Automated Anomalies – Exploring Experiences Commercial Pilots have with Automation

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SUMMARY

This exploratory study investigates commercial pilots' lived experiences with their automated cockpits. Using interpretative phenomenological analysis, a unique dual-impact theory of automation on situational awareness is uncovered. Recommendations focusing on integrating adaptive automation, pilot-in-the loop systems, system transparency, effective autonomy and promoting opportunities for applying manual flying skills are provided.

KEYWORDS

Automation, Human Factors, Cockpits

Introduction

From a four-seat Diamond DA42 to the mammoth 853-seat Airbus A380, automation plays an integral role in the operation of modern-day aircraft. First introduced in the early days of flight, the use of automation in commercial aircraft increased exponentially in the 1960s and 1970s. A strong belief that pilots were fragile, fallible beings combined with the advent of small, lightweight computers resulted in commercial aircraft cockpits being swept by a wave of increasingly complex automation designed for driving safety. However, while safety levels increased initially, studies suggest that today's automation may have actually created new hazards which continue to ignite and drive pilot error (Beaty, 1995; Konnikova, 2014; NTSB, 2014; Hiraki & Warnink, 2016).

Method

This qualitative study aimed to investigate and delve into the lived experiences pilots have with automation, the meanings they attach to these experiences and provide policy and design recommendations for the future. Semi-structured interviews were conducted with commercial pilots (ages 24 to 56 and with 1600 – 9000 flying hours) flying a range of aircraft (Boeing 737, Airbus A320, Embraer 190). Data were analysed using Interpretative Phenomenological Analysis (IPA).

Results

Participants lauded automation for improving safety, reducing workload and task saturation and making aircraft easier to fly. They stated that focus on automation in training, their knowledge of the system, its reliability and the quality of flight manuals moderated their trust in the automation.

However, automation poses some significant impediments. While knowledge of the automation includes knowing its limitations and when to take over, increasing complexity has made it harder for pilots to fully gain such knowledge. Issues such as mode-confusion have contributed to several incidents, such as the fatal crash of Asiana Airlines 214 in 2013 (NTSB, 2014). Participants also lamented that automation and its mandated full-time use by airlines had eroded their manual flight

skills, something they rarely get to practice, but have to rely on completely in emergencies. This was seen in the case of Air France 447, where the pilots were unable to manually fly the plane when the automation failed, resulting in a fatal crash. The report found that out of the 346 hours the captain flew in the six months preceding the crash, he flew manually for only 4 hours (BEA, 2012).

The study also uncovered two previously unreported findings. Participants claimed that automation increased and decreased their situational awareness (SA) simultaneously. While it improved SA of the surroundings such as air traffic, weather and radio calls, the participants suggested that automation reduced their SA of the aircraft itself i.e. elements like heading, altitude etc. Thus, this study proposes a dual-impact theory of automation on SA, which warrants further research. Another element that finds little mention in extant literature pertains to flight manuals, an important source of knowledge for pilots. Those flying Airbus aircraft reported that information in the manuals seemed incoherent and disparate, likely because they were translated from French to English. With the indispensable importance of these manuals, this requires immediate attention and rectification.

The participants accepted that automation had transformed their role from active fliers to supervisors of a system, but felt that they were operating alongside the automation, feeling out-of-the-loop and claimed that they were supplementing the automation, instead of the automation supplementing them. With their roles transformed, it is important for pilots to actively monitor the aircraft. However, the lack of SA about the aircraft reflects a “looking but not seeing” effect when pilots passively monitor aircraft parameters. The accident of Korean Airlines 007, which deviated over 700 kilometres from its flight path due to inadequate pilot monitoring, highlights the importance of keeping the pilot in the loop and ensuring active monitoring (Langewiesche, 2009).

Recommendations

With the paradoxes of automation and the drive towards increased automation and autonomy, it is vital to integrate the following into pilot training, cockpit/aircraft development and flight processes:

- Designing pilot-centred, pilot-in-the-loop automation with effective feedback mechanisms and adequate system transparency to build trust and effective human-automation teaming.
- Exploring adaptive automation that leverages pilot cognitive and performance data like workload to alter automation levels and ensure optimal pilot engagement.
- Continuing research in the dual-impact automation-SA relationship uncovered by this study.
- Changes in airline, manufacturer and regulatory policy to promote sufficient opportunities for pilots to practice and use their manual flying skills in simulators and real flight conditions to prevent skill deterioration and ensure preparedness for emergencies,
- Improving the quality of flight manuals and making information more accessible to pilots.
- Leveraging human-autonomy teaming principles to effectively integrate autonomy.

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