Pupillometry as a method for measuring mental workload within a simulated driving task

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Abstract

In this contribution a method of pupillometry is discussed to identify high mental demands on the driver in a simulated driving task. A new method allows to identify the effect of mental demand by measuring changes in size of the driver’s pupil and to display the actual demand through an index called “Index of Cognitive Activity” (ICA, Marshall et al., 2004). A study will be discussed where a simulated driving task was used in combination with the method of pupillometry. This study shows that the ICA increases in situations with a higher mental demand on the driver when performing lane change manoeuvres or an additional secondary task. Hence the index of cognitive activity seems to be a suitable method for continuously measuring mental demands while driving.

Introduction

The main issues when developing new automotive human machine interaction concepts are to provide an optimum of functionality and to ensure the safe and efficient use of these systems while driving. Additional systems such as driver information and communication systems that can be used while driving may significantly increase the operational demands on the driver. Using these systems while driving, forces the driver to divide his or her attention between the additional system and the driving task itself (De Waard, 1996). If the resulting demand for the driver through such a dual task situation reaches a critical level, the risk of driving errors increases. Therefore when developing new driver-information or driver-communication systems the goal is to design these systems in such a way as to reduce the additional demand on the driver when interacting with these systems to a minimum.

Because of the apparent necessity to identify the amount of mental demand while driving, several different methods have been proposed to identify this effect on a driver. O’Donnell & Eggermeier (1986) specify three groups of workload measures: (1) Subjective measures (or self-report measures, see De Waard, 1996). These measures directly investigate the subjectively perceived mental workload in a given situation (e.g. questionnaires, interviews). (2) Performance measures. Performance