Predicting the onset of driver musculoskeletal fatigue

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Abstract. Driver fatigue is a result of the complex interaction of environmental, psychological, biological and vehicle factors exacerbated by conditions such as vibration, long duration sitting or high-workload driving. The objective of this paper is to outline a methodology capable of providing insight on determining the onset of musculoskeletal fatigue, quantifying levels of fatigue and fatigue tolerance in simulated long-term driving.

Keywords. Musculoskeletal Fatigue; Driving; Seating; Automotive.

1. Introduction

It is known that movement is beneficial and that frequent changes in posture are good for disc nutrition and spinal health as well as for reduction of musculoskeletal fatigue and discomfort. A three year research project was set up with an automotive manufacturer to explore seat technologies designed to delay the onset of driving-related musculoskeletal fatigue and improve feelings of driver wellbeing. Fixed postures from prolonged driving, referred in the literature as *postural fixity*, cause static loading, particularly on the spine, buttocks and thighs (Gyi, 2013). As a result, local circulatory disruptions occur such that oxygen delivery and nutrients reserves as well as metabolic by-products removal are compromised, even for the low levels of sustained muscle contractions in driving. Other consequences are risks to spinal health, aches, cramps, localized pain (e.g., lower back pain), discomfort and mental fatigue (Figure 1). If the factors that contribute to driver fatigue can be better understood then vehicle developers will be better equipped to improve the driving experience, which will positively impact driver comfort, performance, safety and well-being.

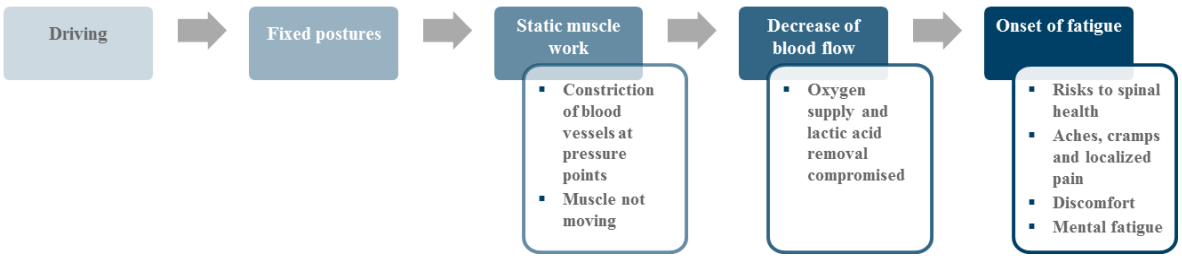

Figure 1 - Driving and musculoskeletal fatigue relation.

2. Methods

This paper outlines the methodology of a study to provide insight into determining the onset of musculoskeletal fatigue, quantifying levels of fatigue and feelings of wellbeing in simulated driving. A variety of potential data collection techniques will be explored: discomfort scales (Mansfield, Sammonds and Nguyen, 2015); wellbeing questionnaire (Ahmadpour, Robert and Gitte Lindgaard, 2015); postural analysis (Porter and Gyi 1998); seat fidgets and movements (Sammonds et al., 2015); and monitoring of oxygen

saturation in blood and pulse rate using a fingertip pulse oximeter (Parakkat et al., 2006). Healthy drivers (n=6-8), no age or gender requirement, will take part in the experimental study using a driving rig mounted on a Multi Axis Vibration Simulator (MAViS), for a 60 minute simulated driving test. Participants must hold a full UK driving license, with at least one full year of driving experience. In addition, only healthy and non-smoker individuals are accepted and participants are asked not to ingest water or caffeine (tea/coffee) and not to exercise one hour before the session as well as to wear comfortable clothing (no heeled shoes). The objective of the study is to extract parameters indicative of early driver physical fatigue, the state of fatigue itself and feelings of wellbeing.

3. Results

The driving task is a complex interaction of different physical and mental factors. The proposed research aims to develop a methodology to understand driver musculoskeletal fatigue. The poster will present details of the selected techniques and results of the study. These findings will contribute to the development of techniques to predict driver musculoskeletal fatigue leading to an improved driving experience.

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