



Separation vs. directness: Safety perceptions of vulnerable road users at different intersection designs

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INTRODUCTION

Perceived safety is highly relevant, particularly for vulnerable road users, because it shapes on-site behavior and mode choice. When residents feel that walking or cycling are unsafe in their city, this might be one reason for unintentional behaviour or for not choosing these modes for their trips at all. Perceived safety of cyclists is mainly analysed for street sections and less for intersections. Friel et al. (2023), as one of the few identified studies investigating the influence of single design elements of intersections on cyclists' safety perception, find in their simulator study that physical separation from cars, continuous cycle facilities and suitable sight conditions increase perceived safety. In contrast, lateral shifts in cycle facilities (bends) and limited sight conditions have the opposite effect. Hardly any literature exists on the perceived safety of pedestrians and persons with restricted mobility. This study aims to investigate the perceived safety of cyclists and pedestrians with and without mobility restrictions at intersections with different types of cycle facilities. These are distinguished first into cycle lanes (Cycle Lane Intersections, CLI), and second into cycle paths following the Dutch-style design of "Protected Intersections" (PI). This study is done using qualitative in-depth analysis methods to capture participants' perceptions of the detailed elements of each intersection and to deeply understand the mechanisms behind perceived safety from both pedestrians' and cyclists' perspectives. This study is conducted with a small sample of participants as a pilot study to test the methodology and provide indicative insights that may be useful for future research to address existing research gaps, particularly for pedestrians and persons with mobility restrictions.

RESEARCH METHODOLOGY

The perceived safety of cyclists and pedestrians without mobility restrictions was studied on-site at four intersections in Enschede (The Netherlands), which were selected in a two-by-two matrix of each one signalised vs. non-signalised intersection and one CLI vs. PI, and at five intersections in Dresden (Germany) which were all signalised and equipped with cycle paths. Four participants in Enschede and eight participants in Dresden investigated these intersections in fall 2022. Participants had three tasks at each intersection: (1) turning right with the bicycle, (2) turning left with the bicycle, (3) moving all around as a pedestrian. In addition, four persons with visual impairments and one person in a wheelchair investigated one intersection with cycle paths (similar to PI) in Dresden by moving all around in summer 2023. All 17 participants were asked to talk while cycling, walking or using their wheelchair into a microphone about what they perceive in each moment and how this affects their perceived safety. Instructions were based on a "Let's play-scenario", participants were invited to speak freely about what comes to their mind. Group discussions were added before and after visiting the intersection for the participants with mobility restrictions to provide a calm and safe environment to discuss individual experiences of walking around the intersection. All voice recordings were transcribed afterwards and subject to content analysis. Detailed determinants of perceived



safety were extracted from the recordings, systemised and aggregated afterwards to grouped determinants as introduced below. The approach follows a simplified variant of grounded theory, to form categories from the material linking theoretical assumptions to empirical data.

RESULTS

The results of this study will be presented in three steps. First, we present detailed insights on perceived safety for the two types of intersections (PI, CLI) from the perspectives of unimpaired pedestrians and cyclists. Second, we generalise the detailed insights and derive the main groups of determinants of perceived safety for these two user groups and the two types of intersections. Third, we present the results for the five persons with visual or physical mobility restrictions and compare them with the general findings in step two.

Nine main groups of determinants are identified in the third step:

- (1) Complexity: overall dimension of the intersection, traffic volumes, etc., as a proxy for the sheer physical size of the intersection in correlation with noise and air quality, with a negative impact on perceived safety for all user groups
- (2) Continuity: understandability of the own facility, routing and priority, smooth facilities, etc., with a positive impact on perceived safety for all user groups
- (3) Separation: clear separation motorists–cyclists–pedestrians, sufficient widths of facilities, etc. with positive impacts on perceived safety for all user groups; cyclists wish to be separated from motorists, pedestrians want to be separated from cyclists; this desire is particularly pronounced among persons with mobility restrictions
- (4) Directness: direct and swift routing through the intersection with higher relevance for cyclists than for pedestrians; directness was hardly mentioned at all by persons with mobility restrictions
- (5) Visibility: marking, colouring, etc. with high relevance for all user groups
- (6) Sight conditions: sufficient sight distances with high relevance for all user groups
- (7) Traffic signal poles: visual and acoustic information on the location of traffic signal poles with high relevance for visually impaired persons
- (8) Courtesy: mutual respect and courtesy in on-street behaviour with relevance for all user groups but particularly for persons with mobility restrictions
- (9) Conformity with traffic rules: use of the own facilities, respect for priority, maximum speed, etc., raised by persons with mobility restrictions but barely mentioned by unimpaired users

DISCUSSION AND CONCLUSION

Overall these findings correspond well with previous studies on cyclists and add new insights into the comparative perception of PI and CLI. For pedestrians and persons with mobility restrictions, this study gives first indications on perceived safety in an emerging research field with barely any previous studies. The methodology worked well and could be the basis for future quantitative studies. The different perspectives of cyclists and pedestrians lead to a tension between cyclists' preference for PI and pedestrians' preference for CLI designs.

REFERENCES

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