

## Subjective Safety of Bicycle Infrastructure at Intersections and Roundabouts

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### 1 INTRODUCTION

Cycling provides individual and societal benefits, such as improved health [1], faster intra-urban commuting [2], lower CO<sub>2</sub> emissions [3] and all in all lower societal costs [4] compared to most other traffic modes. However, the national average of the cycling mode share was only around 10% in 2008 and has not increased remarkably ever since [5].

Several studies indicate that the lack of subjective safety may be a crucial reason to refuse using the bicycle [6, 7]. While there is evidence on how to improve subjective safety through infrastructure on road sections [8], there is none concerning intersections or roundabouts yet.

To close that gap, we investigate subjective safety at junctions depending on different infrastructure designs.

### 2 METHOD

Participants ( $N=48$ , 54,17% female,  $M_{age}=44$ ,  $SD_{age}=16,5$ ) were asked to pass differently designed and simulated junctions followed by focused interviews.

#### 2.1 Junction Design

For the analysis, we selected four different junction designs to be presented to our participants (see Figure 1):

- intersection with cycle lane without offset and without physical separation (German: “Radfahrstreifen”; RFS)
- intersection with cycle lanes between car lanes (German: “Radfahrstreifen in Mittellage”; RiM)
- intersection with cycle path with offset and physical separation (so-called protected intersection; PI)
- roundabout with cycle path with offset and physical separation (German: “Kreisverkehr”; KV).

The designs correspond to current technical regulations [8, 9]. Some parameters represent best practices that are not (yet) part of official infrastructure guidelines, such as the continuously coloured bike lanes [10].

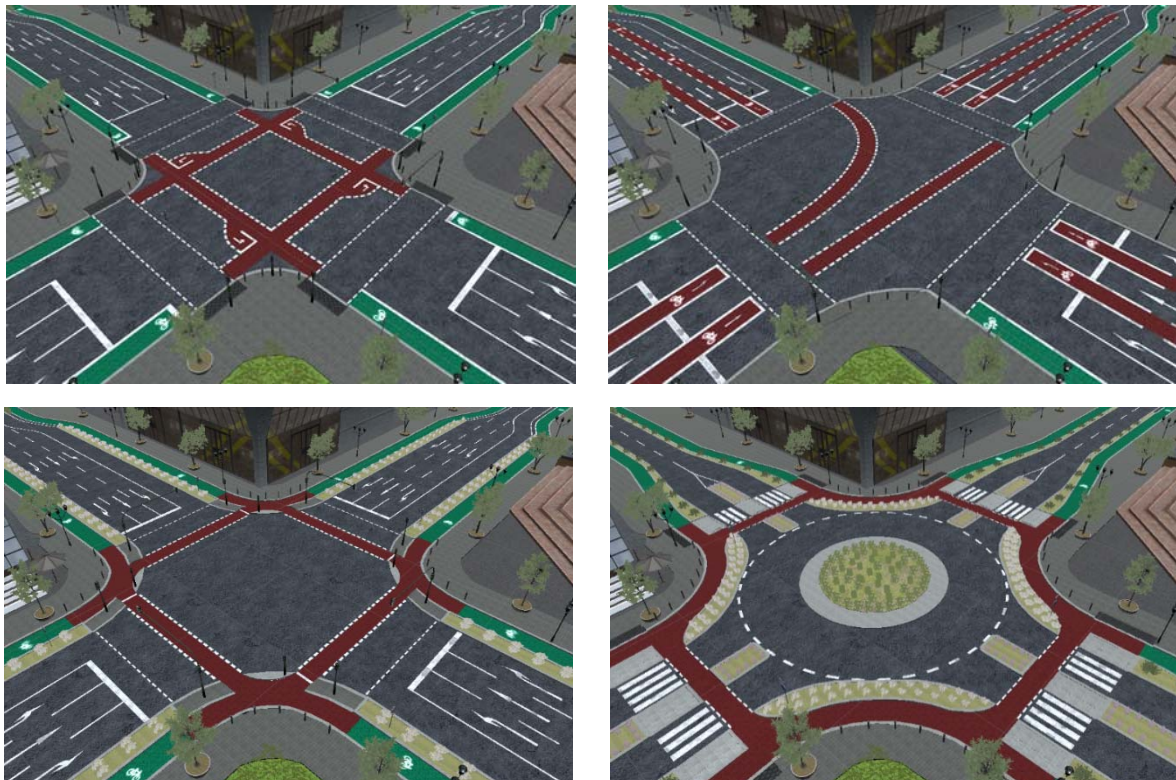


Figure 1: The four junction designs as shown in the simulation (top left: RFS, top right: RiM, bottom left: PI, bottom right: KV)

## 2.2 Presentation mode

The junction designs were presented in a bicycle simulator that operates in a 360°CAVE (Cave Automatic Virtual Environment). The technical setup of the bicycle simulator comprises measuring the steering angle and rear wheel speed of a stationary bicycle and transferring them via an Arduino to Unity to navigate the participant in the virtual city traffic scene.

## 2.3 Participants' task

Participants were asked to ride through four different simulated cities. Each city consists of three subsequent identical junctions separated by 75 metres of straight road with a protected bike lane. Participants had to turn right on the first junction, pass straight through the second one and turn left on the third one. After each ride, we conducted a focused interview on this specific junction design.

## 3 RESULTS

In general, most participants felt safest cycling through the PI design, followed by KV, RFS and RiM. Nevertheless, a few participants preferred RiM to the other designs.

Apart from this general assessment, we will analyse our data in the next months to identify positive and negative aspects for each design. We will present these results at the conference.

## 4 DISCUSSION

Overall, our results indicate that most cyclists and non-cyclists feel safer and thus prefer to ride with physical separation from motorized traffic on junctions. However, since some cyclists feel uncomfortable with the physical separation, a differentiated approach is needed to design junctions that fit all cyclists.

## 5 PROSPECTS

To respect this subjective nature of safety perception we will structure and interpret our recent findings, taking into account established cyclist typologies. We already conducted detailed interviews on mobility socialization and cycling behavior that will build the foundation of this analysis.

Furthermore, we will create and test new designs based on the statements of our participants. A multi-disciplinary advisory board will evaluate these designs in the end.

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