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What is a good visual scan speed for military pilots?

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Content

Objective: Military pilot training is demanding and every day student pilots must demonstrate their ability to progress, at the risk of being excluded. From the first hours of flight, instructors assess students on their ability to manage flying situations. To do this, the students' attention skills, especially visual, are examined through their ocular behaviour. Two aspects of the ocular behaviour of student pilots are of particular interest to instructors: speed and completeness of the visual scan. However, it is not easy to quantify these two notions objectively. We have sought to objectify the notion of speed of the visual scan by providing tangible and reusable metrics to improve understanding and communication on the topic.

Background: For the pilot, an effective and efficient ocular behaviour is necessary, since most of the information needed is visual. However, the education of this ocular behaviour is relatively unstudied [1,2] even though the vast majority of accidents often involve a lack of situational awareness due to poor visual information acquisition [3]. In initial military flight training, talking about ocular behaviour is complicated and often boils down to telling a student that his visual scan is too slow and/or incomplete in certain phases of flight (landing, turning, descent). However, for an ab initio student-pilot, there is no objective reference (personal or from the expert) to refer to, in order to understand and carry out the instructors' remarks.

With an eye tracker, it is possible to objectify ocular behaviour. However, it is difficult to choose between the many existing metrics [4,5]. Among them, we believe that the combination of the analysis of the number of fixations per minute and the average duration of fixation could provide the missing objective data in order to fluidify the pedagogical dialogue between instructors and students.

Method: We conducted an experiment with ab initio student-pilots (N=11), students having validated the first phase of training (N=11) and instructors (N=11), with an average flight experience of 41, 112 and 1449 flight hours respectively. On a Cirrus SR20 simulator with a wearable eye tracker, the 3 groups of participants had to perform different manoeuvres taught in the military training. In this article, we present our analysis of the speed of the visual scan during turns (30° inclination) and "operational" descents.

Results: The results show that with 185 fix/min in turns and 155 fix/min in OPS descents, the instructors have a significantly faster visual scan than the two groups of students. Furthermore, during the turns, the fix duration is not significantly different between the groups (M=275ms), while in the descents the instructors (299ms) make shorter fixations than the ab initio (324ms) and intermediate (338ms) students.

Applications: These results provide students and instructors with "simple and basic" metrics to improve pedagogical exchanges. It also allows us to start building a database of target values, making it possible not only to educate ocular behavior [6] but also to monitor pilots in operation, which is the key to future challenges such as flights with a single pilot operator.

Keywords : Eye tracking, EEG, fNIRS, Other measurement methods, Brain computer interfaces