Concurrent validity of an ocular measure of mental workload

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Abstract

In previous studies, eye fixations were recorded from participants playing a videogame and from professional pilots during a simulated flight. Ocular data were then analyzed using spatial statistics algorithms, and results showed sensitivity of fixations' dispersion to variations in mental workload. Particularly, a tendency towards spatial randomness of fixations was associated to the most demanding phases. Implementation of this procedure is still in its early stage, thus making it necessary to assess its validity. In the present study, the index has been used to assess mental workload during the execution of another visuo-motor task: the Tetris game. Task demand was manipulated by varying the degree of difficulty of the game. This was accomplished implementing three levels of difficulty of the game that were selected in a pilot study involving a sample of gamers. Additionally, the amplitude of the P300 component of ERPs was used as a concurrent measure of mental workload. Results showed that fixations dispersion is a valid index of mental workload.

Background

Ocular activity has been often related to mental workload and different attempts have been made to find ocular indices that showed variable diagnostic power (e.g., eye-blinks, pupil diameter, fixations frequency and duration). However, the relation between ocular activity and mental workload load is not straightforward, mostly because there is a lack of agreement about the nature of this construct. Indeed, while mental workload is a key topic in Human Factors / Ergonomics (HF/E) research, its definition and assessment are still a matter of debate (see Annett, 2002 and commentary for a recent discussion). For example, it is still unclear whether mental workload is associated with the activity of functionally separated resources, or if those modular resources are combined with a general-purpose resource that is invoked for all processing activities (Parasuraman & Caggiano, 2002). Nevertheless, most theories and models agree on a basic set of assumptions: "(a) people have a limited mental and attentional capacity with which to perform tasks, (b) different tasks will require different amounts (and perhaps different types) of processing resources from the same individual, and (c) two individuals might be able to perform a given task equally well, but it may be more difficult for one than the other" (Baldwin, 2003, pp. 132 f.).

In D. de Waard, G.R.J. Hockey, P. Nickel, and K.A. Brookhuis (Eds.) (2007), *Human Factors Issues in Complex System Performance* (pp. 117 - 129). Maastricht, the Netherlands: Shaker Publishing.