Clearer Road Signs Ahead

Development of a new road sign alphabet improves legibility and recognition.

IS IT POSSIBLE TO IMPROVE THE readability of legends on conventional road guide signs? There are two reasons to think that the answer is yes.

First, for 85 years it has been known that people read lowercase type faster than text written in all uppercase letters (Starch, 1914, in Tinker, 1963). Almost half a century ago, this was also shown to be true for traffic signs. In 1950, Forbes, Moscowitz, and Morgan demonstrated that the use of properly sized mixed-case letters (lowercase with an initial capital) improves the ability of guide sign readers to more accurately recognize destination names. Yet, to this day, all-uppercase is used almost exclusively on conventional road guide signs and street name signs (*Manual on Uniform Traffic Control Devices*, 1988).

Second, the current 40-year old highway guide sign font's thick stroke or "bold design," coupled with the latest high-brightness reflective signing materials (such as 3M's Diamond Grade and VIP retroreflective sheeting), results in a visibility-reducing phenomenon known as *irradiation*, or *halation* (Mace, Garvey, & Heckard, 1994; also see Figure 1 on page 8).

To address these two issues, a new font, subsequently named Clearview, was developed by Meeker & Associates and tested by the Pennsylvania Transportation Institute (PTI) at Pennsylvania State University (Garvey, Pietrucha, & Meeker, 1997). After creating initial versions of the fonts, we subjected them to an iterative design process based on the results of subjective field evaluations, objective tests of the typefaces' degradability, and objective laboratory studies using computer simulation. This development process resulted in the evolution of a final version of Clearview, which PTI used in a series of guide sign visibility studies. The steps in this process are described in this article.

Topics of Focus and Data Collection Methods

In this section we address the general experimental methodology we used to collect data on three topics related to guide sign visibility:

1. how selecting a *word-legibility* versus a *word-recognition* task can have a dramatic impact on sign-reading distance;
2. how all-uppercase words are read differently from mixed-case words, and;
3. how a newly designed font called Clearview can improve guide sign readability over the current mixed-case Standard Highway Series E(M) font.

We constructed a 122-cm (48-inch) sign panel on which a set of 12.7-cm (5-inch) capital-letter-height words were placed using mount-

Above: Experimental participant's point of view.

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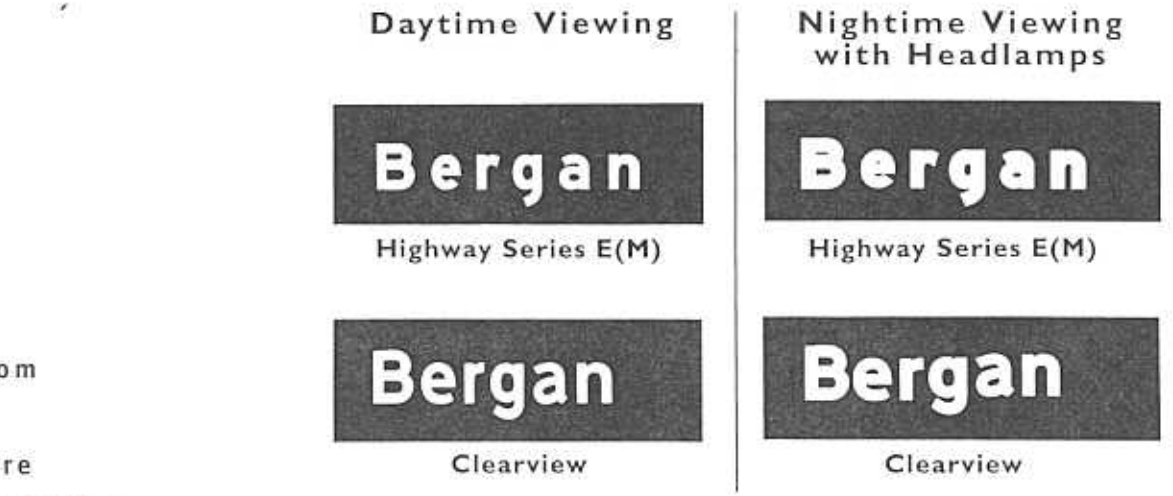

Figure 1. Irradiation of Standard Highway font versus Clearview font.

ing clips (see Figure 1). Participants (a group of 48 individuals 65 to 83 years old) were seated in the front passenger seat of a 1993 Ford Probe. An experimenter took the vehicle to a starting point 305 m (1000 ft) upstream of the sign and drove toward the sign at 8 to 16 km/h (5 to 10 mi/h) (see the photo on page 7). This slow rate of speed allowed us to establish accurate reading distances while avoiding some of the problems associated with static sign presentation, such as adaptation to sign brightness. The experimenter drove the vehicle in the center of a 3.7-m (12 ft)-wide, straight, flat section of the PTI test track; the sign was located 3.7 m (12 ft) to the right of the center of the vehicle at a mounting height of 1.8 m (6 ft) from the road to the bottom of the sign. The road was marked in 7.6 m (25 ft)-intervals.

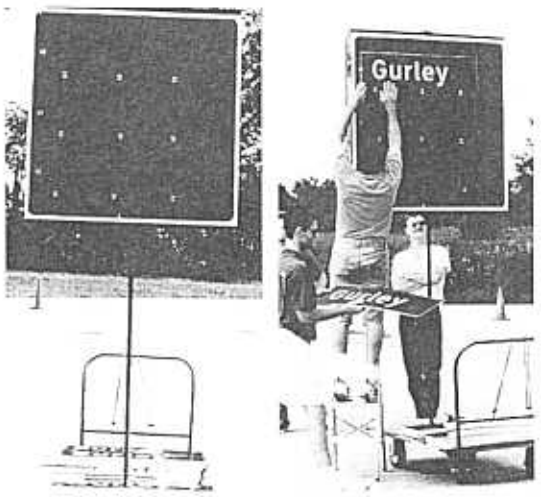

Figure 2.
Experimental sign apparatus and stimuli.

When the participant read the sign correctly, the experimenter stopped the vehicle and recorded the distance. The vehicle was then turned around and the procedure repeated. Six distinct fonts were tested: mixed-case Standard Highway Series E(M), all-uppercase Standard Highway Series D, and four versions of Clearview. (Illustrations of the highway fonts can be found in Standard Highway Signs, 1978.) The study was run both during the day and at night.

Word Legibility versus Word Recognition

We used two dependent measures to evaluate sign readability: word legibility and word recognition. For the legibility measure, a single word was placed in the middle of the 4-ft sign, and the participant's task was simply to read the word correctly. With the word recognition measure, three words (all of the same font) were placed on the sign (see Figure 3); before viewing began, the participant was told one of the words and then was asked to find it on the sign (top, middle, or bottom).

For all fonts under daytime and night conditions, the word recognition task resulted in a large and statistically significant improvement in reading distance over the legibility task. Figure 4 shows a comparison of mean legibility and recognition reading distances under day and night conditions.

This phenomenon is not new, as we stated earlier. Forbes et al. (1950) found a 40% improvement in recognition of familiar names over the legibility of random scrambled letters. In addition, the results are not surpris-

Figure 3. Sign panel for the recognition task.

ing. In a legibility task with unfamiliar words, guide sign readers need to read each letter and construct the word (Tinker, 1963), whereas in a recognition task, all that is needed is identification of the word's overall shape, or footprint, and the ability to differentiate that shape from those of other words in the set. One would expect that global word recognition can be done at a much greater distance than individual letter recognition. However, what *is* surprising is that the results from legibility research are used in selecting letter height for guide signs, when in fact guide signs are not read letter by letter.

As guide sign readers look for a particular location, it is assumed that they have an idea of what might be on that sign. They compare the sign message with a mental image of their intended destination's name and either accept or reject the sign on the basis of a comparison or discrimination between the two – a comparison that is similar to the technique used in the PTI studies that resulted in accurate place-name recognition at twice the distance found in legibility studies.

We are not suggesting that results from recognition distance studies should be the new standard for selecting guide sign letter height. Rather, we propose that by understanding how people read guide signs, we are in a better position to improve guide sign visibility. The next section emphasizes this point.

All-Uppercase versus Mixed-Case Signs

Using the procedure described earlier, we compared the reading distance of words depicted in the Standard Highway Series D all-uppercase font with that of words shown in the mixed-case Clearview font. Two styles of the Clearview font were used. Although all words tested used the same number of letters, one of the Clearview font styles resulted in words that took up less sign space ("smaller mixed case") than those depicted in the Series D font, and one (because of an increase in letter size) resulted in words that took up the same amount of sign space ("same-size mixed case") as the Series D font. We recorded reading distances for both legibility and word recognition tasks under daytime and nighttime conditions.

In the legibility task, requiring individual letter reading, the larger letters used with the all-uppercase font resulted in significantly longer legibility distances than the smaller mixed-case font. There was no statistically significant performance difference between the same-sized mixed-case font and the all-uppercase font (see Figure 5 on the next page).

When viewed from far away, all-uppercase words look like fuzzy rectangles, whereas words in mixed case have a distinctly recognizable overall shape.

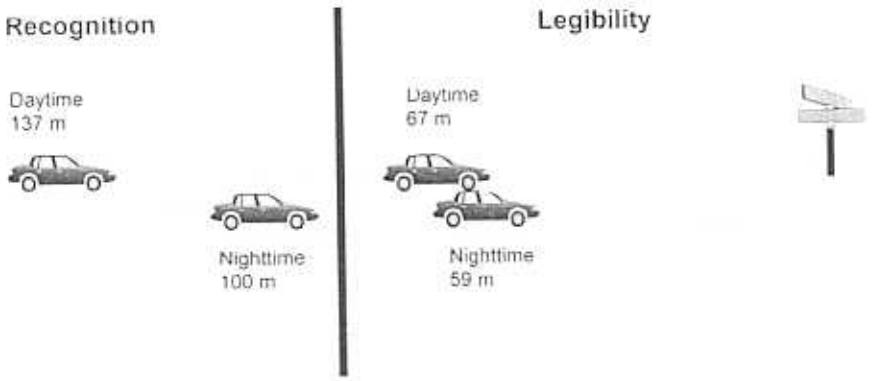

Figure 4. Day and night recognition versus legibility distance.

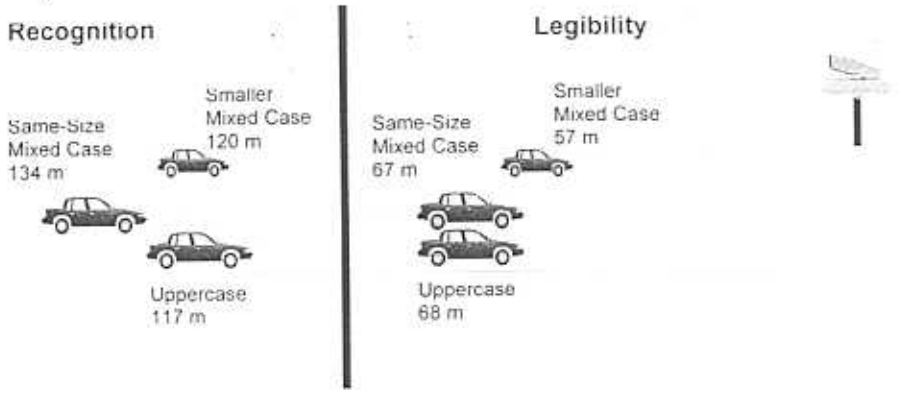

Figure 5. Reading distance of mixed-case versus all-uppercase.

The basic principle behind the new font's design was to open the interior spaces of the letter forms so that irradiation would not diminish the distance at which the alphabet could be read.

In the recognition task more closely representing real-world behavior, the same-sized mixed-case fonts performed significantly better than the all-uppercase. Even the mixed-case font that took up less sign space performed as well as the all-uppercase font (see Figure 5).

If one considers how signs are read, two likely reasons emerge for the mixed-case superiority in the recognition task. First, when viewed from far away, all-uppercase words look like fuzzy rectangles, whereas words in mixed case, with their ascending and descending elements, have a distinctly recognizable overall shape, or footprint. Second, most reading material is in mixed or lower case, making it easier for observers to recognize mixed-case sign copy (Tinker, 1963).

Standard Highway Series E(M) versus Clearview

As mentioned earlier, the thick stroke design of the Series E(M) highway alphabet, both upper and lower case, when used with high-brightness signing materials, results in irradiation, or halation. Irradiation becomes a problem when the reflective letter material is so bright that it bleeds into the letter form's open spaces, creating a blurring effect that decreases legibility (Mace et al., 1994). The Clearview font was designed to reduce the effects of irradiation. The basic principle behind the new font's design was to open the interior spaces of the letter forms so that irradiation, when it occurred, would not diminish the distance at which the alphabet could be read (see Figure 6). Because of the increased openness of the Clearview characters, we hypothesized that intercharacter spacing for Clearview could be smaller than Standard Highway spacing. We compared Series E(M) with two versions of the Clearview font, one that matched

Figure 6. Clearview font development.

Figure 7. Sign area as a function of font.

Figure 8. Reading distance of Clearview versus Standard Highway font.

Series E(M) in letter width and height but, because of smaller intercharacter spacing, resulted in smaller word area, and one with the letter size increased so that the Clearview words were the same size as the Series E(M) words (see Figure 7).

Under daytime conditions, the Series E(M) and both of the Clearview fonts had essentially equal readability distances. At night, however, with headlamps and bright signing materials, the Clearview font that took up the same amount of sign space as the Series E(M) resulted in statistically significant improvements in readability distance (see Figure 8). This was true in both the legibility task and the recognition task. The smaller version of Clearview performed as well as the Series E(M).

Conclusions

The Clearview font was specifically designed to improve sign readability at night with high-brightness sign materials. Under these conditions, Clearview significantly outperformed the current highway fonts while using the same amount of sign space. A 16% increase in recognition distance was found with the Clearview font. With highway-sized signs on 88 kph (55 mph) roadways, this could translate into an additional 49 m (160 ft), or two more seconds to read and respond to a sign.

Guide signs play an important role in driver wayfinding. Well-placed and well-designed guide signs can steer an individual toward his or her destination with minimal attentional demand, whereas poorly visible signs can sap a driver's cognitive and perceptual resources. This abuse of driver capabilities can result in erratic maneuvers, such as inappropriate rates of deceleration and untimely lane changes.

References

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