openEyes

Online Cognitive Load Analysis from Pupil Dilation

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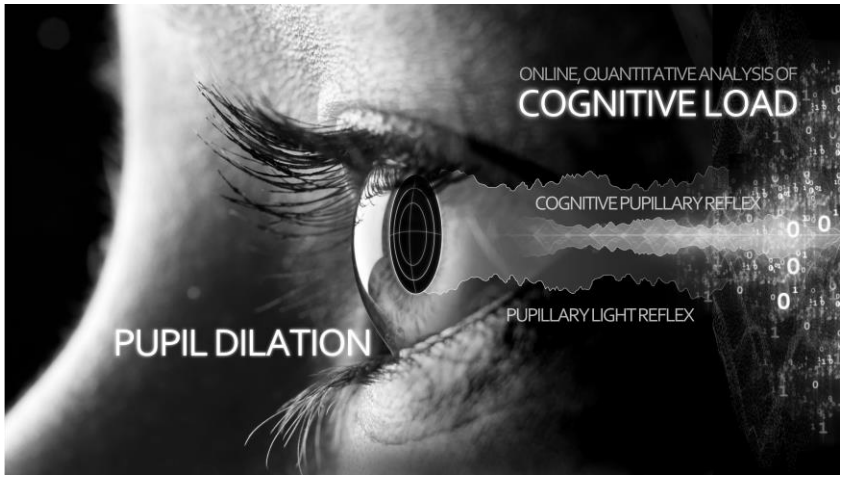

Fig. 1: openEyes :: deriving online, quantitative analysis of COGNITIVE LOAD from pupil dilation

Fig. 2: Pupil-Labs mobile eyetracker

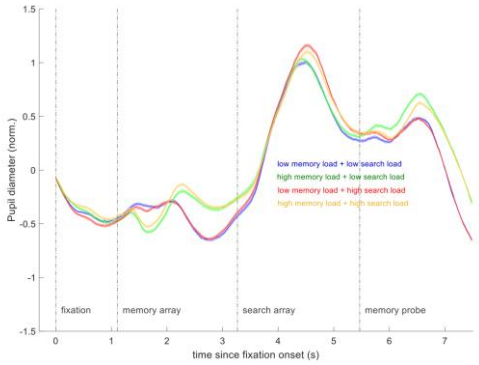

Fig. 3: results from cognitive load analysis study, showing differentiating between task type and difficulty

Attention-Aware Systems

The vision of an attention-aware system design is to enabling computer systems to be aware, not only of the physical presence or activities of users, but also of their cognitive state via the integration of measuring, modelling and managing of human attention.

Such systems could elevate the role of users from a being the limiting bottleneck in information transfer to the becoming implicit and explicit control entity of interaction design (as to e.g. avoid information overload by adapting information distribution to perception capabilities, prevent attentional errors via the detection and handling of distraction, or actively support of users in paralleled, multi-task scenarios).

Pupil Dilation As Indicator of Cognitive Load

Besides light incidence control, the pupil is also sensitive to psychological and cognitive activities and mechanisms, since the musculus dilatator pupillae is directly connected to the limbic system via sympathetic control.

Challenge

A technological approach towards automated analysis of cognitive load from pupil dilation needs to overcome two issues.

OpenEyes is able to provide:

Compensation of pupillary light reflex :: Changes in illumination cause significant adaptations of the pupil size. However, assessing illumination effects on the pupil represents an essential prerequisite to enable separation of illumination from cognitive effects, thus enable modeling of cognitive load in real-world environments.

Online Modeling of cognitive pupillary reflex :: openEyes realizes the integration of cognitive parameters into dynamic interaction design via enabling an online interpretation of cognitive load from pupil dilation on both algorithmic and system design levels. It combines an empiric model of cognitive pupillary behavior with an runtime optimization algorithm to model cognitive load levels over time.

Cognitive Load Analysis

Transferring Pupil Analysis from laboratory restrictions into real-world environments:

- Online modeling of cognitive pupillary reflex – application of online curve matching approach towards cognitive load interpretation based on Task-evoked Pupil Response.
- Online extraction of cognitive pupillary response by compensation of evironmental brightness and computation of pupillary light reflex.

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