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The Influence of Situational Complexity, Stress, and Stated Skill on Cyclist Gaze Behaviour

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Introduction

Although generally global road safety is improving, cyclist injury and fatality rates have not decreased at the same rate as motorist and passenger injury and fatality rates. Both countries with high cyclist volumes, like the Netherlands, and countries interested in increasing cyclist volumes are interested in reducing these cyclist injury and fatality rates. It is known from driver studies that mental workload can lead to missed safety-critical events and tunnel vision, but how it influences cyclists is a relatively new research topic. Not yet studied is how mental workload in combination with cyclist confidence and skill influence cyclists' gaze behavior. This study aims to fill this gap through the use of eye tracking glasses and quasi-naturalistic cycling.

Method

This study took place in Delft, The Netherlands, with 8 female and 18 male participants, all affiliated with the university. Based on the assumption that mental workload is higher during peak hours, cyclists were asked to ride an instrumented bike for about 30 minutes on a route with minimal vehicle interaction during both off-peak and peak hours. Cyclists also filled out a survey about their cycling habits, attitudes, and skill and were interviewed about their stress levels at three designated locations during/after the ride. Pupil Labs wearable eye tracking glasses and an instrumented bike with GPS and LiDAR were used to collect data. The eye trackers provided information on the location of the gaze at each time and whether fixation occurred, while data from the instrumented bike provided cyclists speed and proximity of other road users. Using the video data as a guide, the data were segmented between high and low complexity moments. These high and low complexity moments were also paired by task to control for the influence of the task on gaze behavior. The high and low complexity moments were compared in terms of pupil diameter, gaze distribution, areas of interest, fixation frequency and duration, gaze speed, and cyclist speed. They were both compared across all participants at these locations and within participants' two rides.

Results

Although the data continue to be analyzed, we have several expected results based on preliminary analyses. First, cyclists with higher mental workload focus closer to themselves and spend more time looking in a small area with task-relevant deviations. In contrast, cyclists with lower mental workload have a more evenly distributed gaze distribution and casual gaze speed. It is also expected that cyclists with higher confidence and higher rated skills will be less likely to experience or be influenced by high mental workload. These results can have safety consequences, for example if cyclists with high mental workload are looking too close to themselves, they may miss a safety critical cue ahead. This, in turn, could influence future design choices with regards to visibility. These results will also be used for continued research into how cyclist gaze behavior is influenced by stress, as defined by anticipatory stress and mental workload.