

Thoughts in Flight: Automation Use and Pilots' Task-Related and Task-Unrelated Thought

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Objective: The objective was to examine the relationship between cockpit automation use and task-related and task-unrelated thought among airline pilots.

Background: Studies find that cockpit automation can sometimes relieve pilots of tedious control tasks and afford them more time to think ahead. Paradoxically, automation has also been shown to lead to lesser awareness. These results prompt the question of what pilots think about while using automation.

Method: A total of 18 airline pilots flew a Boeing 747-400 simulator while we recorded which of two levels of automation they used. As they worked, pilots were verbally probed about what they were thinking. Pilots were asked to categorize their thoughts as pertaining to (a) a specific task at hand, (b) higher-level flight-related thoughts (e.g., planning ahead), or (c) thoughts unrelated to the flight. Pilots' performance was also measured.

Results: Pilots reported a smaller percentage of task-at-hand thoughts (27% vs. 50%) and a greater percentage of higher-level flight-related thoughts (56% vs. 29%) when using the higher level of automation. However, when all was going according to plan, using either level of automation, pilots also reported a higher percentage of task-unrelated thoughts (21%) than they did when in the midst of an unsuccessful performance (7%). Task-unrelated thoughts peaked at 25% when pilots were not interacting with the automation.

Conclusion: Although cockpit automation may provide pilots with more time to think, it may encourage pilots to reinvest only some of this mental free time in thinking flight-related thoughts.

Application: This research informs the design of human-automation systems that more meaningfully engage the human operator.

Keywords: cockpit automation, awareness, mind wandering, attention

INTRODUCTION

An often-touted benefit of the introduction of automation to the airline cockpit is that it frees pilots' attention from tedious control tasks and affords them more time to look up, think ahead, and focus on "the big picture" of the flight. Time once spent staring at a few instruments can now be devoted to planning around potential weather hazards, monitoring the health of the airplane's many systems, fielding requests from air traffic control, or contemplating alternatives should anything go amiss (Norman & Orlady, 1988; Wiener, 1988). Numerous studies have confirmed that, at least during some phases of flight, automation can indeed help lower pilot workload and free up time (Casner, 2009; Roscoe, 1992; Wiener, 1989). This leaves us with the question of how pilots make use of this free time. It is every flight instructor's dream that pilots would use this time in the ways just described: to think ahead or mentally prepare themselves for any contingencies that might arise. But contrary to these hopes, studies of pilots flying while using high levels of automation cast some doubt on the idea that pilots are using their free time in this way. In more than one experiment, when awareness was tested, pilots failed to answer basic questions about their situation (Endsley & Kiris, 1995) or even know where they were (Casner, 2005).

Two explanations have been proposed for the loss of awareness associated with the use of automation. A first explanation is that, during periods in which the automation is used and things are going well, pilots might engage in what psychologists have referred to as "task-unrelated thought" or "mind wandering" (Schooler et al., 2011; Smallwood & Schooler, 2006) and cease to meaningfully follow the events that are transpiring in front of them. A second explanation is that, during periods in which the automation is used and difficulties are

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