reports about activity in their area. Additionally, instructors intervened at predetermined intervals in order to help teams interpret available information and encourage improvements to their analytical process. At the end of each day, all teams briefed a prepared assessment of the insurgent activity to an instructor role-playing their commander. All teams received the same reports and similar interventions and briefed their commanders at approximately the same time. As a result, these events served as embedded
probes to elicit cognitive challenges and team mindsets without observer interaction.

The study of distributed work in complex domains is typically hampered by two aspects – the complexities of the tasks that are particular to the domain, and the concurrent work taking place in multiple locations. Well-adapted cognitive work occurs with a fluency that disguises the resolution of difficult demands and dilemmas (Woods & Hollnagel, 2006). Researchers may overlook critical vulnerabilities due to unfamiliarity with the work and may not be able to observe distributed interactions and simultaneous processes. In order to gain familiarity with the scenario, the observation team took part in a two-day compressed version of the training scenario. This experience helped the observers understand the operational language of the domain as well as typical instructor interventions. Additionally, the observation team would be able to anticipate particularly interesting or challenging segments of the scenario.

In order to observe the concurrent work of the four teams, one observer was assigned to each of the four teams while two observers established a command post in an adjacent room. The observers transmitted all observations for their team via asynchronous instant messaging software to the command post. The command post saved all observation logs and cross-cued observers as interesting behaviors emerged. The primary investigator, who is a military intelligence officer, retained the ability to move between the teams, discuss performance with instructors and interact directly or via the command post with observers to clarify domain-specific activity. At the end of each day, the observation team held a “hot wash” in order to refine observation protocol and share general perceptions about participant performance. Each observer was responsible for summarizing their transcripts prior to the next day’s observations. In effect, the observers were the source of data as well as diagnosticians with respect to their data.

One other source for data was the instructors. Having conducted this exercise multiple times for earlier classes, they were familiar with common areas of difficulty. Discussions with them before and during the exercise served as predictive indicators of team behavior. This allowed the command center to prime observers for points of interest. Most significant, however, was their feedback to the teams during the daily briefings, the discourse generated during their instructor interventions and their final judgments of whether the teams passed or failed on the final briefing. These instances served as expert judgments of behavior and opportunities for externalization of team cognition.

All further analysis was done by the primary investigator (PI). After reading the summaries and transcripts, the PI traced the processes for each team. These process traces categorized observations in the following manner:
- Team interpretation of report
- Working hypotheses about the scenario
- Instructor interventions
- Other team activity

By placing all observations on a timeline with respect to the incoming reports, comparative analysis of the teams’ cognition could be conducted. Patterns emerging from this analysis suggest findings relevant for design and pedagogy in analysis.

**FINDINGS**

As intelligence analysts, the teams in this study were responsible for inferring the following information for their commanders: the organization and modus operandi of the insurgents and a list of high value targets that should be protected. In this study, the teams were presented with a “Garden Path” scenario, in that the initial intelligence assessment indicated that British Commandos were waging the insurgency. Subsequent reports would increasingly indicate that there were no Commandos, but rather a local militia. They were also presented with an “Emerging Path” scenario in that they initially had no information on the next likely target for the insurgents. Subsequent reports would indicate that the insurgents were planning another attack on their headquarters. In the end, the instructors judged that Teams One and Three passed and Teams Two and Four failed. Team Two had the correct assessment, but their final briefing did not convey sufficient analytical rigor (i.e. they did not articulate how their assumptions were supported by facts). Team Four actually reverted back to an earlier incorrect assessment on the last day. Interim briefings and behavior within the four teams suggested some strategies contributed to better team cognition.

![Figure 1 - Comparison of Room Layout and Activity](image-url)
Open Workspaces

In this study, teams were provided the same materials (e.g. dry erase boards, tack boards, computers, maps and tables) and were free to organize their tasks and workspace as they saw fit. Figure 1 depicts the room layouts of the four teams. While the physical layout of workspaces differed between teams, the manner in which teams used these spaces also varied dramatically. The two successful teams (One and Three) arranged their workspace to allow for a large common area in which team members frequently huddled around large analytical artifacts (e.g. map boards, dry erase boards). For example, Team One always had at least two members conversing over the shared artifacts and held team meetings three or four times throughout the eight hour workday. On the other hand, teams Two and Four, which had to redo their final briefings, worked in small isolated teams around the peripheries of their rooms. Team Four held no team meetings until the final day, with the team leader moving about the room serving as the team’s synthesizer for information from the sub-groups.

Teams were also able to realize interim successes with the help of open tools. One early success story for three teams was that they were able to rapidly deduce the insurgents’ operational timeline (i.e. hours before the other team) by posting their activity on a wall-sized calendar which allowed them to perceive the pattern easily. Based on these differences in configuration and team behavior, it is likely that externalized cognitive work aided in collaborative analysis.

Work Balance Dilemma

Cognitive systems engineers have proposed a model for macrocognition that includes sense making, coordination, planning, adaptation, problem detection and naturalistic decision making (Klein, et al., 2003). However, the relationship between these functions is not clear.

Time constrained intelligence analysis can be seen as a cognitive workflow. While the process is certainly iterative, there overall success depends on balancing the requisite functions within the allotted time. A model of how intelligence teams might balance their cognitive work is illustrated in Figure 2. In this model, the team receives the initial analytical task, or completes a briefing to the commander (CDR), and plans their analytical work for the upcoming cycle. Once division of labor, initial guidance and a production schedule are issued, the team begins to process available information. Intermittent episodes of coordination complement sensemaking in established working groups.

Experienced military intelligence teams use backward planning in order to ensure that they have adequate time to select a course of action (COA) and prepare the commander’s brief. Additionally, a system of indications and warnings facilitates ongoing problem detection. For larger organizations, this function may be specifically assigned to a sub-group. When an anomaly has been detected, experienced teams begin to adapt and the resulting replanning causes further time compression as the sensemaking and coordination must begin anew.

This study elicited multiple instances of inexpert teams falling behind in their cognitive work. These instances can be generally characterized as one of two types of cognitive work misbalance. The first (Type I) type, as depicted in Figure 3, includes instances where sensemaking tasks (i.e. working in sub-groups, individual analytical tools, reading reports, hypothesis exploration) get in the way of coordination efforts. This usually results in teams being unable to share their assessments with a decision maker or being rushed to prepare briefings. This was the most common misbalance observed in this study and was seen on five occasions.

Team One experienced this misbalance on two occasions. On Day 3, they decided that many of the team members were unfamiliar with the many reports that they had received, so they decided to review all of them in a team meeting. This two and a half hour meeting lasted until the instructor entered for the end of the day brief, leaving them with no time to prepare. On this same day, the social network analysis sub-group worked independently the entire time. They dedicated no time to preparing a product based on their analysis, so they had no way to share their analysis and struggled to articulate it themselves. On Day 4, the instructor prompts them to depict their hypotheses for testing and briefing. Instead of doing this, they spend the day discussing and elaborating on their favored hypothesis.

Figure 2 – Model of macrocognitive work in time constrained analysis – a prolonged period of sensemaking coincides with intermittent periods of coordination. At some point, team must decide on favored hypothesis and prepare briefing for commander to communicate their analysis. Mechanism for anomaly detection is present throughout, which can cause a further time constrained process.

Team Two experienced this misbalance on Day 1. They spent all day making analytical tools (e.g. terrain analysis product and calendar of past events), but do not complete geospatial pattern analysis and are unable to form a coherent assessment by the end of the day. As the time for their briefing arrives, the instructor states that he will be 25 minutes late for the briefing. Interestingly, despite noticing the shortcoming in synthesis and preparation for coordination, they do no further work during this extra time.
Team Four experienced this misbalance on both Days 1 and 2. On Day 1, two individuals rapidly develop a temporal analysis of past events, but the team produces no geospatial analysis. They spent two days working in insular sub-groups on individual intelligence products and hold no team meetings. There were several hours in the first day in which no words were spoken. This was made worse because they had no one assigned to read incoming reports until the end of Day 2.

This team also demonstrated a second type (Type II) of work misbalance that may have been a bit of overcompensation from their shortcomings in Days 1 and 2. As Figure 4 illustrates, Team 4 spent most of its resources preparing briefing slides during Day 3. This misbalance can result in inadequate resources being dedicated to sensemaking (i.e. hypothesis exploration) at the team level. Consequently, it also leaves teams vulnerable to undetected anomalies.

Team Four actually exhibited their most balanced cognitive work during Day 4. Due to the coordination and team-level sensemaking efforts of the leader, they were prepared with an accurate assessment for their daily briefing. In Day 5 of the exercise, a new team leader for Team Four held the longest (1 hour) sustained team meeting to discuss their assessment.

Table 1 summarizes the instances of cognitive work misbalances that were observed in this study. Team Three was the only team that exhibited no discernible evidence of falling behind and they passed in the end. Team Four exhibited the most instances of misbalance and they ultimately failed.

**DISCUSSION**

This study has illustrated the complexities and necessity of research in training and team cognition in realistic settings. Given this preliminary look at the data from this study, we see further support for Hutchins (1995) call for Open Tools in the collaborative workplace. Furthermore, we have observed that it is not merely the material or tool that is important, but rather it is also how the workspace is used that creates open or private work.
Our data suggests that inexpert teams find it difficult to manage macrocognitive workloads, and often find themselves falling behind as a result. Designers and educators for analytical communities should account for and support analysts with this work balance dilemma.

Finally, this study suggests the persistence of story construction as an analytical strategy. Inexpert analysts will find it difficult to adopt new strategies and it is likely that time constrained or fatigued teams will revert to these strategies. Furthermore, it is not entirely clear that one strategy is better than the other. Further research is warranted in determining when particular analytical strategies are weak or sufficient.

Acknowledgements
This research was supported by the Department of Defense (BAA-001-04). The views are those of the authors and do not necessarily reflect those of the Department of Defense, the Army or the United States Military Academy. We especially would like to thank the staff of the Military Intelligence Captains Career Course at Fort Huachuca, AZ for their assistance and permission to conduct this study.

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