Visual attention and speeds of pedestrians, cyclists, and electric scooter riders when using underpass: a field eye tracker experiment

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1 INTRODUCTION

Cycling and walking are typical forms of local locomotion, especially common in the urban environment. During the last five years, portable electric scooters were developed and quickly gained popularity and, at the same time, generated previously unknown challenges associated with safety [1]. Their users compete with pedestrians and cyclists to occupy the same space [2], which may create conflicts and cause accidents. The balance between the safety of pedestrians and ES riders is still being sought [3], while the legislation process lags behind the rapid emergence and popularity of this new micromobility transportation mode [4, 5].

The aim of this research was a comparison of visual gaze behaviour of cyclists, electric scooter users, and pedestrians passing the same route stretch – a broad busy underpass in city centre. Visual interaction of the test participants with other road users was analysed to understand threats and risks for each of these modes of transport during selection of the path; speeds and behaviour during manoeuvres were also assessed. Differences in perception, depending on the utilized mode of transport, should bring better understanding of their specific needs and may support appropriate regulation. This research work could be considered as an extension of previous study when, in the similar way, behaviours of road-users utilizing a shared road were analysed [6].

2 GENERAL INSTRUCTIONS

2.1 Methodological aspects

For many years, eye tracking has been utilized extensively in various research [7], including applications related to behaviours of cyclists [8 .9] and pedestrians [10, 11]. Despite advances in technology of the equipment, the basic concepts include metrics associated with pupil movements of the test subject: gazes, saccades, fixations, and fixation durations. For this research, equipment based on video recording of combined pupil and corneal reflection, spectacles Tobii Pro Glasses 2 (Tobii AB; Danderyd, Sweden) were utilized.

2.2 Field experiment

Eye tracking technique was used to analyse visual behaviour of 15 young people, each of whom was given the task of following the same quite complex urban path, approximately 1500 m long, using the three evaluated modes of transport. Their gazes and fixations were assessed in detail when they were travelling through an underpass 50 m long as well as stretches of around 75 m before and after that stretch; exemplary cyclist's trajectory is shown in the Figure 1. Besides visual attention, speeds, manoeuvres, and the number of other road users who were overtaken, overtaking, and bypassed were taken into account.

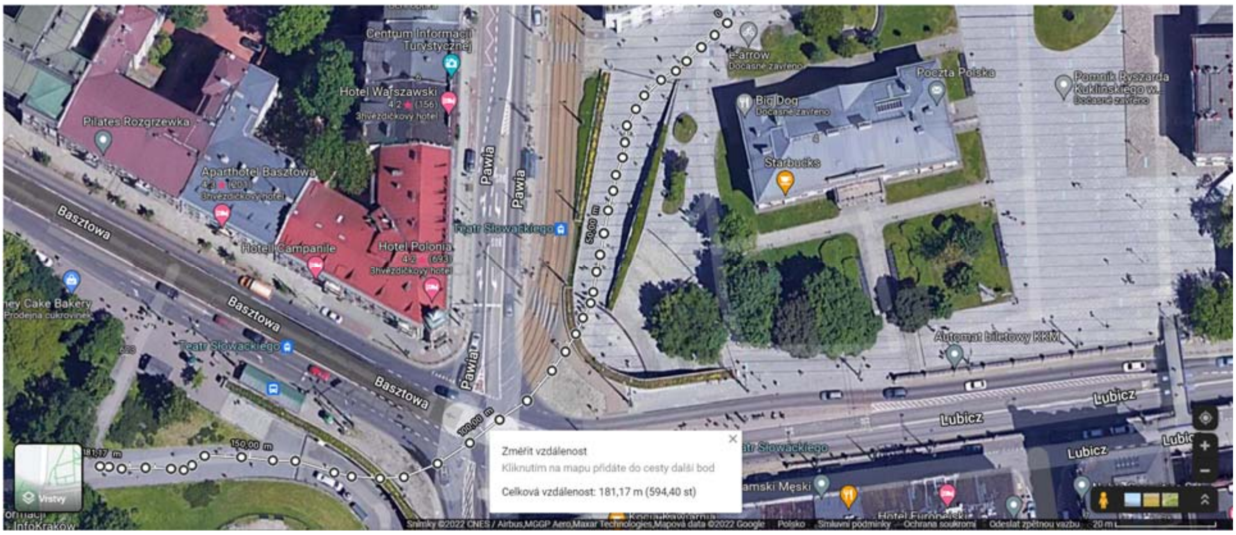

Figure 1: An example of cyclist's trajectory going through the considered underpass.

3 RESULTS EXPECTED

It is anticipated that there would be differences in visual attention depending on the mode of transport. From exemplary data related to distribution of fixations presented in the Table 1, the differences between the transport modes are evident: riders were concentrating their attention on pedestrians, while test participants travelling on foot were more interested in the surroundings. This research of behaviours and visual attention should permit for understanding whether the differences were mainly caused by the interaction between road users and depended only on traffic load, or were also influenced by other factors.

Table 1: Fixations distribution.

Mode of transport	Total number of fixations	Fixations on pedestrians [%]	Fixations on other obstacles [%]
Foot	218	24.8	43.6
Bicycle	194	71.6	7.2
Electric scooter	174	60.3	12.6

4 CONCLUSIONS

Understanding of visual behaviour will bring an important information not only for scientists, but also for engineers involved in designing or re-designing the road infrastructure and for legislators.

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