Single-Pilot Workload Management

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INTRODUCTION: Integrated glass cockpit systems place a heavy cognitive load on pilots (Burian & Dismukes, 2007). Researchers from the NASA Ames Flight Cognition Lab and the FAA Flight Deck Human Factors Lab examined task and workload management by single pilots. This poster describes pilot performance regarding programming a reroute while at cruise and meeting a waypoint crossing restriction on the initial descent.

METHOD: Thirty-three certificated Cessna Citation Mustang (CS10-5) pilots flew an experimental flight with two navigational legs involving high workload management in a Cessna Citation Mustang simulator (see above). While en route in the northeast corridor, we asked participants to reroute from their original flight path and meet a crossing restriction on the descent. Air Traffic Control (ATC) called to provide the pilots with their reroute clearance as the COPES waypoint was crossed, just 18.6 nm before Modena (MXE); the reroute required a turn toward Dupont (DQO). Original route and reroute are shown below.

RESULTS: Of the thirteen participating pilots, more than half (n = 6) had difficulty programming and flying the reroute. There was a mixture of errors in completing the reroute including: not crossing DQO, programming the turn to DQO after having flown past MXE, not effectively managing the waypoints in the clearance, and not meeting the crossing restriction at DQO. Seven of the pilots (53%) had some difficulty completing the reroute. Four (30%) failed to meet the crossing restriction. Of note, no difference was found between owner-operators and professional pilots in terms of successfully completing the reroute and the crossing restriction.

Understanding the clearance with enough time to enter changes into the flight plan aided orderly management of the flight. Those that had fewer errors in completing the revised clearance had more time to make changes to their flight plan before arriving at MXE and were more likely successful in completing the reroute (t-test was significant, t(8) = -2.785, p = .24). It was also found that interleaving tasks (such as checking paper charts) could result in an extension of the time taken to enter the reroute information.

DISCUSSION: The programming strategy found to be most successful was to quickly input DQO as the next waypoint after MXE, prior to actually arriving at MXE; and then complete the more time-consuming tasks of entering the rest of the reroute, programming the crossing restriction, and deleting non-pertinent waypoints. Some participants programmed a vertical path (VPTH) descent to meet the crossing restriction at DQO at the same time that they added DQO to their flight plans. This eliminated the need to reselect DQO later after completing other tasks associated with the reroute (e.g., entering the rest of the reroute, deleting old waypoints) to complete the programming. This increased the likelihood that the descent to meet the crossing restriction was initiated on time, even if the pilot was engaged in other tasks.

When time is short and workload is high, inserting new waypoints one at a time while interleaving other tasks may be necessary. Unless the legs between waypoints are very short, pilots may be able to enter them before the waypoints are crossed, even when interleaving other tasks. Although this strategy may be necessary on occasion, it is probably not ideal since it increases vulnerability to forgetting to insert all new waypoints.