Designing a virtual cognitive assistant for pilots: a user-centered approach

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Content

Piloting an aircraft takes place in a complex, changing and dynamic environment. It requires fast decision-making process and high level cognitive abilities, including executive functions. For instance, pilots need to process a lot of information, store data in short term memory, plan actions or regulate their own behavior in case of a stressful event. Executive functions also support situational awareness and actions planning thorough the flight. On top of all this, an important perceptual activity is necessary to integrate all various information displayed on the cockpit instruments or coming from the outside world.

The effects of cognitive aging, including the impact on executive functions are now well known and documented in the literature. Some executive functions, like working memory, begin to decline from the age of 55 (Causse, 2010). Contrary to commercial aviation, there is no age limit for flying in general aviation and many private pilots are 65 years old or above. In those older pilots, alteration of executive functions due to age can lead to human error, possibly compromising flight safety. Surprisingly, very few studies investigate how technological developments could be used in order to mitigate the effects of cognitive aging on piloting performance.

To address this question, we first focused on identifying pilots' general needs while flying in terms of assistance, without considering their age. For this purpose, we conducted a semi-structured interview with 8 pilots (5 from general aviation, 3 from commercial aviation, all males), aged from 34 to 52 years. We investigated whether pilots express the need of technological assistance as well as which tasks could be relevant, and what interaction techniques they would consider as usable or unusable with this assistance.

In our study, all pilots from general aviation-all single-pilot aircrafts-are in favor of being assisted. Most of the general aviation pilots described the ideal assistant as a supervisor of the systems that should be able to alert them in case of an abnormal situation. However, pilots expressed a number of conditions that would be necessary to accept and use such an on-board assistant, in particular remaining the only person in charge and be able to take control of the aircraft at any time. They also insisted on the fact that the assistive system should not be intrusive. We also found that most of the pilots would like to be able to control the assistive system by voice commands (input), but would strongly reject voice feedback from the assistant (output).

In our future work, we will build a functional prototype of an on-board assistant aiming at reducing cognitive workload of elderly pilots. This prototype will be tested with end users. To design a system that meets users' needs, we will apply a user-centered design approach (Beaudouin-Lafon et al., 2007) and involve users at every stage of the design process. We will conduct brainstorming sessions with pilots using our first finding as inputs. It will help us acquiring a precise understanding of the pilots' needs.

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