Eye (2022) 36:651–652
https://doi.org/10.1038/s41433-021-01409-0

The ROYAL COLLEGE of OPHTHALMOLOGISTS

CORRESPONDENCE

Visual distraction from automobile displays: an impediment to visual performance

Julie Lovell[1] · Jeff Rabin[1] · Alejandro Cerrillo[1] · Mercedes Luevano[1] · Rachel Rowland[1] · Lissette Silva[1] · Kennith Startz[1]

Received: 30 December 2020 / Revised: 8 January 2021 / Accepted: 14 January 2021 / Published online: 1 February 2021

To the Editor:

Visual and auditory distraction (cell phones, texting, displays) increase automobile accidents [1]. While cell phone distraction has been a focus of major concern [2], automobile displays with auditory cues delay performance but research on their visual distraction is lacking [3]. Our prior research showed that simulated hands-free phone calls can impair low contrast color and black–white (BW) visual performance [4]. We report that a simulated automobile display imposes comparable effects on vision threatening driver safety.

Subjects were tested binocularly with a computer program (Innova Systems, Inc.) which measures cone-specific color contrast sensitivity (red, green, and blue cone CS), BW CS and low contrast (6%) visual acuity (VA) on a calibrated Microsoft Surface display viewed in a dark room at 3 feet. Each subject was tested, in randomized order, with and without visual distraction from an iPad mini display immediately to the right of the Surface display. The iPad displayed an image of a roadway intersection with a symbol in one of four quadrants. During distraction, an auditory cue 'look' occurred every 10 s. during which the subject was required to view the iPad and verbally identify the symbol and its intersection quadrant location while continuing to complete CS and VA tasks (Fig. 1). Outcomes included average response time to identify letters, CS and VA scores, and number of correct intersection symbol identifications with and without distraction. Repeated measures ANOVA and paired t-tests assessed distraction effects.

Twenty-four adults (27 ± 5 YO, 14 females) participated after providing written informed consent in accord with our IRB approved protocol. Overall mean CS and VA were improved without distraction ($F = 13.09$, $P < 0.001$), but post-hoc t tests indicated that only red cone CS was decreased with distraction ($P < 0.02$). However, consistent with cell phone auditory distraction [4], response time with visual distraction was significantly increased on all color and BW tests ($F = 50.53$, $P < 0.001$, Fig. 2). Mean [SE] response time with distraction (1.80 [0.07] s) was higher than without distraction (1.56 [0.06] s; mean increase with distraction: 0.24 [0.06] s, 95% CI: 0.12–0.36 s, $P < 0.001$). All but one identified all navigation symbols with distraction.

Response time to identify low contrast color and BW targets was significantly increased in the presence of visual distraction from a simulated automobile navigation display (mean response time increase: 0.24 s). This increase is comparable to that with verbal distraction from simulated hands-free phone calls (mean: 0.30 s) [4]. Our results suggest that a driver traveling 65 miles/h (95.33 feet/s) attending to an automobile display for 0.24 s would experience diminished driving visibility for 22.88 feet (1.6 car lengths), posing a formidable threat to safety. This effect is likely exacerbated in elderly individuals, given their substantive loss of useful field-of-view, which is the ability to identify centrally viewed targets while detecting peripheral targets [5]. Future research, involving older individuals and those with ocular, systemic and/or neurologic disease, may reveal more deleterious effects of visual and auditory distraction on response time and visual performance in critical tasks like driving.

✉ Julie Lovell
julie.lovell2017@outlook.com

[1] University of the Incarnate Word Rosenberg School of Optometry, San Antonio, TX, USA

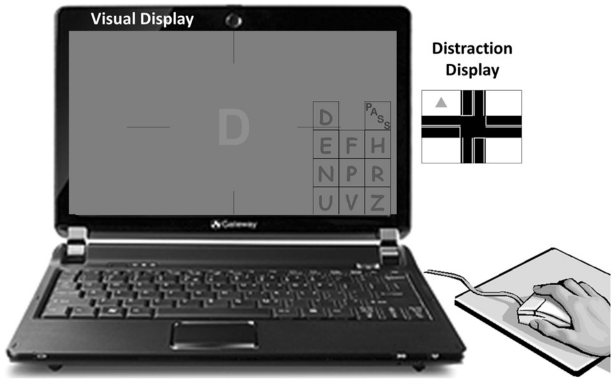

Fig. 1 Visual performance testing display. The main display for testing visual performance is shown at the left with a diagram of the simulated navigation display immediately to the right.

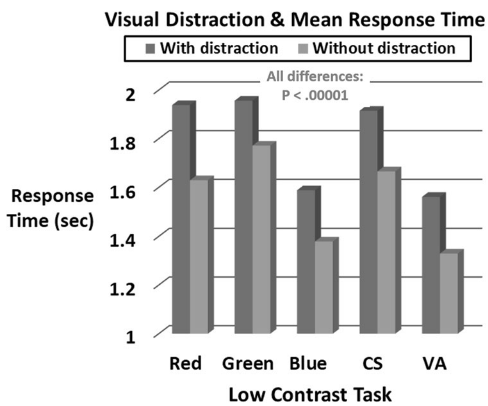

Fig. 2 Mean response times are shown with and without visual distraction from the simulated navigational display. All differences were highly significant ($P < 0.001$) confirming increased response time to detect targets when using a simulated navigation display.

Funding This study was internally funded by Rosenberg School of Optometry, University of the Incarnate Word.

Author contributions JAL was responsible for conducting the investigation, formal analysis, conceptualization, writing original draft, reviewing, and editing draft manuscript, and project administration. JR was responsible for conceptualization, methodology, formal analysis supervision, resources, writing original draft, reviewing, and editing manuscript. AC, ML, RR, LS, and KS were responsible for data collection, validating data, and data curation.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Publisher's note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

References

1. Peng Y, Boyle LN, Hallmark SL. Driver's lane keeping ability with eyes off road: Insights from a naturalistic study. Accid Anal Prev. 2013;50:628–34.
2. Beanland V, Fitzharris M, Young KL, Lenné MG. Driver inattention and driver distraction in serious casualty crashes: data from the Australian National Crash In-depth Study. Accid Anal Prev. 2013;54:99–107.
3. Lacherez P, Virupaksha S, Wood JM, Collins MJ. The effects of auditory satellite navigation instructions and visual blur on road hazard perception. Accid Anal Prev. 2019;125:132–7.
4. Rabin JC, Bradshaw TL, Chacon AM, Johnston SK, Yu DB. Hands-free phone calls impair visual performance. Am J Prev Med. 2016;51:e117–e118.
5. Rusch ML, Schall MC Jr, Lee JD, Dawson JD, Edwards SV, Rizzo M. Time-to-contact estimation erros among older drivers with useful field of view impariments. Accid Anal Prev. 2016;95:284–91.