Effects of simulated mild vision loss on gaze, driving and interaction behaviors in pedestrian crossing situations

PURPOSE Interaction is the process of behavior adaption between two or more participants primarily based on what they visually perceive. It is an important aspect of traffic participation and supports a safe and efficient flow of traffic. However, prior driving simulator studies investigating the effects of vision impairment have typically used pre-programmed pedestrians that did not interact with the human driver. In the current study we used a linked pedestrian and driving simulator setting to increase the ecological validity of the experimental paradigm. We evaluated the effects of mild vision loss on interactions between drivers and human-controlled, interactive pedestrians compared to preprogrammed, non-interactive pedestrians. METHOD Young subjects (mean age 31 years) wore safety goggles with diffusing filters that reduced visual acuity to 20/50 Snellen and contrast sensitivity to 1.49 log units. Two types of crossings (zebra vs. free lane) and two types of
pedestrians (non-interactive vs. interactive) were presented to the driver using a multiple simulator setting. Gaze, safety and time series measures were analyzed to quantify the behavior of the participants during the different crossing situations. RESULTS Simulated vision impairment significantly increased the time taken to first fixate on the pedestrian, but only had mild adverse effects on safety measures and subsequent interactions. By comparison, pedestrian type and crossing type were found to significantly affect interaction measures. In crossings with the interactive pedestrians the behavior adaption between the driver and the pedestrian took longer and was less correlated in contrast to the situations with the non-interactive pedestrian.

CONCLUSION Mild vision impairment (slightly worse than the common 20/40 requirement for driving) had little effect on interactions with pedestrians once they were detected and only had mild adverse consequences on driving safety. Time series measures were sensitive to differences in behavior adaption between road users depending on the level of interaction and type of crossing situation.

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