TECHBRIEF

Traffic Control Device Conspicuity

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This document is a technical summary of the Federal Highway Administration (FHWA) report *Traffic Control Device Conspicuity* (FHWA-HRT-13-044).

Objective

The *conspicuity* of a traffic control device (TCD) is defined as the probability that the device will be noticed. However, there is no agreed-upon measure of what constitutes being noticed. Various measures such as eye fixations, recall, and other verbal reports have been suggested. In this TechBrief, four conspicuity studies are reported and recommendations for increasing the conspicuity of TCDs are provided.

Introduction

The studies reported examined the following main issues:

- What factors influence TCD conspicuity?
- How should TCD conspicuity be assessed?

Researchers have used several methods of assessing TCD conspicuity. One method is to ask drivers to identify TCDs immediately after they are passed. Another method is to track drivers' gazes and determine whether drivers have fixated on the TCDs. Yet another method is to determine at what angle observers can look away from a sign and still determine whether the sign is present or what message the sign displays. The efforts reported here utilized all of these methods.

Glance Behavior and Sign Recall

Eye glances to and recall for 21 TCDs along a 34-mi drive through urban and suburban areas of northern Virginia were recorded for 17 drivers. Recall was solicited about 2 s after selected TCDs (speed limit signs, warning signs, crosswalks, street names, and information signs) were passed. To assess the effect of the recall requests on glance behavior, nine drivers' glance behavior was recorded without requests for sign recall.

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Several striking trends emerged from the on-road tests. One was that drivers were generally aware of the posted speed limit regardless of whether they had looked at the speed limit sign. Only changed speed limits or the first speed limit sign on a road were queried; so correct recall of sign content could only have been the result of detecting the most recent posted speed or assuming the speed limit from other roadway context. Because drivers who were unfamiliar with the roadways had similar speed limit recall to that of drivers who were familiar with the roadway, memory from previous trips cannot explain this finding. Ability to recall warning sign content was dependent on looks to the warning signs. The relationship between looking at signs and recalling them is shown in figure 1.

Although familiarity with a road segment was not related to whether drivers looked at speed limit signs, the same was not true for warning signs. Unfamiliar drivers were more likely to look at and recall warning signs than familiar drivers. This was expected because drivers who are familiar with a road are likely to be aware of its hazards.

Sign Detection Conspicuity

A laboratory study was conducted to determine what factors influence the ability of drivers to detect the presence of TCDs. Drivers must attend to the roadway and other vehicles. Signs on the side of the roadway need to be conspicuous to attract drivers' attention. This study examined the relationship between sign properties and the properties of the surrounding environment on the ability to detect TCDs.

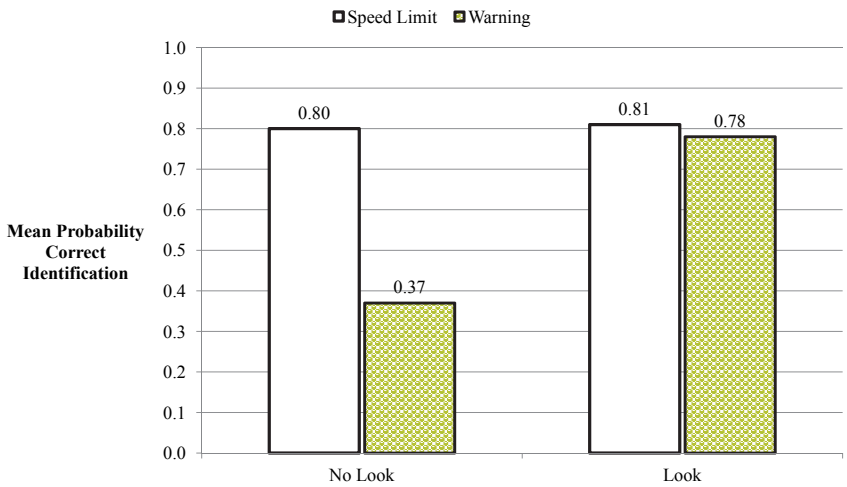
Outdoors, participants were asked to slowly look away from signs until they could no longer detect the signs in their peripheral vision. Indoors, speed limit and warning signs were briefly presented on a screen while participants focused their gaze on fixation crosses that varied in angular distance from the signs.

Results from the indoor portion of the study are shown in figure 2. These results are consistent with the outdoor findings. To be detected, signs in cluttered urban environments need to be closer to the direction of gaze than signs in less cluttered environments. Speed limit signs are particularly susceptible to clutter effects, probably because they contrast less with the surrounding environment than amber or fluorescent yellow signs.

Sign Identification Conspicuity

In the on-road study, a substantial proportion of signs were correctly recalled even when glances toward those signs could not be detected. This raised the question of how far a driver's gaze could be from a sign and still allow the sign's message to be comprehended. In this study, signs with five different text-based warnings and signs with five different speed limits were briefly flashed on a screen while participants focused on a fixation cross at various horizontal offsets from the sign location.

Figure 1. Recall of speed limit and warning signs as a function of whether the signs were looked at.

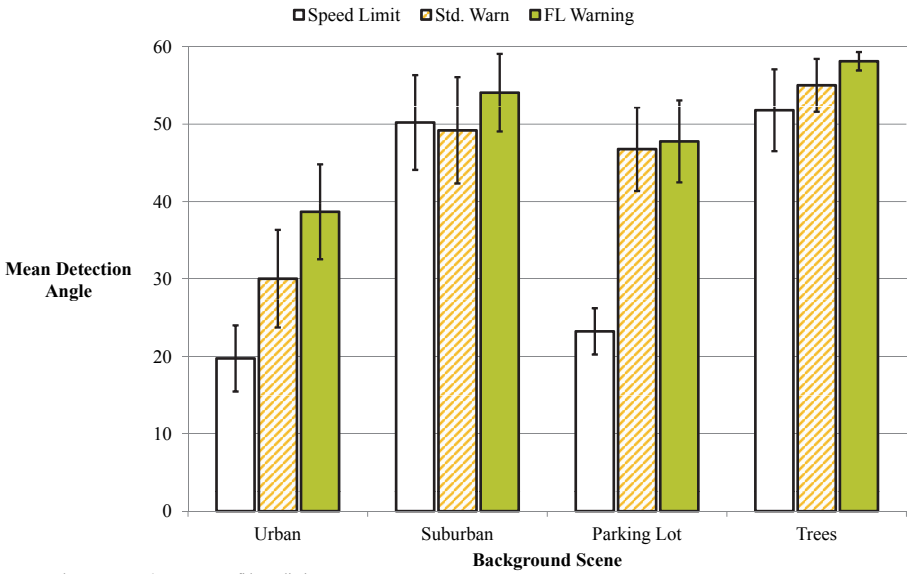


The findings are shown in figure 3. Consistent with the on-road findings that speed limits could be identified in the absence of direct fixation, speed limits could be identified with about 80 percent accuracy when the eye was fixated about 9° to left of the sign. Warning sign text, which is smaller than speed limit numbers, could be correctly identified with 80 percent accuracy when the eyes were fixated 3° to the left of the sign.

Recommendations

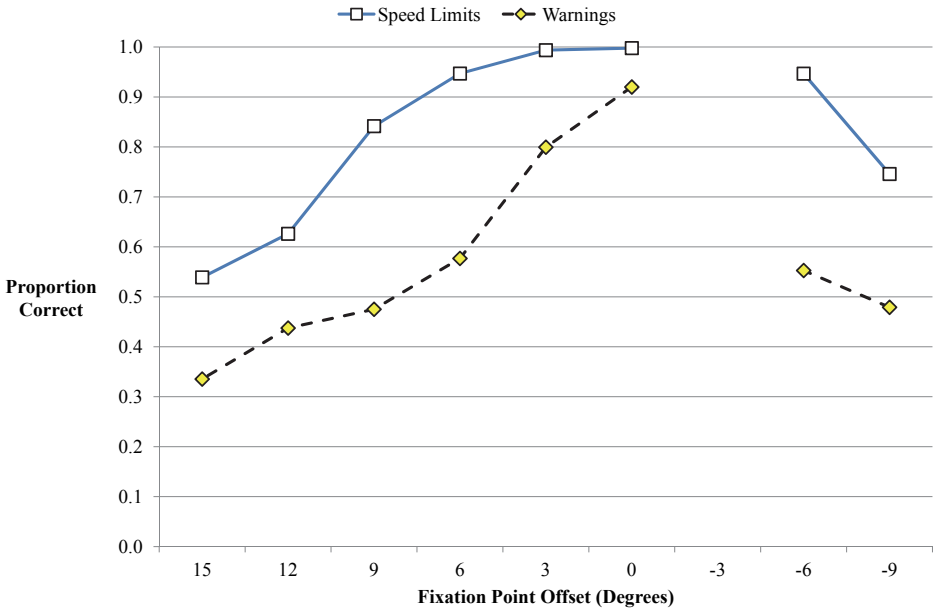
Before drivers can behaviorally respond to signs, they must detect them. The sign detection angle appears to be a good measure of detectability. In these studies, the sign background affected the detection angle, but it was not clear whether the effects of background were the result of the general background or that part of the

Figure 2. Angle of fixation at which the sign could be correctly detected 50 percent of the time.



Error bars represent 95 percent confidence limits.

Figure 3. Proportion of signs correctly identified as a function of sign type and fixation point offset.



background that was immediately around the signs (i.e., within 2° of visual angle). Further studies could clarify this issue.

The methods used in the current study should also be applied to assess the effectiveness of various conspicuity enhancements in mitigating the degrading effects of cluttered background scenes. Mitigation strategies that should be evaluated include increasing sign size and adding yellow plaques to regulatory signs.

The *Manual on Uniform Traffic Control Devices* suggests that TCDs should be in a road user's view and that location and legibility should provide adequate time for response.[1] The present results suggest that the field of view for sign detection exceeds 60° under favorable conditions (low-clutter background that contrasts with sign color). In high-clutter environments, attention should be given to ensuring that signs stand out from their backgrounds. The present study used the speed limit sign as an exemplar of regulatory signs. Black-on-white regulatory signs are particularly susceptible to the effects of clutter.

Intersections are a common location for a variety of black-on-white regulatory signs such as lane and turn restrictions. The need to place these signs on mast arms or posts in the immediate intersection environment often dictates the use of smaller signs and limits the ability to control sign background and proximity to other signs. In these cases, strong consideration should be given to increasing the conspicuity of safety-critical signs (e.g., no U-turn and no turn on red). Many intersections present drivers with challenging visual environments. Unlike the observers in the sign detection experiment, drivers in the real world have multiple visual tasks to perform and will often lack the spare capacity to detect or read small signs in their peripheral vision. To ensure that drivers look at and read safety-critical signs, every effort should be made to make the signs as large as possible and, if necessary, add conspicuity enhancements such as yellow notice plaques.

The full report contains additional guidance to practitioners on the placement of regulatory and warning signs to better ensure the signs are detected and read.

Reference

1. Federal Highway Administration. (2009). *Manual on uniform traffic control devices for streets and highways* (2009 ed.). Washington, DC: U.S. Government Printing Office.

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