

MOTORISTS' MISUNDERSTANDING OF SYMBOLIC  
SIGNING: SAFETY IMPLICATIONS

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**INTRODUCTION.** Each year since 1978 motor vehicle traffic deaths in the United States have exceeded 50,000 (6). The Journal of Insurance (1) has reported that two out of five traffic fatalities may be traced to lack of awareness or misunderstanding of traffic control devices. Two factors contributing to this phenomena are more complicated roadway and guide systems, and an increase in the number of drivers, adding to the intensity of travel in both rural and urban areas.

The problems brought about by increased traffic and complex roadways can be mitigated somewhat with an effective communication system that is comprehensible to all drivers. One step that has been taken to provide this effective communication system is the shift away from the use of word message highway signs and toward the use of symbol signs. This 'universal' symbol communication is considered by the U.S. Department of Transportation and the Federal Highway Administration to be "a desirable and important step toward the greater safety and facilitation of traffic" (4).

**SIGN STANDARDS.** Signs are essential where special regulations apply at specific places or times and where hazards are not self-evident. Standards are specified that underlie a code for all signing. There are eight colors and eight shapes that define for motorists the purpose of each sign (4). This basic code provides information that is additional to the message illustrated on the sign.

Current guidelines are for a broader use of symbols in preference to word messages. However, recognition is given to the fact that a change from word messages to symbols requires time for public education and transition. During this period educational plaques accompany new symbol signs. The prescribed period for public education and transition is three years; although there is no mandate to remove educational plaques after three years as long as they are in serviceable condition.

**STUDY APPROACH.** A study was conducted in 1977 (3) which involved a booklet survey in 10 Department of Public Safety driver licensing stations in Texas. The booklet consisted of photographed signs and other traffic control devices with a response set. This test type survey revealed some surprisingly low scores for several signs, and indicated a

relationship between certain driver characteristics and low scores.

The study prompted a further investigation into the effectiveness of symbol signing. A second, more probing study was conducted that would illuminate the extent to which symbol signs are misunderstood, as well as the forms of incorrect interpretations. This was accomplished with in-depth interviewing, and again substantiated by a statewide survey booklet. A sample of 94 Texas drivers were selected for the in-depth interviews with demographic characteristics representative of Texas' driving population with respect to age, sex, and ethnicity.

Using information obtained from in-depth interviews, common misinterpretations were offered as responses for the statewide follow-up survey. Urban and rural licensed drivers (375) were randomly selected, although a quota by demographic characteristics was used as one selection criteria.

**STUDY RESULTS.** Texas motorists evidenced a mean comprehension level of 65 percent for commonly used traffic controls including signs, pavement lines, and signals. Only five percent of Texas drivers surveyed correctly identified 90 percent or more of the survey items.

Recollection of the physical characteristics of signs was lower than expected for all signs. Signs that are abundant and commonly used, such as the Stop sign were included in the test, as well as signs that are more situation specific, such as construction and guide signs. The range of correct responses was from one to 87 percent. Respondents had a tendency to recall roadway signs as square-shaped, and black and white.

**The Do Not Enter sign.** The Do Not Enter sign is a 30-inch white square on which is a 29-inch diameter red circle, with a white band five inches in width placed horizontally across the center of the circle. The design of this sign is supposed to make recognition very easy for the driver, even at a distance. The red color alerts the driver to a prohibitory regulation.

The Do Not Enter symbol was presented without the words on it to determine the level of understanding of the symbol itself. Forty-five percent recognized the symbol. A significant 34 percent did not know what the symbol was, and 30 percent thought the symbol related to emergency facilities. Apparently the symbol itself is not effectively communicating the message printed on it.

**The Prohibitory symbol.** The Prohibitory symbol is increasingly being used internationally to convey the message that the pictured item behind the symbol is not allowed. Although its adoption for use on roads has recently become more widespread and

includes a variety of prohibited actions, the symbol's meaning as applied to traffic movement was not found to be understood by all drivers.

The prohibitory symbol was presented with no picture behind it to determine if motorists can identify the concept of the symbol as it applies to any driving situation. The most frequently checked response was "don't know," (37 percent). Incorrect interpretations included civil defense shelter (15 percent), hospital zone (10 percent), and no smoking (five percent).

The prohibitory meaning of the red slashed circle was better understood when the prohibited action was pictured behind it. However, an alarming discovery was that approximately seven percent of drivers held the interpretation of only instead of no. This interpretation surfaced as respondents were asked to identify a prohibited right turn symbol sign. Eighty-five percent knew the symbol sign's meaning, but more illuminating was the seven percent who responded "right turn only." Furthermore, the fact that understanding improved by only two percent in a simulated driving context with verbal responses emphasizes the problem. The difficulty can not be attributed solely to a reading or test-taking inadequacy, but as verbal responses to the filmed driving sequence indicate, the symbol has an unfamiliar meaning to a portion of drivers. The in-depth interviews, statewide survey (7), and earlier work (3) consistently document this problem.

Unfamiliarity was related to several driver characteristics. Drivers with more years of driving experience were more likely to check the "right turn only" and "don't know" responses. These drivers were characteristically older and had not taken a driver education course.

**CONSTRUCTION SIGNS.** For street construction, maintenance operations, and utility work, traffic control devices perform important dual functions. They serve to direct safe and expeditious movement of traffic through work zones. Also, they insure the safety of the work force performing these maintenance or construction operations.

The same major categories of traffic signs - regulatory, warning, information and guide signs - apply to work zone signing with regard to shape and standard of application. Their distinctive characteristic is that they uniformly have a black legend on an orange background. However, because a vast number of conditions and situations exist, drivers do not encounter a set of signs that are a consistent or predictable pattern for all construction and maintenance operations. It is therefore of increased importance that drivers can easily and thoroughly comprehend

the messages they receive as they move through these areas.

Flagger Ahead Symbol Sign. The Advance Flagger sign is one of the best examples of the important dual function of the work zone signs mentioned above. This sign provides advance notice of a situation where speed is adjusted dramatically, the motorist may be required to stop, and subsequent information is necessary to continue through the area. Additionally, driver comprehension of the sign is an important factor in the safety of the flagger.

The Flagger Ahead symbol sign was frequently given several interpretations. One consistent problem was recognition of a construction area, but lack of awareness of a person giving flag signals ahead. Seventeen percent failed to be alerted to the fact that they would be approaching a person in or near the roadway giving flag signals necessary for guidance, which could be a serious mistake, for the motorist as well as the flagger.

Another 17 percent described the Flagger Ahead symbol as a school crossing guard sign. Other interpretations included: litter facilities, hitchhickers in the area, and stop.

The color cue for construction and maintenance signing was obviously overlooked (or unknown) by many of the drivers tested. Thirty-five percent thought the sign was yellow, and 14 percent assigned it the color red.

Advance Road Construction Sign. During interviews, respondents were shown a filmed approach to a sign with the message, "ROAD CONSTRUCTION AHEAD," and asked what their response would be if they were driving. Every respondent questioned was able to give a response that indicated an appropriate driving maneuver. Each driver could identify and read the message presented in a real-time format. They also exhibited a thorough knowledge of what to expect and how to respond appropriately.

Using the Advance Flagger and the Advance Road Construction signs for comparison, the findings indicate a more effective communication via the word legend than the pictograph symbol for construction areas. In the one example symbol sign, the symbol was often given imaginative meanings. Sometimes an association with construction was made, but the exact function of the sign was often missed. However, no evidence of confusion was found concerning the written message, "ROAD CONSTRUCTION AHEAD."

The surveys illuminated the fact that drivers are unaware of the use of the color orange specifically for work zone signs. The study was limited in its examination of construction and maintenance signing to the two signs discussed above. The findings suggest that more in-depth study of the use of

written messages versus symbols is needed. This need is sadly supported by the Texas statistic of seven roadway construction and maintenance employees killed on the job in the previous 11 months (2).

**WARNING SYMBOL SIGNS.** A multiplicity of warning signs are encountered by drivers in all settings—urban and rural. The one common characteristic for warning signs is their yellow color. The diamond shape is the standard design, with few exceptions.

Symbol signs posed a problem for certain segments of the driving population. Ethnic minorities, older drivers, and the lower educated were more likely to misinterpret the intended meaning of the symbols. Newer signs posed problems for drivers with more years of driving experience. On the other hand, less experienced drivers showed more difficulty with symbol signs that have been in existence longer.

Turn and Curve Signs. In comparing the responses to the Curve and Turn signs, one observation was that a portion of the respondents were not able to correctly distinguish the two signs. The in-depth interviews revealed that the drivers did not confuse the Turn sign with the Curve sign and vice versa; rather, they tended to equate one sign with the other. The Turn sign is used specifically where a turn is to be made that requires a speed of 30 miles per hour or less. A Curve sign is intended for use where engineering investigations of roadway conditions show the recommended speed on the curve to be in the range of between 30 and 60 miles per hour. Both signs may be accompanied by an advisory speed plate. Since as many as 35 percent chose Curve over turn, and 15 percent verbally described the Turn sign as a Curve sign, it is suggested that the advisory speed plate is warranted on all Turn signs. No one in the in-depth interviews indicated any knowledge of a maximum safe speed to negotiate the turn. The consequences of interpreting both signs as indicating a curve instead of a turn are much less severe than the reverse interpretation.

Stop Sign Ahead. The Stop Ahead and Yield Ahead signs have been commonly used when the announced sign is not visible for sufficient distance for the driver to react accordingly. Recently, new symbol signs have been introduced that will eventually replace the word message signs. Many drivers who participated in the survey had never seen the Stop Sign Ahead symbol sign, and were interpreting it for the first time.

A common incorrect interpretation of the Stop Sign Ahead symbol sign was that the combination of the stop symbol and the arrow indicates to the driver to stop and then go straight. Twenty-three percent of those

interviewed described the function of the sign as such.

Overall, the meaning of this traffic control device was misconstrued by 60 percent of the respondents. Deviant interpretations included: directions to a football stadium, railroad sign, danger ahead, and blinking red light ahead.

Pavement Width Transition Sign. The Pavement Width Transition sign is intended for use if advance notice is needed to warn of the reduction in the number of lanes, as from three to two lanes. In the interviews it was determined that there is a great deal of variability in the interpretation of this sign. For instance, responses to a filmed approach to the Pavement Width Transition sign included such diverse interpretations as divided highway ends, two-way road becomes one-way, side street merging into main street, curve, and two-way traffic. These were all multiple responses, not unique individual responses. Another eight percent of the interpretations were unduplicated individual misinterpretations.

As with other symbol signs, the common threads among those who misinterpreted this sign were age, driver education, and years of experience as a driver. The older, more experienced drivers who lacked driver education were most apt to respond inappropriately.

Slippery When Wet. The most striking misinterpretation of the Slippery When Wet symbol sign is the association of a winding road or curves ahead. This misconception poses a hazard for misguided motorists who do not respond appropriately to a more dangerous road condition. A common interpretation is that the sign indicates a constant slippery condition. Responses were "slippery road," or "icy road," with failure to note that this warning is specific to certain situations. This misconception (held by 21 percent) would elicit a more cautious response, and therefore poses no real hazard for the errant driver.

Low Shoulder Symbol. The Low Shoulder symbol sign is distinct from the Uneven Lanes sign; however, it is most often confused with it. These two symbol signs are very similar in appearance, but have important differences in their messages. The study showed that the Low Shoulder symbol sign is not an easy one for drivers to interpret. The large frequency that gave "don't know" responses (10 percent) is indicative of the vagueness of the symbol. Furthermore, associations with other hazards such as a high curb, bumpy road, or uneven lanes are obviously dangerous. Consider the consequences of a confused motorist who, believing the center of the roadway to be uneven, compensates by staying very near and possibly going off a low shoulder. It is important for drivers to understand completely

from pictographs of automobiles on pavement which surfaces have elevation differences.

The No Passing Zone Pennant. The pennant shaped No Passing Zone sign is relatively new and is currently being introduced selectively on Texas highways. It has several unique characteristics. It is pennant shaped and is always displayed on the left side of the roadway. This sign is supplemental to pavement markings and/or the Do Not Pass sign, and is recommended for use because of its demonstrated target value in critical passing maneuvers. However, the effectiveness of the No Passing Zone pennant is yet to be fully ascertained. The study revealed that Texas drivers are not familiar with the sign. The word message is easy to understand, but the effectiveness of this sign lies more in perception and recognition. At this point, recognition of this sign is poor based on its physical appearance (27 percent). There also appears to be a problem of the sign generating false anticipation of similar controls at the end of the no passing zone. Forty-nine percent of the drivers surveyed said they would look for an equivalent sign at a later point stating that passing was permitted or the zone had ended. This may precipitate unnecessary caution at best, but confusion and neglect for other traffic controls at worst. Notably, seven percent of those interviewed said "pass when you can see clearly", and five percent did not know how to judge when to pass.

School and Pedestrian Signs. Drivers are not aware of the difference between the School Advance, School Crossing, and Pedestrian Crossing signs. The School Crossing sign is for use only at established crossings used by pupils going to and from school. These crosswalks must be adjacent to the schools, or on established school pedestrian routes. They are always preceded by a School Advance sign. The School Crossing and School Advance signs both have pentagon shapes that distinguish them for school areas. The Pedestrian Crossing symbol sign is distinctly different from the School Advance and School Crossing signs in both function and appearance. Pedestrian Crossing is a standard diamond-shaped warning sign used at locations where crossing is hazardous or not readily apparent, and is not related to school areas.

A significant proportion of drivers interpret all signs with a pictorial representation of people walking as pedestrian crossing signs. The pentagon shape of the school area signs and the fact that the 'people' on these signs are carrying books apparently does not clarify the school area designation of these signs. Driver reaction to each of the three signs may be similar, but the hazard involves a failure to consciously watch for school children, who are more vul-

nerable than any other age group to vehicle/pedestrian accidents (5).

CONCLUSIONS AND RECOMMENDATIONS. Symbolism is an increasingly popular practice used by traffic engineers, city officials, and others involved in the design and construction of roadway systems. It is important that the representations be conceptually and operationally clear for symbolic signing to be effective communication to the users of those systems.

Differences among drivers produce a range of information processing abilities that determine how well signs can be detected and understood. Ethnic minorities, older drivers, and those with low education levels were most likely to misinterpret the intended meaning of symbol signs.

In some cases the mistaken association of a symbol leads to a more cautious response by the driver. Examples that were found were the interpretation of a Curve arrow as a more severe Turn Arrow, and the assumption that a Slippery When Wet symbol indicates a road surface that is slippery or icy at all times.

However, in many cases the misinterpretation of a symbol sign results in potentially hazardous consequences. For instance, drivers who perceive a prohibited right turn as a right turn only symbol; the 55 percent who are unfamiliar with the Do Not Enter symbol; those who fail to be alert for school children crossing the street; and drivers who do not know when it is safe to pass other vehicles - all greatly increase the potential for accidents.

A significant degree of confusion and lack of familiarity with many signs that may contribute to slower reaction time was found. On a basic level, signs providing operational requirements, warnings, and information represented by symbols are designed to have redundant, reinforcing characteristics with their shape and color. This code is quite unfamiliar to the majority of drivers.

It is recommended that educational plaques remain on symbol signs until public understanding is increased to a more acceptable level. Further, in addition to on-site information provided by plaques, public information and education efforts should be implemented that not only address the driving public at large, but are directed at targeted groups who have specific information needs. Driver education and driver improvement programs are positive predictors of knowledge of traffic controls. Attention should be given in these programs to the shape and color code and the meaning of symbol signs.

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#### BIOGRAPHY

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