1. Controlled Field Observation

   Erratic vehicle occurrence between matched test and control sites.

2. In-Vehicle Navigational Task Performance

   Driver commentary or other response measures of information acquisition and information processing over test courses involving route finding tasks using both reflectorized and nonreflectorized signs.

REFLECTORIZED GUIDE SIGNS: HUMAN FACTORS

Richard F. Pain, Essex Corporation

Five human factors aspects of guide signs are discussed to identify outstanding future research issues.

Legibility

Much is known about legibility. Letter height, font, stroke width, legibility distance, reading time, information extracted per glance, effects of contrast, and acuity deficiencies have been researched and design guidelines have been developed. However, there are questions that cannot be fully answered by available research.

Standards that require illuminated overhead signs demand a high initial and maintenance cost. Methods for maintaining legibility, conspicuity, and color code, but at a reduced cost, would benefit operating agencies and taxpayers.

Another interesting question is whether higher-intensity sign faces or letters can improve legibility. The very high intensity reflective sheeting under development or in the marketplace presents design options with unknown effects on driver perception.

A continuing research need is to improve sign legibility under poor visibility conditions. Another continuing dilemma is the effort to maintain legibility when drivers are in impaired states.

Attention Value/Complexity

For many years researchers and traffic engineers have been aware that the complexity of the sign and its background affect attention value and, in all likelihood the driver's ability to extract information from the sign. Only in recent years have resources been allocated to research this topic. The results of the research are discussed by D. Mace elsewhere in this Circular.

Attention value or conspicuity has been studied, and the impact of brightness ratio, size, and color on visibility or detection distance are generally known. Given these characteristics, the visibility distance of a particular sign can be predicted.

Again, although much is known, much is left to determine. Many studies of attention value were performed using stimuli without white borders. The outdoor field validations of results were performed on bordered signs but the effect of a white border, particularly at lower sign face luminances, is not understood.

The effect of low sign face luminance on attention value and driver performance is a current question being studied for the Federal Highway Administration (FHWA) by Systems Technology, Inc. An offshoot of this question is the need to determine an optimum visibility distance. Is it possible that signs can be detected too far away? Obviously too short a distance is deleterious. Such a question should be debated to determine if it is worth answering.

Information Coding

Guidelines have been written to standardize the type of information found on guide signs. What is useful information for motorist navigation is a difficult judgment and one requiring additional research.

Expectancy and Priority

Often color is considered the redundant or secondary source of information. In some circumstances, for example, at night, color is the first piece of information perceived by the driver. This alerts the driver and gives him or her more time to attend to (read) the sign and it eliminates confusion with other types of signs.

What happens when there are minor code inconsistencies? Further, is there any effect on driver understanding, expectancy, or behavior when color coded and noncoded signs are included in a sign sequence. Finally, how much inconsistency is tolerated before the meaning of the coding scheme is undone or loses credibility?

System Performance

Only one accident study has addressed the effect of reflectorization on highway system performance, but because of confounded variables it is impossible to interpret. Intermediate criterion measures of guide sign performance were developed and validated by Hanscom and Berger (1). There is a need to develop normative data for the validated measures. Traffic engineers can then compare results of evaluations performed by using these measures against nationally standardized data.

Research Needs Overview

The predominant research themes identified here are as follows:

A. If sign face background brightness and sign color are substantially reduced at night:

   - Is driver behavior altered due to:
     - Loss of color code
     - Attention value
     - Greater variability in legibility performance
   - Are drivers with visual acuity deficiencies or other impairments (alcohol, fatigue) put at greater risk?
   - At what point does the color coding loose credibility?
   - Does a reflectorized white border counteract changes in attention value from lower sign luminance?
   - Are driver behavior changes different for heavier traffic volume or impaired visibility conditions?

- How does background complexity affect driver sign detection and reading performance?

B. Data of guide sign evaluation measures need to be gathered nationally so there are standards or norms for interpreting results obtained at the local level.

Considerable research on the human factors aspects of guide signs has been conducted. There are many questions still to be answered and benefits to be derived by the driving public from future research.

Reference

1. F. R. Manscom, and W. G. Berger, Motorist Response to Highway Guide Signing, Volume 1, Field Evaluation of Measures, BioTechnology, Inc. for NCHRP, January 1976.

REFLECTORIZATION OF CURVES

R. Wade Allen, Systems Technology, Inc.

The driver's use of roadway delineation for guidance and control information along curved paths is addressed in this presentation. The driver needs strong curvature cues for positive guidance, although the critical components of curvature cues are still not completely understood. Godthelp and Riemersma (1) make a strong case for perceiving curvature in perspective, which is most strongly presented by delineation at or near the road surface as opposed to higher post-mounted information. Brummelaar (2) discusses various features of the perspective road picture that may result in curvature cues for the driver. The primary thesis of this presentation is that all information on reflectorization of curves (e.g., raised pavement markers (RPMs), markings, curvature alignment signs, post-mounted reflectors) should be integrated and evaluated for its overall collective ability to give the driver strong curvature cues on which to base steering and speed guidance commands.

The effect of curvature information on steering performance has previously been demonstrated in simulator and field experiements (3). Steering performance improves under reduced visibility conditions such as night driving, in the presence of road surface delineation with characteristics such as small gaps, long dashes, and short repetition cycle lengths. The extent to which chevron alignment signs and other post-mounted devices contribute to curvature cue perception is not known, although they certainly have an important alerting and warning function that is critical for speed control.

Several perspective scene slides of a table top model of a delineated road were shown to illustrate how various delineation elements contribute to curvature cue perception. Past research has shown that curvature perception is strong with increased eye height above delineation. Road surface markings give the strongest curvature cues, while chevron designs on post-mounted panels give the strongest guidance cues (1). Other work with drunk drivers has shown that chevron alignment signs are best for long-range guidance, while wide edge lines are best for providing short-range steering control commands (4).

The requirement for integrating road surface, elevated guard rail, and post-mounted delineation and advance warning signs is not well understood. Issues that should be addressed for information on elevation include placement relative to curves and spacing between individual elements. For road surface information, retroreflector spacing and edge line width should also be considered. These issues should be addressed from the point of view of optimizing the overall delineation system at given curve locations.

References

1. H. Godthelp, and J. B. J. Riemersma, Perception of Delineation Devices in Road Work Zones During Nighttime, SAE Paper 820413 presented at the International Congress and Exposition, Detroit, Michigan, February 1982, pp. 22-26.

2. T. tenBrummelaar, The Reversal Point in the Perspective Road Picture, Australian Road Research, Volume 13, Number 2, June 1983, pp. 123-127.

3. R. W. Allen, and J. F. O'Hanlon, Driver Steering Performance Effects of Roadway Delineation and Visibility Conditions, Driver Performance, Passenger Safety Devices, and the Bicyclist, in Transportation Research Record 739, TRB, National Research Council, Washington, D.C., 1979, pp. 5-8.

4. I. R. Johnston, The Effects of Roadway Delineation on Curve Negotiation by Both Sober and Drinking Drivers, Australian Road Research Board, Volume 13, Number 3, Research Report ARR Number 128, September 1983, p. 243.

GUIDERAIL DELINEATION

Arthur W. Roberts, New Jersey Department of Transportation

In New Jersey, state traffic engineers have become interested in guiderail delineation. There has been increasing construction of guiderails on roadsides. Like the New Jersey concrete median barriers, of which hundreds of miles have been installed, hundreds of miles of guiderails are now being installed. More thought needs to be given to letting drivers know that guiderails are there, because they are fixed objects and colliding with them can cause some damage to both the vehicle and the guiderail itself. Of course guiderails are designed to cause less damage than colliding with trees, poles, abutments, and many other fixed objects.

In few, if any, states, there are no detail standards, warrants, or criteria to help traffic engineers determine when and how guiderails should be delineated. Guiderails are lower than 4 ft., so there is a question about whether a guiderail-mounted reflector can substitute for a 4-ft. delineator.

The compatibility between guiderail-mounted reflectors and other roadsides or even roadway reflectors has not been determined. If a large number of reflectors are installed at a curve or another critical driver decision location, the scene can be visually chaotic unless these reflectors are carefully organized according to the