Evaluating Cycling Routes in a Bicycle Simulator

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1 INTRODUCTION

Although cycling becomes more and more popular, many people are still deterred from cycling by various aspects including a lack of perceived safety [1]. To offer preferable infrastructure and, hence, to better promote cycling, it is therefore crucial to examine how cyclists evaluate their routes, and to figure out what makes an infrastructure seem unsafe or unattractive.

Some studies have already identified important route criteria like safety or comfort, and have connected them to certain route attributes. High traffic volumes and cycling on no or poor cycling facilities are experienced as stressful by cyclists [2], [3], and they try to avoid these routes in order to reduce possible interactions with motor vehicles [4]. In contrast, a separated cycling facility, low speed, and low traffic volumes are evaluated as safe and stress-free [2], [5]. Furthermore, cyclists prefer comfortable routes, that is, routes with low gradient and few stops and traffic lights as well as attractive routes with a green and pleasant surrounding [6], [7].

Most of the studies investigated those criteria deductively, that is, the researchers analyzed the results theory-driven and in terms of predetermined criteria. In a previous study, we examined them in an inductive and qualitative approach that allowed us to collect criteria with the participants' individual wording and content [8]. We found that cyclists evaluate their route attributes in terms of Mental Comfort, possible interactions with other road users, Physical Comfort, the Ease of Use of the infrastructure, and the pleasantness of the surrounding. Safety and stress were found to be sub-aspects of Mental Comfort, whereas Interaction was associated with attention and concentration due to other road users. The term comfort, however, was mentioned by participants only in terms of physical comfort.

The aim of the present study is to validate these evaluation criteria found in our previous study, and to connect them to certain route attributes using the experimental approach of a bicycle simulator in combination with qualitative surveys.

2 METHOD

2.1 Procedure

The study is planned for June 2022 and will be conducted in the bicycle simulator at the Department of Traffic and Engineering Psychology at the Technische Universität Braunschweig.

The participants will cycle 13 sections that vary in certain route attributes (Table 1). Each participant will cycle each scenario, but in randomized order. After each scenario, the participants will be asked to stop in a side street and to answer a short survey about the experienced scenario. The survey will ask to rate how much the participant liked the section, to state good and bad aspects of the section, and to evaluate the section in terms of the criteria Mental Comfort, Interaction, Physical Comfort, Ease of Use, and the Environment. A description of the criteria is given to the participants as a handout so they can reread their meaning during the surveys.

2.2 Bicycle simulator and test scenarios

The bicycle simulator consists of a lady's bicycle standing on a motion platform that allows the bicycle to tilt slightly to the left and right. Twelve monitors assembled in a hexagon allows a 360°-view. Via noise-cancelling headphones the participant can hear simulated surrounding noises such as motor vehicles or birds. The simulator runs with the simulation software SILAB 7.0 [9].

The test drive will consist of 13 sections that vary in road class, the type of the cycling facility, the traffic volume of the motor traffic and the pedestrian traffic as well as in the gradient and the need to stop. A list of the scenarios is presented in Table 1. We focused on those attributes that both have been shown to highly influence cyclists' route choice, and that may vary in their evaluation on the criteria. Additionally, we needed to exclude other important attributes to avoid too many scenarios and, hence, a too long test ride.

Table 1: List of the scenarios used as sections in the test ride.

Nr.	Road Class	Cycling Facility	Traffic Volume		Gradient	Stop
			Veh/h/l	Ped/h		
01	Arterial	Advisory Lane	1000	100	-	-
02	Arterial	Advisory Lane	1000	100	-	Traffic Light
03	Arterial	Advisory Lane	400	20	-	-
04	Arterial	Cycle Path	1000	100	-	-
05	Arterial	Cycle Path	400	20	-	-
06	Arterial	Shared Footpath	1000	100	-	-
07	Arterial	Shared Footpath	400	20	-	-
08	Residential	none	400	100	-	-
09	Residential	none	400	100	3%	-
10	Residential	none	100	20	-	-
11	Residential	none	400	100	-	Priority
12	Park	Shared Footpath	-	100	-	-
13	Park	Shared Footpath	-	20	-	-

3 DISCUSSION AND CONCLUSION

We expect the evaluation of the sections regarding the criteria to be similar to the results of our previous study. That is, Interaction will increase and Mental Comfort will decrease with less separated cycling facilities, higher traffic volumes, and on arterial roads. However, the ratings of these two criteria might differ between volumes of pedestrians and motor vehicles, as high pedestrian traffic might be perceived as mentally strenuous, but not as unsafe or stressful. Sections with a gradient or stops should be evaluated as less comfortable, and the park should be evaluated positively regarding the surrounding environment.

However, one interesting aspect will be whether the criteria captures all relevant aspects that cyclist use to evaluate their infrastructure. Therefore, it will be interesting to see whether the overall rating on how much the participants like the section can be explained by the ratings of the criteria. Furthermore, the responses of the open questions that asks for good and bad characteristics of the section will either confirm or correct the criteria.

Using a bicycle simulator as compared to pictures and description as in the first study will validate the findings of our first study in a more realistic way that enables the cyclists to really experience these attributes. However, a bicycle simulator is not fully able to provide an experience like riding on a real bike. Additionally, we cannot include all relevant route attributes as too many sections would result in an unreasonable participation time.

Hence, the findings will be limited to the few examined attributes. However, our study will also provide the benefits of the experimental design of the simulator approach, that is, a controlled setting and conclusions about cause-and-effect relationships. The results will obtain further insights into cyclists' evaluation and preferences of routes and route attributes, and will help to understand what makes a route preferable.

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