

Effects of impaired vision on eye movements, psychophysical stress parameters and behaviour

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The decline of visual performance as a function of age is proceeding slowly and hard to realise by drivers. There is a significant reduction of visual function as of 50 years, problems mostly occur during night driving. The limit of visual acuity in German driving licensing is a visus of 0.7 which is equivalent to glasses with 1 dioptre to correct for normal vision. In order to estimate the effect of reduced but legal loss of visual acuity a field study was performed. Male drivers with a visual acuity of 0.7 (myopic drivers [MD], N = 19) as well as normal drivers ([ND], N = 26) were driving on a 50 km track including all types of roads. A driving instructor on the front passenger's seat was able to intervene in case of urgent troubles. Additionally he rated the drivers' performance on a questionnaire. While driving eye movements were stored by a remote eye tracking system (Dornier, Friedrichshafen). Heart beat rate, electromyography (EMG) and driving speed as well as position (GPS system) were used to analyze psychophysical stress and behaviour. The drivers got instructions where to drive and had to search for traffic signs indicating the direction. In case of no vehicles ahead the MD group reduced driving speed while passing the traffic signs. There were slightly more fixations in a near distance to traffic signs with longer fixation durations. At six signs the drivers had to report the content. The MD group significantly reported no or wrong contents compared to drivers with normal vision. In normal driving saccadic activity of the drivers was reduced in all conditions, the level of significance was reached on the motorway. Heartbeat rate was increased in the MD group compared to the ND group. After 30 minutes the ND group the heartbeat rate was reduced remarkable until the end of the test drive of about 60 minutes whereas the MD group showed high level heartbeat rate up to the end. The EMG showed increased values in urban traffic and while passing urban villages for the MD group. The driving instructor stated less performance of the MD group in the factor "driving skills". A driver questionnaire revealed reduced alertness and power after driving.

The study shows that a small reduction of visual acuity induces psychophysical stress and reduces driving skills. Myopic drivers need more time for information intake and might miss relevant incidents. Hence even slightly uncorrected vision affects performance although critical incidents happened rarely in this study. Therefore drivers of 45 years or older should have an eye on their visual performance. Self tests as a number plate test or by examination by professionals should be run every now and then.