Understanding Reliance and Trust in Decision Aids for UAV Target Identification

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ABSTRACT

The use of automation is prevalent in almost every aspect of modern life, and since its inception researchers have been investigating trust in automation. There are many methods of measuring trust. Given that trust means different things to different people and by nature is subjective, most methods are subjective survey assessments (Freedy, DeVisser, Weltman, & Coeyman, 2007; Jian, Bisantz, & Drury, 2000). Many studies have investigated how the reliability of an automated agent or the level of automation changes subjective trust in the automation (Dixon & Wickens, 2006; Du, Zhang, & Yang, 2018; Khasawneh, Rogers, Bertrand, Madathil, & Gramopadhye, 2019; Rogers, Khasawneh, Bertrand, & Madathil, 2017).

Reliance can be measured objectively either by measuring the time a user spends using the automation or setting a benchmark of use, but a recent study focuses on the use of eye tracking to measure reliance based on visual attention (Lu & Sarter, 2018). Lu and Sarter (2018) developed a UAV target assessment task with automation assistance; however, the automation was in the same area of interest as the visual search task. To further investigate how reliance and trust are affected by reliability of automated agents and task complexity, we separated the automation on the display and varied the number of UAVs to control. This study aims to answer the following research questions:

1. How do operators use automated agents in a target search task and how does this change with lower reliability agents?
2. How are reliance on automated agents and trust in automated agents related?
3. How does increased task complexity change reliance and trust in automated agents?
4. How do reliance on automated agents and task complexity effect performance in target search tasks?

The interface, shown in Figure 1, was used by 30 university students who were recruited to participate as operators in a UAV target identification task for a 20 minute mission. Participants were randomly assigned to either high reliability automation (90% hit rate, 10% miss rate) or low reliability (50% hit rate) and completed 2 simulations (the order of which was counterbalanced), one with 2 UAVs and one with 4 UAVs. Participants were asked to search for the red dots in the environment. They could use a joystick to scan the environment along the flight paths, or monitor the automation cues, and tag targets with the trigger as quickly as they could while responding to periodic questions from ground control.

Participants were primed to the automation reliability based on prior research (Lu & Sarter, 2018), participants in the high reliability condition were told they have new sensors in their UAVs, participants in low reliability were told they have old or worn out sensors. Participants were asked every two minutes to rate their subjective trust and asked to rate their trust on a 12 item Trust in Automation Scale after the simulation. Using a Tobii X60 eye tracker we collected fixations to measure reliance on the automation. Workload was measured using NASA-TLX, as well as accuracy and time to respond to the chat questions. Target tagging performance, time to tag and percentage of targets tagged, was also collected by the simulation.

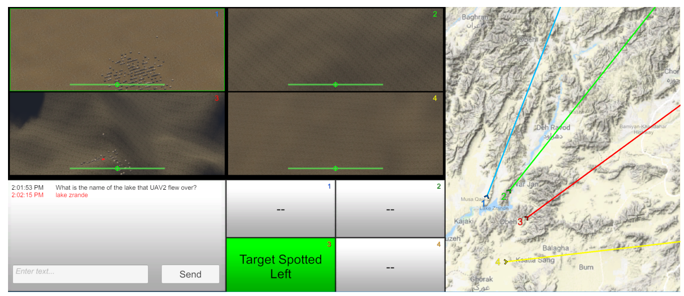

Figure 1: User view of 4 UAV condition interface with a target spotted on UAV 3 path

The results presented here are only for the 4 UAV condition to determine differences between reliability conditions as we are in the process of collecting data.

One-way between subjects ANOVAs using ezANOVA in R were conducted to determine differences in the dependent variables. The average of trust ratings taken during the simulation was significantly higher in the high reliability condition than the low reliability. Many of the subscales of trust in the Trust in Automation Scale also indicated significantly higher levels of trust with high reliability automation. Reliance changed between the reliability conditions; total fixation duration on the UAV visual was significantly longer in the low reliability condition, meaning participants used their own searching ability for a longer duration in that condition. It is possible that given the large area to search for targets and ability to manipulate UAV view contributed to longer fixation on the UAV visuals. However, high reliability automation did improve tagging performance, and the only measure of workload that was higher in low reliability was frustration. Moderate correlations were found between subjective trust measures and reliability measures.

The findings of this experiment support some of the conclusions of previous research, that reliability of automated agents affects operator reliance, trust and performance. However, future research should further investigate reliance and trust given the moderate correlations found in this study and determine how task complexity changes the trust and workload in these tasks.

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