Letter to the Editor re: Selective Auditory Attention and Spatial Disorientation Cues Effect on Flight Performance

Dear Editor:

The research article titled "Selective Auditory Attention and Spatial Disorientation Cues Effect on Flight Performance" was published in *Aerospace Medicine and Human Performance* in November 2018.[3] The authors have concluded that the results obtained partially support their hypothesis that performing the Duration Discrimination Task (DDT), even in the absence of SD conflict, significantly affects pilots' flight performance.

The authors expressed surprise at the lack of activation of the "posture first" principle in contrast to Barra et al.[1] and attribute the same to increased cognitive load, or the pilot being oblivious to the aircraft situation.

In this regard I have concerns about the methodology used in the research study.[3] The quoted article by Dux et al.[2] used multitasking as a combination of manual response to auditory stimulus (AM) and verbal response to visual stimulus (VV), whereas, the authors in the current study[3] use a motor response for both stimuli, that is, flight control and the Duration Discrimination test. This methodology created a response execution bottle neck at the level of the motor cortex. It is likely that the difference in their response was due to this bottleneck and not due to the cognitive overload, thus the inferences drawn by the author from the article by Dux et al.[2] seem inappropriate.

In addition, the study by Ruhm et al. quoted herein[4] compares the Difference Limen (DL) between healthy subjects and those with sensory neural hearing loss. Comparing the ability to detect the difference between a 50-ms and 80-ms sound with the effects of cockpit conversation and warning signals on flight performance may be inappropriate. Therefore, the duration determination test could be designed with longer stimuli, thus simulating the pilot's conversation with ATC or cockpit emergency warning signals.

Lastly, the author, despite possessing a database of flying experience, has only made a conjecture regarding the role of flying experience on the results. A statistical analysis of experience and recognition of disorientation would be more interesting.

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In Response:

We thank Dr. Manu Ningaiah for his interest in our article and in-depth analysis of the data presented in it. We appreciate the value of a different approach to our research and interpretation of the results, but we do not agree with all of the comments in his "Letter to the Editor."

Regarding the first comment, it can indeed be assumed that differences in flight performance could also be the result of overload of the motor cortex. This is an alternative explanation of the results of our study, but it does not mean that our methodology is unsuited to examining how pilots' cognitive load affects their flying. During a flight the pilot simultaneously performs flight control and other manual activities (e.g., setting a radio, radar, weapons, or flight plan) and so he or she may be responding motorically to many simultaneous cockpit stimuli.

In the study we attempted to create flight conditions as close as possible to those that occur in an actual flight. Finally, we would like to emphasize the fact that findings from the study by Dux et al.[2] were not used in discussion of our results. They were presented only in the Introduction section in order to demonstrate that there is a limit both to what we can perceive and what we can act on in multitask settings (such as the piloting of an aircraft).

We are in agreement with the comment that the sounds we used are not representative of the auditory stimuli present in the pilot's work environment (e.g., pilot's conversation with air traffic control or cockpit emergency warning signals). The duration of auditory stimuli was set to ensure that they would be neither too easy nor too difficult to distinguish. The longer auditory stimuli were closer to the stimuli that occur in natural conditions, but using naturalistic auditory stimuli would have precluded the generation of a sufficient number of sounds (their number was limited by the length of the flight profile and duration of the disorientation condition).

Lastly, our aim was not to examine whether flying experience affected the pilots' flying performance, but how pilots' performance was influenced by the combined impact of disorienting

DOI: https://doi.org/10.3357/AMHP.5342.2019

stimuli and additional cognitive load. It is well known that older, more experienced pilots are more likely to recognize spatial disorientation conflicts. Despite the variability in age and flying experience of our participants, we were considering dividing the pilots into two groups based on their flying experience (those with less than 1000 hours of flying and those with over 1000 hours of flying) and analyzing the effects of this condition on the pilots' flying performance. However, we refrained from such a statistical analysis as it was not the primary goal of our study. Perhaps, in future, we will examine how flying experience was related to ability to recognize spatial disorientation in this study.

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