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# Year 24 Final Report

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## Technology Adoption and Use Across the Lifespan

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Fonts are a central design element of any interface that displays text. In safety critical applications such as driving an automobile, the wide universe of typographic design decisions may affect basic readability and the ability to quickly target and identify information of interest. This is critical to reducing workload and preventing distraction. While the link between font design and auto safety seems obvious to typographers, it has received minimal attention from automotive manufacturers and HMI designers. Based on our conversations with font experts, it appears that the fonts commonly used in vehicle interfaces may not be optimal. Vehicle interface designers frequently prioritize brand requirements over legibility when selecting a typeface. The optimization of visual information across all aspects of the vehicle interior, e.g., instrument cluster, telematics displays, heads-up displays, etc., might reasonably be expected to reduce demand on the operator and free-up resources for the primary operation of the vehicle.

The importance of providing a driver with a visual user interface in which controls can be rapidly identified and information easily read appears self-evident. If text or numeric characters are hard to read, user satisfaction is negatively impacted and the risk of accident may increase due to both increased time of the eyes being directed away from the roadway and from cognitive distraction. While significant investment has been placed on typeface optimization in respect to driver vehicle interfaces (e.g. ISO 15008, 2009) these standards are informed by traditional stamped (static) media and primarily focus on the extrinsic characteristics of the font's display (size, weight color, etc.), not the intrinsic characteristics of the font's individual letterforms and the characteristics of modern electronic (dynamic) displays. Considerable investment has already been made in legibility for other areas of the automotive operating environment. For instance, the Clearview typeface was developed and tested to specifically enhance legibility of positive contrast roadway signage (Holick, Chrysler, Park, & Carlson, 2006; Chrysler, Carlson, & Hawkins, 2003; Garvey, Pietrucha, & Meeker, 1998; Garvey, Pietrucha, & Meeker, 1997). The legibility benefits of Clearview were evident at night with a high-brightness reflective material, but were not present in a study of negative contrast signs in uppercase (Chrysler, Carlson, & Hawkins, 2003; Holick, Chrysler, Park, & Carlson, 2006).

This project assessed a select set of hypotheses on aspects of typeface design and their impacts on driver behavior. The initial focus considered the amount of visual-attention (eye tracking) required to complete a simple menu selection task in a driving simulator. The task was presented in two typefaces that closely resembled those used by several automotive manufactures as part of their interior user interfaces. The results of two experiments are summarized in Reimer et al., 2014. The process of assessing differences in typographical characteristics in a driving simulation environment using eye movement is time consuming and complex. Therefore, the exploration of the vast number of intrinsic and extrinsic characteristics that may impact the legibility of a typeface may be limited in this context. To assess the degree to which simpler laboratory based psychophysical technique (lexical decision) could be utilized to assess legibility differences that were observed in an automotive context, a second set of experiments (Dobres et al., 2016) was conducted. The work firmly suggests that the simple laboratory based testing of legibility differences can be readily used in theoretical research and an applied evaluation context for optimizing interface characteristics. One key take away from the effort appear to be that older observers are more strongly affected by suboptimal designs (small type and negative polarity displays).

For further information on this research please see:

Reimer, B., Mehler, B., Dobres, J., Coughlin, J.F., Matteson, S., Gould, D., Chahine, N. & Levantovsky, V. (2014). Assessing the Impact of Typeface Design in a Text Rich Automotive User Interface. *Ergonomics*, 57(11), pp. 1643-1658. DOI: 10.1080/00140139.2014.940000.

**Abstract:** Text-rich driver-vehicle interfaces are increasingly common in new vehicles, yet the effects of different typeface characteristics on task performance in this brief off-road based glance context remains sparsely examined. Subjects completed menu selection tasks while in a driving simulator. Menu text was

set either in a 'humanist' or 'square grotesque' typeface. Among men, use of the humanist typeface resulted in a 10.6% reduction in total glance time as compared to the square grotesque typeface. Total response time and number of glances showed similar reductions. The impact of typeface was either more modest or not apparent for women. Error rates for both males and females were 3.1% lower for the humanist typeface. This research suggests that optimised typefaces may mitigate some interface demands. Future work will need to assess whether other typeface characteristics can be optimised to further reduce demand, improve legibility, increase usability and help meet new governmental distraction guidelines.

Link to full text: <http://www.tandfonline.com/doi/full/10.1080/00140139.2014.940000>

Dobres, J., Chahine, N., Reimer, B., Gould, D., Mehler, B. & Coughlin, J.F. (2016 in press). Utilizing Psychophysical Techniques to Investigate the Effects of Age, Typeface Design, Size, and Display Polarity on Glance Legibility. *Ergonomics*. DOI: 10.1080/00140139.2015.1137637.

**Abstract:** Psychophysical research on text legibility has historically investigated factors such as size, color, and contrast, but there has been relatively little direct empirical evaluation of typographic design itself, particularly in the emerging context of glance reading. In the present study, participants performed a lexical decision task controlled by an adaptive staircase method. Two typefaces, a "humanist" and "square grotesque" style, were tested. Study I examined positive and negative polarities, while Study II examined two text sizes. Stimulus duration thresholds were sensitive to differences between typefaces, polarities, and sizes. Typeface also interacted significantly with age, particularly for conditions with higher legibility thresholds. These results are consistent with previous research assessing the impact of the same typefaces on interface demand in a simulated driving environment. This simplified methodology of assessing legibility differences can be adapted to investigate a wide array of questions relevant to typographic and interface design

Link to full text: <http://www.tandfonline.com/doi/pdf/10.1080/00140139.2015.1137637>

Other publications supported through this project include:

Dobres, J., Chahine, N., Reimer, B., Gould, D. & Zhao, N. (2016). The effects of Chinese typeface design, stroke weight, and contrast polarity on glance based legibility. *Displays*, 41, pp. 42-41. DOI: 10.1016/j.displa.2015.12.001.

Link to article: <http://www.sciencedirect.com/science/article/pii/S0141938215300470>

Dobres, J., Reimer, B., Parikhal, L., Wean, E. & Chahine, N. (2015). The Incredible Shrinking Letter: How Font Size Affects The Legibility of Text Viewed in Brief Glances. *Proceedings of the 8th International Driving Symposium on Human Factors in Driver Assessment, Training, and Vehicle Design*. Snowbird, UT. pp. 435-441.

Link to full text: <http://drivingassessment.uiowa.edu/sites/default/files/DA2015/papers/065.pdf>

Dobres, J., Reimer, B., Mehler, B., Chahine, N., & Gould, D. (2014). A Pilot Study Measuring the Relative Legibility of Five Simplified Chinese Typefaces using Psychophysical Methods. *Proceedings of the 6th International Conference on Automotive User Interfaces and Interactive Vehicle Applications (AutomotiveUI '14)*, Seattle, WA. DOI: 10.1145/2667317.2667339.

Link to article: <http://dl.acm.org/citation.cfm?id=2667339>