# Work, Aging, Mental fatigue, and Eye movement dynamics

by
**Ramtin Zargari Marandi**

Mental load and fatigue are important multidimensional phenomena concerning increasing elderly individuals and computer work. Fatigue may be associated with reduced cognitive resources and increased errors. Micro-breaks are strategic solutions to impede fatigue subject to design constraints, such as a timing plan. The present work aimed to use eye tracking as a promising technology to measure mental load and fatigue in young and elderly adults (Studies I and II), and to apply micro-breaks based on fatigue-related changes in eye movements to decelerate fatigue development (Study III).

A novel task resembling computer work was developed to induce mental load in young and elderly individuals (Study I). Eye movements were recorded during the task execution. The task was performed with three load levels across two days. In addition to the load effects on performance, perceived workload, and the oculometrics, the test-retest reliability of 19 oculometrics was assessed. In Study II, the effect of 40-min time-on-task was explored on oculometrics. Then, a predictive model of fatigue was developed (Study III). Oculometrics-based biofeedback was implemented to detect fatigue using the developed model, which triggered micro-breaks upon fatigue detection to impede it. Perceived fatigue and workload were compared between a session with the biofeedback and a control session with self-triggering micro-breaks.

A set of oculometrics were found to reflect mental load (Study I) and fatigue (Study II) in both age groups. Similar trends in oculometrics with increased mental load and fatigue, implying shared neural systems for both conditions (Studies I and II). Age-related differences were exhibited in a few of the oculometrics (Study II), but age as a feature did not significantly contribute to fatigue detection (Study III). The biofeedback reduced workload and fatigue development, suggesting an improved strategy to design the timing plan of micro-breaks (Study III). Overall, the findings may support the viability of detecting the effects of fatigue and mental load on oculometrics.

**PhD lecture**
**By**

**Ramtin Zargari Marandi**
**Tuesday 12 November 2019**

**DEPARTMENT OF HEALTH SCIENCE AND TECHNOLOGY**
AALBORG UNIVERSITY

This thesis is based on
Ramtin Zargari Marandi´s research work at:

**Department of Health Science and Technology**
**Aalborg University, Denmark**

To fulfill the requirements for the PhD degree, Ramtin Zargari Marandi has submitted the thesis: Work, Aging, Mental fatigue, and Eye movement dynamics, to the Faculty Council of Medicine at Aalborg University.

The Faculty Council has appointed the following adjudication committee to evaluate the thesis and the associated lecture:

**Associate Professor Dan Witzner Hansen**
**IT University of Copenhagen**
**Denmark**

**Professor Edmund Wascher**
**Dortmund University of Technology**
**Germany**

**Chairman:**
**Associate Professor Hendrik Knoche**
**Aalborg University**
**Denmark**

**Moderator:**
**Associate Professor Afshin Samani**
**Aalborg University**
**Denmark**

The PhD lecture is public and will take place on:

**Tuesday 12 November 2019 at 13:00**
**Aalborg University – Room D2-106**
**Fredrik Bajers Vej 7 D2**
**9220 Aalborg East**

**Program for PhD lecture on**

**Tuesday 12 November 2019**

**by**

**Ramtin Zargari Marandi**

Work, Aging, Mental fatigue, and Eye movement dynamics

Chairman: Associate Professor Hendrik Knoche
Moderator: Associate Professor Afshin Samani

13.00    Opening by the Moderator

13.05    PhD lecture by Ramtin Zargari Marandi

13.50    Break

14.00    Questions and comments from the Committee
         Questions and comments from the audience at the Moderator's discretion

16.00    Conclusion of the session by the Moderator

**After the session a reception will be arranged**