Optical blur, fog, and glare significantly delay driver reaction time to driving hazards in younger and older drivers

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Purpose: The ability to detect and react to various forms of hazard on the road is crucial for safe driving. In some countries, the Hazard Perception Test (HPT) is employed as part of the assessment process for driving license acquisition, but there is limited work investigating the impact of impaired vision on hazard perception. This study investigated how driver reaction time (RT) to hazards is affected by different forms of visual degradation while undertaking the UK HPT.

Method: Thirty-one younger (mean ± SD age: 24.1 ± 5.5 years) and twenty-eight older drivers (mean ± SD age: 52.8 ± 8.7 years) with corrected-to-normal binocular visual acuity completed ten HPTs from a set of high-resolution CGI video clips officially used by the UK Driver and Vehicle Licensing Agency to assess hazard perception in learner drivers. Participants undertook the HPTs with and without induced visual degradation, the visual degradation conditions being (i) optical blur (induced with a +2.00D spherical lens), (ii) media opacity (induced with a LEE Fog 5 filter), and (iii) glare (induced with two glare sources to

simulate headlights). These conditions were employed singly and in combination. Participant RT in seconds (s) was then measured with a Cedrus RB540 response box while they completed the HPT. The HPT video clips were randomized, and performance with the induced visual degradations was assessed two weeks after baseline measures (without visual degradation) to minimize memorization effects.

Results: There was no statistically significant difference in RT between younger (1.58s ± 1.22) and older drivers (1.68s ± 1.30) either at baseline ($t=0.91$, $p=0.36$) or in the presence of any of the visual degradation conditions (all $p>0.05$). However, for younger drivers, optical blur, a combination of optical blur and media opacity, and a combination of optical blur, media opacity, and glare significantly delayed their mean RT relative to baseline by 0.62s, 0.83s, and 1.08s, respectively (all $p<0.01$), while for older drivers they reduced it by 0.73s, 0.51s, and 0.78s, respectively (all $p<0.01$). There was also a statistically significant delay in mean RT for older compared to younger drivers (mean diff: 0.88s, 95% CI: 0.13-0.16s, $p=0.02$) under a night-time driving scene where optical blur and media opacity were combined.

Conclusion: Younger and older drivers demonstrated similar delays in RT under simulated visual degradation, although older drivers had significantly poorer performance in night driving conditions. The independent and combined effects of optical blur, media opacity, and glare on delaying RT to driving hazards for both younger and older drivers' highlights the importance of clinically assessing and addressing these visual conditions among drivers of all ages in order to enhance driving safety.

Keywords: reaction time, hazard perception, visual degradation, simulated, glare, blur, fog, driving.