COMPARISON OF THREE METHODS FOR EVALUATING TRAFFIC SIGNS

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Three experiments were conducted to compare three methods of evaluating traffic sign perception. In the first experiment, subjects were required to classify signs according to type and to identify the meaning of the signs while driving toward them under normal highway traffic conditions at 30 mph (48 kph) and 50 mph (81 kph). The distances at which subjects were able to classify and to identify each sign were measured. Two classes of sign, regulatory and warning, were used, and half of each class had symbolic messages while the other half had verbal messages. The second experiment was a partial replication of the first, with certain modifications. The signs were one-third normal size and the subject drove the vehicle at 17 mph (27 kph). The third experiment was a laboratory study in which verbal reaction time required to classify and identify slides of traffic signs was measured. Signs used in the first two experiments were used as stimuli in the third experiment. The results indicated that the three measures of performance were closely related. Signs were classified at a greater distance than they were identified. Performance was better on symbolic than on verbal signs (except for the reaction time measure), and it was better on warning than on regulatory signs. In addition, performance on individual sign messages was highly correlated across the different measures.

•A GREAT deal of research employing a variety of methods has been conducted on traffic sign perception. Both laboratory and field techniques have been used, but there has been little attempt to relate these two approaches. Consequently few laboratory techniques have been properly validated against performance in an actual driving situation. Furthermore, both approaches have suffered from such general problems as improper experimental design, inadequate dependent measures, and unrepresentative samples of subjects. A recent review of methodology in traffic sign research (2) points out difficulties specific to each approach.

The most apparent deficiency in many laboratory evaluations of traffic signs is the lack of the normal visual cues and distractions of attention that are part of the driving task. Some driving simulators are an exception to this, but even they do not duplicate the task perfectly. Some researchers have incorporated loading tasks into their sign recognition experiments. This procedure is considered by Forbes (3) to be essential for any laboratory test of signs.

Most experiments examine only one factor in the complex process of detecting, recognizing, and acting on a sign message. For example, an experiment on legibility distance tells little about the attention value of a sign or whether a new symbol will be understood after it has been seen. The problem of whether a new symbol can be easily learned and remembered is almost always overlooked in the evaluation and development of signs.

Investigations carried out on the road (usually observation of driving behavior) have generally been less adequately designed and conducted than have those done in the laboratory. Field studies of any type tend to involve more uncontrollable variables and

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unpredictable events than do laboratory studies. Driving experience and potential lack of familiarity with the signs on the part of the subject are often not taken into account. Some subjects may not know a sign simply because they have never seen it, even though it could be a well-designed sign. Expectation plays an important role here.

Small numbers of observations of a critical event (e.g., entering a restricted area) are a problem in many studies, perhaps because such events are relatively rare. This difficulty can be overcome by observing driver behavior over longer periods of time.

One of the popular methods for evaluating a new sign is the "before-and-after" technique. Driver response to an existing sign (or to a driving situation where there is no sign) is measured for a period of time, after which the new sign is installed (or replaces the old one) and similar measurements are taken again. The major mistakes made by those who use this method involve evaluating the new sign under conditions different from those in the "before" phase (e.g., different time of day, day of the week, month, weather conditions, and drivers). In addition, the novelty effect of any new sign may attract greater attention from the driver, regardless of the adequacy of the sign itself. Therefore, a new sign may have to be in use for many months before an uncontaminated measure can be obtained. A further difficulty with many before-and-after studies is the inadequate base rate (too few observations taken before the new sign is installed).

With several methods available to measure each of a number of variables one might ask, "Which method is best for my particular need?" For example, knowledge of the meaning of signs can be measured by multiple-choice questionnaire, showing photographs or drawings of the signs, measuring reaction time for meaning or action to be taken, and showing a film of the signs on the highway. The signs can be shown alone or in the context in which they will be used; they can be shown for a fraction of a second (as it may be seen while driving) or for an unlimited time. Legibility distance can be determined by showing motion pictures taken from a moving car, showing slides or photographs of the signs at different distances, having subjects walk or drive toward the signs, moving the signs toward the subjects, or by the use of computer simulation techniques. There has been little attempt to evaluate the relative effectiveness of the many techniques that are available. No doubt some are better than others, but there is no information to indicate which methods are best. There is a great need not only to compare methods but also to establish the reliability and validity of many existing techniques. However, it is not clear what the major criteria (in terms of driver performance) should be in evaluating traffic signs. Additional questions that remain unanswered concern the relative importance of such factors as attention value, legibility, and learnability in the development of a new sign.

In summary, the literature on perception of traffic signs shows many methodological problems as well as a tendency for such research to examine only one aspect of the sign recognition process. It appears that a single method will not be adequate but rather that each of the factors involved (e.g., meaning, attention value, legibility, processing time, learnability, influence on driver behavior) requires its own method of evaluation. Some combination of methods may be required to adequately evaluate a sign or signing system.

As mentioned earlier, few comparisons have been made between field tests and laboratory tests. One such experiment is that of Desrosiers (1), who conducted an experiment to validate the substitution of laboratory tests in which motion picture techniques were used for field research methods. Legibility distance was measured in a field test in which the stimuli were guide signs made to one-third the scale of the normal size for a freeway sign. The signs had destination names on them, and the subject was required to indicate when he perceived a specific target word while driving at 20 mph (32 kph)—which would simulate approaching at 60 mph (96 kph) because the signs were one-third normal size—down an unused section of freeway toward the sign. The subject's task was to indicate, by pressing a button, on which line of the sign the target name was located. The laboratory test was similar but involved a film presentation of the same signs at that particular location. Results indicated that the laboratory test and the field measure showed essentially the same trends, but the mean legibility distances were 5 to 6 times as great in the field test.

Markowitz et al. (4) report a laboratory study and a field study using the same 10 signs. The laboratory study involved the method of signal detection (in which stimuli were presented for a fraction of a second), which provides a pure measure of detectability or legibility. The field test was conducted on the road using the Senders' helmet apparatus, which occludes the driver's vision for short periods of time. Subjects were instructed to drive as fast as possible and to make no driving errors while sampling the roadway only when necessary. The signs appeared at irregular intervals along the roadway. The relative recognizability of the individual signs differed between laboratory and field trials. Two of the three most recognizable signs on the road test were among the four least recognizable of the signs in the laboratory test. The reverse holds for two of the three most recognizable signs in the laboratory test as compared with the road measure. The findings showed recognizability to be lower in the road test than in the laboratory test.

It appears, then, that laboratory tests may give somewhat different results from on-the-road measures, depending on the particular techniques used. However, more research needs to be done comparing laboratory and field techniques before a firm statement regarding their relative merits can be made.

Although laboratory methods have a number of limitations and do not represent the actual driving situation, they can be used to advantage if properly validated against adequate on-the-road measures. Laboratory experiments can be more readily controlled and are less expensive and time-consuming (unless they involve sophisticated simulation techniques). Even modified or scaled-down on-the-road measures are somewhat less expensive and time-consuming than on-the-road measures under normal driving conditions.

This paper describes three experimental techniques used in evaluating the same signs. It is part of a larger project intended to develop and compare several techniques for measuring perception of traffic signs. The techniques described involve (a) a controlled experiment conducted on the highway under normal driving conditions, (b) a modified on-the-road measure, and (c) a laboratory reaction time measure. The on-the-road method was considered to be a good technique against which to validate the other methods. The modified on-the-road technique came close to the actual driving situation but under different conditions that are less expensive and time-consuming. The reaction time study, while not intended to simulate a driving situation, was designed so that performance could be meaningfully compared to that of the other two techniques. It involved much less time and expense than the on-the-road methods.

The optimal index of the adequacy of any traffic sign is the degree to which it conveys the intended message to a driver operating a vehicle in an actual driving situation. However, since on-the-road studies are expensive and time-consuming, the development of laboratory measures validated with measures taken in a driving situation would be a major contribution to the study of traffic sign perception.

The signs for all three experiments to be reported were selected on the basis of pilot research that measured the verbal reaction time required to initiate the correct meaning of each sign. Reaction times (time between the onset of the stimulus and the activation of a voice-operated relay by speech production) to 30 sign messages were determined by having subjects verbalize the response as quickly as possible when a signal came on.

The subject was given the correct verbal response (sign meaning) to be made and instructed to produce this response as rapidly as possible whenever a red field was presented (by a slide projector), but to make no response when a green field was presented. Red and green stimulus fields were presented in a random order, with 50 percent of the stimuli being red. Ten reaction time measures were taken to each sign message. The messages were presented in a different random order for each subject, but all measures on one message were taken before the next message was presented. Ten subjects were tested, one at a time. The data were subjected to a series of analyses of variance. Following each analysis the data from the messages that gave the highest and the lowest reaction times were eliminated, and a further analysis of variance was performed on the remaining data. This procedure was followed until the analysis indicated no significant difference in reaction time between the sign messages. In this manner signs were chosen whose verbal reaction times did not differ, thus eliminating the possibility that the data from certain stimuli might be influenced by the time taken to produce the verbal response.

The results of each experiment will be presented individually following its description. However, discussion of the results and comparison of the methods will be delayed until all three experiments have been reported.

EXPERIMENT 1

Purpose

The purpose of the first experiment was to determine the distance at which subjects could classify traffic signs as being one of two types (regulatory or warning) and the distance at which they could identify the meaning of the signs while driving on a highway under normal traffic conditions.

Method

Subjects—The subjects were 16 volunteers (8 males and 8 females) with a minimum of 5 years' driving experience and ranging in age from 20 to 36 years, with a mean of 25.8 years. Each subject was paid $10 for participating in the experiment.

Stimuli—Sixteen regulation-size traffic signs (obtained from the City of Calgary Traffic Engineering Department) were used as stimuli. Their dimensions were 24 by 30 in. (61 by 76 cm) for white, rectangular regulatory signs or 30 by 30 in. (76 by 76 cm) for yellow diamond warning signs. In addition, the messages on half of the signs of each class were symbolic, while the other half were verbal. The specific sign messages are given in Table 1.

Procedure

The experiment was conducted on a flat, straight stretch of 2-lane, paved, undivided highway with a wide shoulder. The signs were placed at either end of a stretch of highway 5,315 ft (1,620 m) in length, each end of which was marked by a ¾-in. (1.9-cm) nylon rope stretched across the pavement. This rope served as a reference point from which to calculate the distances. As the vehicle was driven by the subject over the rope, the sound inside the vehicle was used as a signal for the experimenter to activate a distance-measuring device. At each end of the stretch of highway there was an acceleration-deceleration zone approximately 800 ft (244 m) in length, and at the end of this zone was a roadway where the subject could turn the vehicle around.

The signs were mounted on poles so that the bottom of the sign was 7 ft (2.13 m) above the highway. They were placed 1 ft (0.3 m) from the right edge of the paved shoulder, 10 ft (3 m) from the outside edge of the driving lane. The signs were attached to the poles so that they could be removed and replaced quickly. Stimuli were placed at both ends (north and south) of the stretch of highway so that the subject could be tested while driving in each direction. The stimuli were presented in a predetermined random order in blocks of 16 trials, with half of the signs viewed by the subject while traveling north and the remainder viewed while traveling south (each sign was viewed once during each block of trials). Four blocks of 16 trials were administered, with a 5-minute rest between each block, during which the locations of the signs (north or south end) were changed in accordance with the predetermined random order in preparation for the next block of trials.

Before the experiment began, each subject was given approximately 20 minutes' experience operating the vehicle (a 1970 Kingswood model Chevrolet stationwagon with power steering, power brakes, and automatic shift). In addition, the subject read the instructions that outlined the experimental procedure, was shown all of the signs to be used in the experiment, and was given the correct verbal response to be made in identifying each sign, as well as the correct classification for each sign.

The subject was required to make two verbal responses during each trial as he drove toward the sign, first to classify it as warning or regulatory and second to indicate its meaning as soon as it was legible. Distances were measured to the nearest

Table 1. Mean distances in feet (experiments 1 and 2) and reaction time in milliseconds (experiment 3) for individual signs under each task and speed condition.

		Experiment 1				Experiment 2		Experiment 3			
		Classification		Identification				Classification		Identification	
Sign and Message Type	Message	30 mph	50 mph	30 mph	50 mph	Classification, 17 mph	Identification, 17 mph	30 mph[a]	50 mph	30 mph	50 mph
Warning, symbolic	Winding Road	3,004.5	2,878.5	1,029.5	1,003.7	831.7	331.2	513.7	521.2	878.1	861.4
	Hill	2,696.8	2,621.3	1,068.2	1,126.1	704.7	284.6	543.3	520.9	876.0	903.3
	Bump	2,899.7	3,080.2	953.0	1,019.2	863.8	286.9	541.6	512.0	787.9	801.3
	Pavement Ends	3,578.0	2,927.2	946.0	864.9	878.7	237.3	551.6	554.2	886.2	958.6
	Men Working							531.7	539.8	772.5	820.7
Warning, verbal	Yield Ahead	3,234.6	3,022.0	596.8	521.3	861.0	140.4	535.8	504.8	657.3	912.8
	Pavement Narrows	2,927.7	3,234.5	410.7	416.2	877.7	98.4	534.0	508.3	773.7	1,030.3
	Soft Shoulder	3,280.8	3,130.6	581.5	555.2	878.6	187.3	546.0	528.9	734.6	979.6
	Fresh Oil	3,210.9	3,075.4	599.3	497.0	934.7	136.1	548.9	526.8	687.3	886.5
	One Lane							542.7	518.3	683.2	873.7
Regulatory, symbolic	No Right Turn	2,540.0	2,781.6	700.4	779.3	694.2	208.7	646.3	596.2	1,036.0	1,048.8
	No U Turn	2,726.3	2,597.5	726.5	764.8	645.1	200.6	568.7	549.4	851.1	876.4
	No Trucks	2,781.9	2,885.7	725.4	675.0	663.3	173.0	541.7	542.4	866.1	905.0
	Turn	2,909.1	2,579.2	721.9	672.7	769.7	196.4	614.6	556.9	1,012.5	1,068.4
	No Stopping							592.8	572.1	926.8	915.1
Regulatory, verbal	No Left Turn	2,638.0	2,868.3	555.3	510.4	610.8	128.5	564.5	575.8	730.0	939.4
	No Parking	3,131.4	3,373.7	486.8	473.9	775.9	106.4	580.6	559.0	763.9	976.1
	Two Way Traffic[b]	3,222.5	3,004.2	443.5	410.4	774.2	121.8	633.1	625.6	781.4	977.2
	Do Not Pass	2,482.3	2,761.3	530.4	521.8	653.1	125.3	579.0	563.2	684.6	888.2
	No Turns							584.1	559.5	652.9	866.9

Note: 1 ft = 0.3048 m.

[a]The speed variable in experiment 3 refers to sign size, 30 mph being the large-sign condition.

[b]The message "Do Not Enter" was used in experiment 3.

Table 2. Partial summary of analyses of variance results for all factors that were statistically significant in any of the three experiments.

	Experiment 1			Experiment 2			Experiment 3		
Variable	F	df	p	F	df	p	F	df	p
Speed[a] (S)	1.31	1,15	NS	n.a.			4.86	1,28	<0.05
Direction (D)	16.44	1,15	<0.005	2.48	1,15	NS	n.a.		
Sign type (ST)	37.18	1,15	<0.001	96.78	1,15	<0.001	64.15	1,28	<0.001
Message type (MT)	45.07	1,15	<0.001	18.37	1,15	<0.001	22.70	1,28	<0.001
Task (T)	259.18	1,15	<0.001	154.78	1,15	<0.001	410.66	1,28	<0.001
S × D	0.85	1,15	NS	n.a.			n.a.		
S × ST	0.48	1,15	NS	n.a.			0.17	1,28	NS
S × MT	0.21	1,15	NS	n.a.			35.78	1,28	<0.001
S × T	1.32	1,15	NS	n.a.			23.05	1,28	<0.001
D × ST	11.96	1,15	<0.005	8.36	1,15	<0.025	n.a.		
D × MT	0.49	1,15	NS	1.67	1,15	NS	n.a.		
D × T	19.23	1,15	<0.001	2.33	1,15	NS	n.a.		
ST × MT	22.05	1,15	<0.001	29.97	1,15	<0.001	26.86	1,28	<0.001
ST × T	3.34	1,15	NS	33.78	1,15	<0.001	0.03	1,28	NS
MT × T	142.89	1,15	<0.001	61.58	1,15	<0.001	19.94	1,28	<0.001
D × ST × T	13.58	1,15	<0.005	12.36	1,15	<0.005	n.a.		
ST × MT × T	6.95	1,15	<0.025	11.82	1,15	<0.005	47.28	1,28	<0.001
S × MT × T	0.04	1,15	NS	n.a.			27.48	1,28	<0.001
S × ST × MT × T	0.19	1,15	NS	n.a.			6.14	1,28	<0.025

Note: NS = not significant; n.a. = not applicable.

[a]Sign size in experiment 3.

foot by a Numetric Distance Measuring Instrument (DMI) model Number P-140. An experimenter in the vehicle beside the subject recorded the distance from the beginning of the stretch of highway to the point at which the subject classified the sign. This distance was subtracted from the total distance to obtain the distance required to classify the sign. The distance between the sign and the point at which the subject indicated the sign meaning to the experimenter was the identification distance for that sign. A specified speed was maintained over the entire distance during each trial. When the sign was passed the subject slowed the vehicle, turned around at the end of the acceleration-deceleration zone, and started in the opposite direction for the next trial. After the subject had driven past the sign in the other direction an experimenter replaced the sign with a new one for the next trial. Each subject viewed each sign four times, twice while driving at 30 mph (48 kph) and twice at 50 mph (81 kph). Each block of trials was administered at one speed only, the order of the speeds being randomly determined. The total length of time required to complete the experiment was approximately 3 hours.

Results

Table 1 gives the mean classification distance and identification distance for each sign at each speed. The data were subjected to a 5-way analysis of variance (Table 2) involving the following variables: speed (30 mph, 50 mph), direction (north, south), sign type (regulatory, warning), message type (symbolic, verbal), and task (classification, identification).

EXPERIMENT 2

Purpose

This experiment was designed to measure classification and identification distances of "miniature" traffic signs (one-third the size of those used in experiment 1) for subjects driving at one-third of the fast speed used in experiment 1—17 mph (27 kph).

Method

Subjects—The subjects were 16 volunteers (8 males and 8 females) obtained from the same population as those used in experiment 1. Their ages ranged from 19 to 35 years, with a mean of 25.8. Each subject was paid $2 for participating in the experiment.

Stimuli—The same 16 messages used in experiment 1 were used in this experiment; however, the signs were one-third of the size of those used in the preceding experiment—either 8 by 10 in. or 10 by 10 in. (20.3 by 25.4 cm or 25.4 by 25.4 cm). They were made of the same material and in exactly the same manner as the regulation signs (including Scotchlite reflective material).

Procedure

The procedure was essentially a replication of that used in experiment 1 with the following exceptions: The circuit was 1,110 ft (338.4 m) in length and was laid out on an unused roadway, 600 ft (183 m) of which was paved and 510 ft (155 m) of which was oiled gravel. This straight, level roadway ran north and south. Subjects drove the same vehicle as used in experiment 1 at 17 mph (27 kph). The signs were mounted so that the bottom of each was 28 in. (71 cm) from the ground. Subjects viewed each sign twice and were required to indicate the distance at which they could classify the sign and the distance at which they could identify it. The total time taken to conduct this experiment was approximately 50 minutes.

Results

The mean distances at which each sign could be classified and identified are given in Table 1. The data were subjected to a 4-way analysis of variance (direction × sign type × message type × task) as shown in Table 2.

EXPERIMENT 3

Purpose

The purpose of this experiment was to determine the verbal reaction time required to classify and to identify traffic signs of different types (warning and regulatory) and message forms (symbolic and verbal).

Method

Subjects—Fifteen male and 15 female volunteers (with at least 5 years' driving experience) participated in the experiment. Their average age was 26.8 years, with a range from 19 to 62. Each subject was paid $2 for participating.

Stimuli—The stimuli were 26 slides of traffic signs rear-projected onto a screen. Six of the stimuli were information signs (3 symbolic and 3 verbal, green or blue in color) and the remainder were warning or regulatory with either symbolic or verbal messages (5 of each combination). Fifteen of these were the same as those in experiments 1 and 2.

Procedure

The subject was seated in a dark vision tunnel 30 ft (9.2 m) from a rear-projection screen onto which was projected the image of the traffic sign. The subject performed two tasks—classification and identification. Half of the subjects performed the classification task first; half did the identification task first. For the former task, the subject was required to indicate as quickly as possible after the stimulus came on by responding "yes" if it was either a warning or a regulatory sign. No response was to be made if the stimulus was an information sign. The identification task involved the subject's replying with the verbal meaning of the sign as rapidly as possible. Verbal reaction times were measured to the nearest millisecond (by means of a Hunter timer) from the onset of the stimulus to the activation of a voice key. Each stimulus was presented for 2 seconds, followed by a 1.5-second interstimulus interval. Subjects were informed that the click of the projector as the slide changed would occur approximately ½ second before each slide appeared and that this was to serve as a preparatory signal. The stimuli were presented in random order in 5 blocks of 26 trials, with each sign appearing once in each block of trials. Each block of trials was presented in a different random order. Subjects were given a 30-second rest between blocks of trials while the experimenter changed slide trays for the next block. The first block served as practice trials, although subjects were not told this. Before the experiment began the subjects were shown all signs (one at a time) and told their classification and the correct response to make when identifying each.

Subjects were randomly assigned to one of two groups. One group was shown small signs, whose visual image on the retina corresponded to that which would be formed by a regulation traffic sign at a distance of 193 ft (59 m), the approximate stopping distance for a car traveling at 50 mph (81 kph) under optimal conditions. The other group of subjects viewed a larger stimulus, which projected a visual angle on the retina corresponding to that which would be formed by a regulation traffic sign at a distance of 83 ft (25.3 m), the approximate stopping distance for a car at 30 mph (48 kph) under optimal conditions.

Subjects were encouraged to respond as rapidly as possible, yet make as few errors as possible. Data from subjects whose error rate was greater than 5 percent were not used. The experiment took approximately 1 hour.

Results

The mean reaction times for each of the 20 signs of primary interest (warning and regulatory) under each condition are given in Table 1. A 4-way analysis of variance (sign size × sign type × message type × task) was performed on the data (Table 2).

COMPARISON OF RESULTS FROM THE DIFFERENT METHODS

The significant interactions of primary interest are shown in Figures 1, 2, and 3. It can be seen that the trends are similar across the different techniques. The statistical significance levels (as indicated by the analyses of variance) for each of the main effects and the two-way interactions, as well as the other interactions that were significant in any of the three experiments, are given in Table 2.

In summarizing the main findings, the term "better performance" will refer to greater classification distance, greater identification distance, and smaller reaction time. It can be seen that performance was better on the warning signs as compared with regulatory signs in all three experiments. Symbols were identified better than verbal signs in the two roadway experiments, but not in the reaction time study. This discrepancy between the laboratory study and the other two field experiments can best be explained in terms of the type of response. A verbal response to a verbal message would be expected to be faster than a verbal response to a symbolic message, since the latter involves the additional process of translating the stimulus meaning into a verbal form for response. The classification measure was better than the identification measure in all three experiments, as would be expected, since classification requires less information than does identification. The interaction between direction of travel and sign type, which was significant in both field studies, indicated that the regulatory signs were seen relatively better at the north end of the stretch of roadway. This may have been because the signs at the north end were facing the sun, and the white regulatory signs were possibly more dependent on bright illumination for easy detection than were the yellow warning signs. The interaction between sign type and message type was significant ($p < 0.001$) in all three experiments. Performance was relatively better for warning signs when they were symbolic than when they were verbal.

On the basis of the comparison of the data from all three experiments, it can be seen that there is a considerable similarity across the three techniques. In addition to the findings based on the analyses of variance, the rank order correlations of the measures obtained across the different experiments were found to be high (Table 3). The correlations for the classification task indicate a direct relationship between distances in experiments 1 and 2. The negative correlations between the experiment 3 measures and the distance measures indicate that signs classified at greater distances tend to be classified more rapidly. The correlations from the identification task follow a similar pattern except for those involving experiment 3 at 30 mph (48 kph)—the larger slides. When all 16 signs are considered in the calculations the correlations are positive and highly significant ($p < 0.01$). The reason for this appears to be that the verbal signs had lower reaction times and smaller legibility distances than did the symbolic signs, and the symbolic signs had higher reaction times and longer legibility distances than the verbal signs. Hence an overall correlation was positive. However, when the correlations were calculated separately for symbolic and for verbal signs, in all four cases the correlations were negative (but insignificant, primarily because of the small N).

In view of the results obtained from these three methods, it can be tentatively concluded that similar information about the relative adequacy of warning and regulatory traffic signs can be obtained from a reaction time experiment and from a modified field technique as from an on-the-road measure under normal driving conditions.

ACKNOWLEDGMENT

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REFERENCES

1. Desrosiers, R. D. Moving Picture Technique for Highway Signing Studies: An Investigation of Its Applicability. Public Roads, Vol. 33, 1965, pp. 143-147.
2. Dewar, R. E., and Berger, W. Methodology in Traffic Sign Evaluation. Paper presented at the International Conference on Highway Sign Symbology, Washington, D.C., June 1972.

Figure 1. Classification distance, identification distance, and verbal reaction time as a function of task and message type.

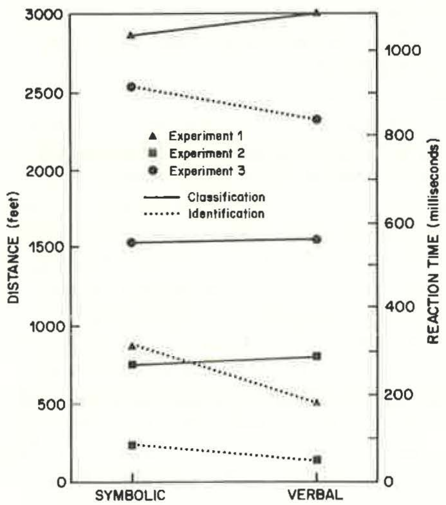

Figure 2. Classification and identification distance (combined) and verbal reaction time as a function of sign type and message type.

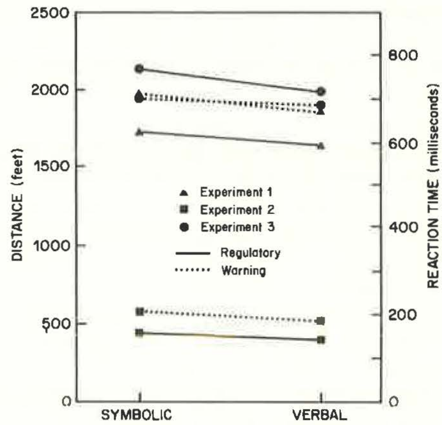

Figure 3. Classification and identification distance (combined) as a function of sign type and direction of travel.

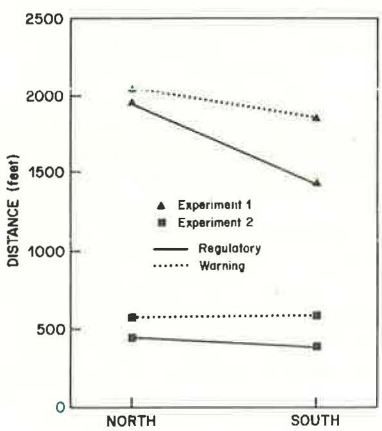

Table 3. Spearman rank correlations between selected measures of sign perception.

Task	Measures Correlated[a]	No. of Signs	r	p
Classification	1 (30)–2	16	0.82	<0.01
	1 (50)–2	16	0.77	<0.01
	1 (30)–3 (30)	15	-0.43	<0.06
	1 (50)–3 (50)	15	-0.58	<0.05
	2–3 (30)	15	-0.50	<0.05
	2–3 (50)	15	-0.49	<0.05
Identification	1 (30)–2	16	0.94	<0.01
	1 (50)–2	16	0.95	<0.01
	1 (30)–3 (30)	15	0.65	<0.01
	1 (50)–3 (50)	15	-0.38	NS
	2–3 (30)	15	0.67	<0.01
	2–3 (50)	15	-0.36	NS

[a]Measures are indicated by experiment number and condition; e.g., 1 (30) means experiment 1, 30-mph condition.

3. Forbes, T. W. Predicting Attention-Gaining Characteristics of Highway Traffic Signs: Measurement Technique. Human Factors, Vol. 6, 1964, pp. 371-374.
4. Markowitz, J., Dietrich, C. W., Lees, W. J., and Farman, M. An Investigation of the Design and Performance of Traffic Control Devices. Bolt, Beranek, and Newman, Inc., Rept. No. 1726, Contract No. CPR-11-5955, 1968.