



Understanding wheelchair pedestrians' road crossing behaviour and traffic safety needs in the Netherlands

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Introduction

This study inquired into the experiences and behaviours of wheelchair users as pedestrians at traffic crossings. Pedestrians have been described as '*the most vulnerable*' and '*the least physically protected*' road users, respectively (AlKheder et al., 2022; Papadimitriou et al., 2013). People with disabilities encounter more and different problems in transportation than their socioeconomic peers (Flynn et al., 2023). Our literature review revealed 4 themes influencing pedestrians' safety perception: (1) Own behaviour (e.g., walking frequency and attitude), (2) Other road users (e.g., number and behaviour), (3) Infrastructure (e.g., sidewalk quality, crossings, traffic) and (4) Temporary conditions (e.g., time of day, weather, obstructions). Little research has focused on wheelchair users' safety perception while moving independently in traffic situations. This study investigated wheelchair users' road crossing behaviour and traffic safety needs at a road crossing in an urban area in the Netherlands. We posed the following research questions: 1. How does a wheelchair user behave when crossing a road in a Dutch urban area?, 2. What influences the (perception of) safety of wheelchair users as pedestrians?, 3. What does a wheelchair user need to safely cross roads and participate in traffic? And 4. What affects wheelchair users' travel choices and behaviour?

Research methodology

We conducted semi-structured interviews combined with field observations with independently moving wheelchair users. We addressed their travelling experience in general, their perceived safety in traffic, fair treatment from other traffic users, future wishes, and the use of their mobility aid. We observed each participant navigate a traffic crossing. We captured rich qualitative data like thoughts and intentions, and identified analytic themes (Braun & Clarke, 2006). The study was HREC approved (Delft University of Technology, reference No. 133513).

Results

In total 11 wheelchair users (4 female, 7 male) participated. Three of them used a mobility scooter, 3, an electric wheelchair, and 5, a manual wheelchair. One participant with a manual wheelchair had a stretched leg. Participants were aged 19 to 74 years. With 8 of them, in-situ observations at a traffic crossing were conducted, while 3 participants perceived conditions as too risky to go out on the day of the research and only the interview part was completed.



Our thematic analysis of the interviews and observations resulted in six main themes: the four themes from the literature and additionally (5) Experiences with other transport modalities and (6) Building accessibility. Within the themes we learned of the participants' wishes, opinions and coping strategies, examples of observed situations and the role of the surroundings and other road users, the participants' experience of these situations, and the effects of temporary conditions such as the weather and obstacles on behaviour and experience. The diversity of participants meant that their experiences were also diverse.

Discussion and conclusions

Our findings confirm and enrich previous findings and added two themes that are relevant to wheelchair pedestrians' traffic behaviour and safety needs. Our participants fully participate in mobility in public but expend extra efforts for independence and safety (compare Flynn et al., 2023): planning, vigilance, and coping strategies such as taking detours around obstacles and avoiding peak times. Wheelchair users need clear traffic situations: visibility from a low vantage point, other traffic users adhering to traffic rules, and clarity who can use which path. They prefer traffic lights for clarity. Resting points such as a median strip help them handle traffic but can also result in them getting trapped. Their preferences are like those of pedestrians (AlKheder et al., 2022), yet they invest more effort in safety and coping strategies. Limitations of our study: we did not conduct a direct comparison with pedestrians with normal mobility. Still, we compared our results with the literature on pedestrian behaviour. The diversity of our sample meant that saturation was not reached. Future research should collect insights on users of each the wheelchair types we studied. Implications for traffic planning are that traffic lights should be prioritised, paths should be more clearly designated to types of traffic users, and peak hours should be addressed. Future research should study visibility and predictability in traffic situations further. The results of this study will be used in a follow-up VR study that prototypes a variety of traffic situations and tests them with wheelchair users.

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References

- AlKheder, S., Alkandriy, F., Alkhamis, Z., Habeeb, M., Alenezi, R., & Al Kader, A. (2022). Walkability, risk perception and safety assessment among urban college pedestrians in Kuwait. *Transportation research part F: traffic psychology and behaviour*, 86, 10-32. <https://doi.org/10.1016/j.trf.2022.02.003>
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77–101. <https://doi.org/10.1191/1478088706qp063oa>
- Flynn, J. A., Circella, G., & Venkataram, P. S. (2023). Disability, Transportation, Activity Performance, and Neighborhood Features in California: Conducting a Focus Group and Designing a Survey. *UC Davis: Institute of Transportation Studies*. <http://dx.doi.org/10.7922/G29K48JZ> Retrieved from <https://escholarship.org/uc/item/0340w08s>
- Papadimitriou, E., Theofilatos, A., & Yannis, G. (2013). Patterns of pedestrian attitudes, perceptions and behaviour in Europe. *Safety science*, 53, 114-122. <https://doi.org/10.1016/j.ssci.2012.09.008>