Eliminating the Speed-Accuracy Tradeoff with Highly Reliable Automation.

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Automated systems of various forms are used to assist human operators in a wide variety of tasks, including UAV operations. Automation aids humans through information acquisition, system diagnosis, response selection, and response execution (Parasuraman, Sheridan & Wickens, 2000). Recently, much research has focused on diagnostic automation with mixed results. Although highly reliable aids can improve human performance relative to unaided conditions (Dixon, Wickens & Chang, 2006), many studies have revealed that the benefits of an automated aid are often less than might be expected (Dixon, Wickens & McCarley, in press; Wiegmann, McCarley, Kramer and Wickens, 2006). An important goal for applied psychology, thus, is to find ways to encourage more optimal patterns of human interaction with automation. The goal of the current study was to analyze these effects in the UAV paradigm, specifically when UAV operators are monitoring top-down camera angles while searching for potential ground targets.

The present experiment tested a potential technique for encouraging more appropriate human reliance on automation and thereby improving human-machine system performance. Participants in our experiment performed a simulated target-acquisition task, whereby they searched static top-down color photos for tanks that were located in semi-random locations. Half of the images contained a tank, while the other half did not. Participants indicated their responses by pressing a button either for "tank-present" or "tank-absent". In some conditions, participants were aided by a diagnostic aid that presented a test message before each trial indicating whether or not the aid had detected a tank. This aid was either 100%, 95%, 80% or 65% reliable, and erred by either making false alarms or misses.

Our main hypothesis was that speed-oriented instructions could be used to switch people into a heuristic mode of processing (Gigerenzer & Goldstein, 2000; Hogarth, 1981), and thereby increase their dependence on the automated aid relative to when unspeeded instructions were used. Previous research has indicated that time constraints induce heuristic processing (Klein, 1998). It follows that if participants in the current task are placed under time pressure via instructions to maximize response speed, their compliance to the automated aid should increase relative to that of participants who receive unspeeded instructions via use of a "compliance heuristic" to overcome the time pressure.

Heuristic processing was thus expected to increase speed of responding regardless of the reliability of the automated aid, but was expected to also increase accuracy only when the aid was highly reliable. Consistent with these hypotheses, data showed a conventional speed-accuracy tradeoff for operators working with an automated aid of low reliability, but a reverse speed-accuracy tradeoff for operators working with a highly reliable aid. That is, when the aid was highly reliable, human-machine performance improved as a function of accuracy *and* response time. These effects were more pronounced when the task was relatively difficult. Practical implications are that UAV operators who are placed under time pressure may become more compliant with diagnostic automation via the compliance heuristic described above. However, this benefit may be mediated by task difficulty.