

A naturalistic pilot study of cyclists' eye- and head movement using head-mounted eye tracking



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INTRODUCTION

As bicycle use increases in European cities, it is significant to consider the high road vulnerability of cyclists. Cyclists accounted for 10-15% of urban road fatalities in Europe by 2017 [1] and accident rates continue to rise [2]. Research suggests that cycling accidents relate to the ability to recognize information in traffic [3] and failing to “look properly” [4]. Head-mounted eye trackers enable the exploration of where cyclists are looking and allocating attention to. However, cyclist eye tracking studies remain scarce and often lack realism [2].

RESEARCH OBJECTIVES

- 1 Test the feasibility of head-mounted eye tracking in a naturalistic cyclist study
- 2 Synchronize head movement, eye movement and GPS data
- 3 Explore which eye- and head movement patterns are characteristic for crossing an intersection

METHOD:

Independent Variables	Dependent Variables
<ul style="list-style-type: none"> Presence of an intersection (yes/no) Cycling environment (no int., 5s prior to int., int.) 	<ul style="list-style-type: none"> Cyclist behavior; speed (m/s), travelled distance (m), head rotations (deg/s) Eye movement; whole fixations (s), proportion of saccades in cycling lane, visits (s), elapsed time (s)



- 1 Participant
- Tobii Pro Glasses 2
- Speedometer App



Cycling along a pre-defined route



Data analysis in Microsoft Excel



Data preparation in Tobii Pro Lab

RESULTS

- No association between presence of an intersection and cycling speed
- Highly significant association between left-right head movements and presence of an intersection
- Highest percentage of whole fixations and visits in the cycling lane when no intersection was present
- Highest percentage of saccadic eye movement in the cycling lane when crossing an intersection

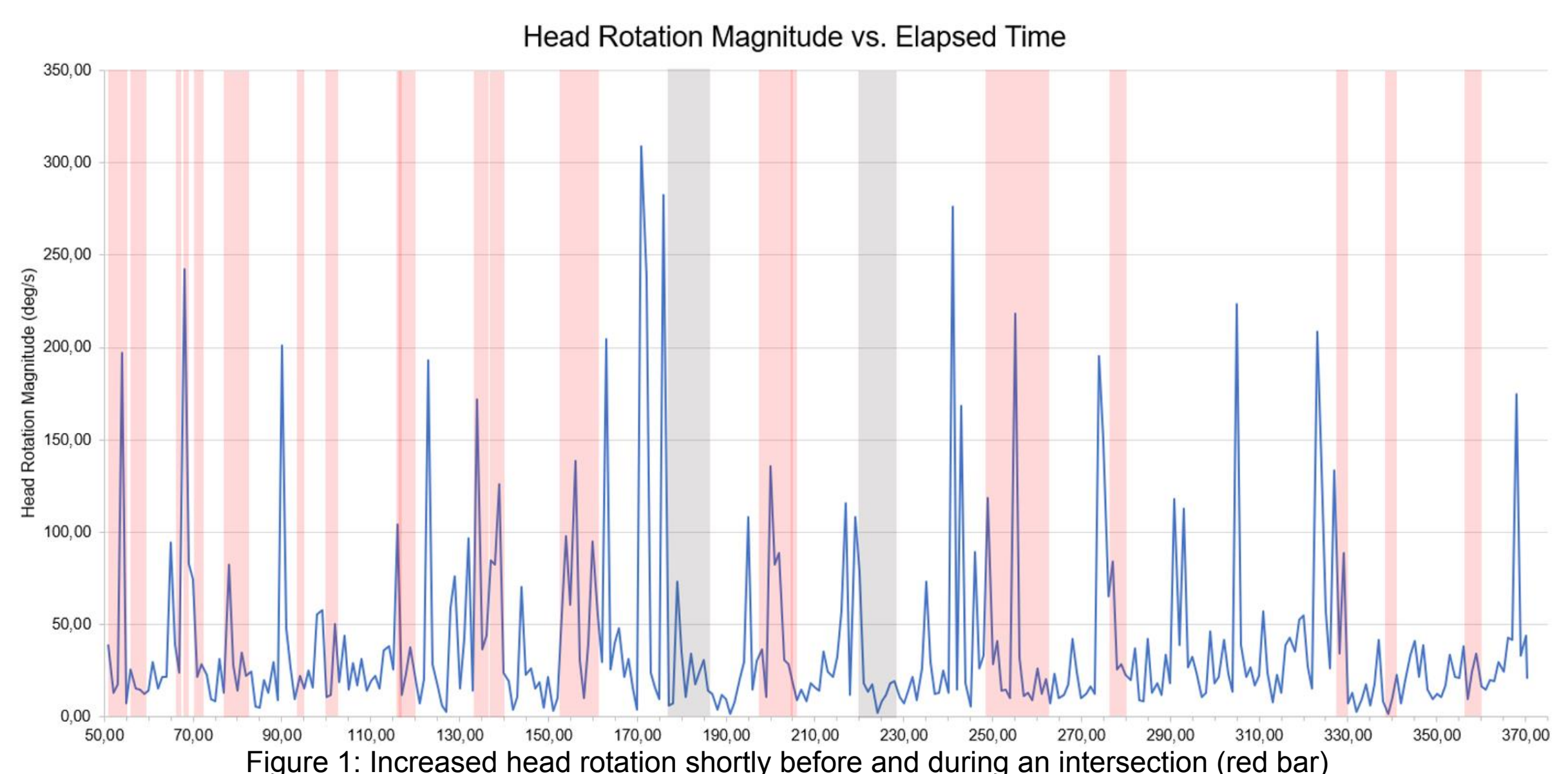


Figure 1: Increased head rotation shortly before and during an intersection (red bar)



Figure 2: Frames of the eye tracking recording indicating that few points of attention fall into the cycling lane when crossing an intersection

DISCUSSION:

Increased head movements shortly before and during an intersection provided a “safety monitoring strategy” which enabled the acquisition of visual information over a larger area, to inform decisions of safely crossing an intersection [5]. More “looking” at the cycling lane was present in less hazardous environments without an intersection, as the cyclist did not have to extract extensive information from other environmental elements to cycle safely. Saccades within the cycling lane were highest when crossing an intersection, as they constitute spatial exploration and visual search strategies [6]. These are needed to scope out the confinements and directions of the cycling lane, to maintain an overview of where to cycle.

CONCLUSION:

Use of the Tobii Pro Glasses 2 is feasible for analyzing head- and eye movements of cyclists in a naturalistic setting. Future research must use a more sophisticated GPS device such that data can be synchronised. Adding a qualitative retrospective think-aloud task can provide useful explanations of where cyclists look.