Driving slow motorised vehicles with visual impairment

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Appendices

Appendix B

The role of contrast sensitivity

In this dissertation, participants have been divided into groups with different types of visual impairment. This division has been made based on their visual acuity and visual field size as these visual functions are currently used in car traffic to determine if someone is visually fit to drive. However, a number of studies have emphasised the importance of contrast sensitivity for safe traffic participation in cars (Bal, Coeckelbergh, Van Looveren, Rozema, & Tassignon, 2011; Guo, Fang, & Antin, 2015; McGwin Jr., Chapman, & Owsley, 2000; Owsley & McGwin Jr., 2010; Owsley, Stalvey, Wells, Sloane, & McGwin, 2001; Van Rijn et al., 2011). Therefore, the role of contrast sensitivity on driving safety in slow motorised vehicles has been explored in this appendix.

Peak contrast sensitivity was measured using the Groningen Edge Contrast Kaart Ontwerp (GECKO; Kooijman, Stellingwerf, & Van Schoot, 1994), a test designed for measuring the peak contrast sensitivity in visually impaired people. The test is assessed with a distance of 1m and an illuminance of 500lux. The maximum score is 16 and the minimum score is 0. Scores of 16, 15, and 14 are considered normal values and scores of 13 and 12 are classified as almost normal. Scores below 12 are considered as abnormal.

The GECKO scores of the people who failed the mobility scooter on-road test have been explored. Furthermore, mobility scooter driving performance (see Chapter 4) and performance in the driving simulator (see Chapter 5) was compared between participants who performed below and above the cut-off (12) on the GECKO.

Results

Four out of the five participants who failed on the mobility scooter on-road test had a contrast sensitivity below cut-off (80%; Table B1). Of the people who passed the mobility scooter on-road test, approximately 65% had a score above cut-off on the GECKO, whereas 35% performed below cut-off (Table B2). Participants with a score below cut-off on the GECKO performed worse both on the mobility scooter
on-road drive ($T(86) = 2.89; p = 0.005$; Table B3) and the driving simulator tasks ($U = 128; p < 0.001$; Table B4). There is a small, but significant correlation between the mobility scooter on-road test performance and the GECKO ($r = 0.251$, $p = 0.018$) and a moderate significant correlation between driving performance in the driving simulator and the GECKO score ($r = -0.348$, $p = 0.011$).

**Discussion**

Because contrast sensitivity has been shown to play an important role in safe traffic
participation in cars, the role of contrast sensitivity in slow motorised vehicles has been explored in this appendix. Results show that contrast sensitivity has an impact on driving performance in slow motorised vehicles. A low score on the GECKO was associated with worse performance in both performance on the mobility scooter on-road test and the driving simulator, although the effects were small. Especially in the driving simulator, low contrast sensitivity contributed to a higher number of collisions. This is in line with the finding that visually impaired participants showed difficulties with objects that had a low luminance contrast (see Chapter 5).

Furthermore, almost all of the participants who failed the mobility scooter on-road test had an abnormal score on the GECKO. Therefore, the GECKO seems to be a sensitive measure to detect unsafe traffic participation. However, the GECKO is not an optimally sensitive measure, as only 65% of the people who passed the mobility scooter on-road test, showed a normal GECKO score. Therefore, the outcome of the GECKO needs to be interpreted with caution to avoid classifying people as
unsafe who would very well be able to use slow motorised vehicles safely. On the other hand, good contrast sensitivity does imply good driving performance.

Concluding, the results of this exploration show that contrast sensitivity affects driving performance, but that it cannot be used to accurately predict who will be safe in traffic or not. Results could rather be used to make rehabilitation professionals aware of what difficulties visually impaired individuals might encounter during an on-road drive. For example, a low contrast sensitivity might mean that a particular client might have difficulties with the borders of a pavement or an increased chance to collide with obstacles that cannot be easily distinguished from the environment. Furthermore, this outcome is also relevant for infrastructure design as it is important to create sufficient contrast. In that respect, contrast sensitivity adds valuable information to help improve rehabilitation and direct training, but should not be used as a means to identify unsafe drivers. Furthermore, future research should add contrast sensitivity as a measure to their design to gain more
information about the role of contrast sensitivity in slow motorised traffic.

References


