EVALUATION OF REAL-TIME VISUAL INFORMATION DISPLAYS FOR URBAN FREEWAYS

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A questionnaire and slide presentation, designed by a multidisciplinary team, were administered for the purpose of determining driver preferences for real-time visual information displays for urban freeways. A total of 505 employees of 17 organizations in the cities of Houston and Dallas participated in the survey. Evaluation of the responses provided design inputs for the development of a real-time freeway information system. It was found that participating motorists preferred real-time information displays that were simple in nature over designs containing diagrams that orient them to the freeway and arterial streets. They also indicated a preference for unique design features, such as the use of color, to distinguish between usual and abnormal traffic conditions. In addition, the survey indicated that the motorists favored a design that explicitly distinguishes real-time visual displays from other types of freeway signing. Evaluation of symbols (circle, arrow, or bar) that could be used as part of a real-time visual display indicated no preference for any of these symbols.

•TO broaden the application of real-time freeway operations systems, the Texas Transportation Institute and the Texas Highway Department, in cooperation with the U. S. Department of Transportation, began a research project entitled Freeway Control and Information Systems. This project is an outgrowth of previous research on the Gulf Freeway in Houston that culminated in an operational freeway ramp control system (1).

One of the objectives of the project is to develop functional requirements for a freeway communications system. Toward this end, it was reasoned that the motoring public should play a major role in establishing the system design because the purpose of the system was to help fulfill their transportation needs. A questionnaire and slide presentation, designed by a multidisciplinary team, were therefore administered to obtain inputs from the motoring public.

This report discusses one major phase of the survey directed at an evaluation of driver preferences for real-time visual information displays. A large volume of results was obtained from the survey, and additional results are reported in other publications (2, 3). A total of 505 licensed drivers participated in the survey, 329 from Houston and 176 from Dallas. Some of the social and driving characteristics of the participants are summarized in Table 1.

BASIC VISUAL DISPLAYS

Four basic designs were developed to evaluate driver preferences for real-time visual information displays:

Design 1—This sign contained words and color indications to describe the traffic conditions;

Sponsored by Committee on Motorist Information Systems and presented at the 50th Annual Meeting.

TABLE 1

SOCIAL AND DRIVING CHARACTERISTICS OF PARTICIPANTS

Percentage of Participants

Sex		Age		Education	
Male	68	24 or younger	24	Grade school	4
Female	32	25 to 44	45	High school	29
		45 to 64	31	Business college	12
				Two years of college	21
				Graduated from college	34

Occupation		Received Driver Education		Years of Driving Experience	
Professional	30				
Technician	26	None	45	0 to 4	5
Clerical	22	Classroom	13	5 to 14	36
Salesworker	3	Behind the wheel	15	15 to 24	21
Craftsman	8	Classroom and behind the wheel	27	25 to 34	22
Service worker	2			35 to 44	13
Other blue collar	4			45 or older	3
Student	5				

Miles Driven per Year		Trips Via Freeway per Week	
Less than 8,000	14		
8,000 to 12,000	28	None	3
12,000 to 18,000	37	1 to 5	15
18,000 to 30,000	18	6 to 10	26
Over 30,000	3	11 to 20	39
		Over 20	17

Daily Use of Freeway for Work		Perference of Travel in Urban Areas	
Yes	70	Freeway	90
No	30	City streets	10

Design 2—This sign used only color indications to reflect the traffic conditions;

Design 3—This sign showed a diagram of the area and used illuminated color symbol indications to show traffic conditions; and

Design 4—This sign showed a diagram of the area and gave travel speeds between reference points.

There was one exception to this pattern, which will be discussed later. All of the signs were similarly designed with white letters on a green background, a red indication to describe congested conditions, and a green indication to specify normal conditions. The diagrams, when used, were illustrated in white. Travel speeds were depicted by using white numerals on a black background.

The designs were such that only one basic difference existed between Designs 1 and 2, between 2 and 3, and between 3 and 4 respectively. Consequently, the participants' choice of, for example, Design 1 over 2 would indicate a preference for the use of word messages to describe the traffic conditions. A preference for diagrams to help the motorist in orienting himself in the street system would be reflected by the selection of Designs 3 and 4. Analysis of the basic differences will help to determine the desirable characteristics of the final design.

Through the use of a slide presentation, the participants were confronted with three separate hypothetical situations: Case I, displays on the major street; Case II, displays on the frontage road; and Case III, displays on the freeway. In each of the three cases the participants were asked to evaluate sign design alternatives that would display the necessary freeway traffic information.

In the first situation, the participants were requested to assume that they were driving along a major street that ran parallel to the freeway. Their intended route was to

turn right on a major street, proceed to the freeway, and then turn left onto the freeway. For some reason, the lanes of the freeway had become heavily congested. This congestion would cause extra delay in their trips if they continued to use the freeway. Changeable message signs located in advance of the major street intersections would inform the drivers of the existing condition on the freeway.

The second hypothetical situation was the same as in the previous case, except it was assumed that the respondents, as drivers, had already committed themselves to the freeway service road. By means of signs located in advance of the freeway entrance ramps, they would be informed of the traffic condition on the main lanes of the freeway.

In the third situation, the participants were asked to assume that they were driving on the freeway and were approaching the congested area. Signs on the freeway would inform them of the condition ahead.

Each of these three cases was individually presented to the participants. They were asked to rank each sign independently, giving it a rating from a low of 1 to a high of 5, according to how well it described the traffic condition to them as motorists. After each sign was individually rated for a particular case, the participants were shown a slide containing all four designs and were asked to rank these according to their preferences. Although the basic designs were similar for each of the three cases, the signs were shown in random order for each case to eliminate any bias that may have occurred from the order of presentation.

The purpose of the individual rating tests was to determine if any of the basic designs were acceptable as candidates. For example, if all designs received very low ratings, one could assume that none of the alternatives was acceptable to the participants. If some received high ratings whereas others received low ratings, one could evaluate the basic differences between the signs that were most desirable to the participants.

Ranking, on the other hand, was used as a test to determine the relative desirability of the various designs in cases of equal ratings. For example, if two designs were given equal ratings as to their abilities to communicate the appropriate messages, then the rankings would produce the relative desirability between them. Mean rankings were computed by assigning 4 points for each first choice, 3 points for each second choice, 2 points for each third choice, and 1 point for each last choice.

When ratings are given to individual items, the question arises as to what constitutes "good." A rational decision had to be made prior to analyzing the data. With respect to the signs that were given ratings by the participants using a scale that ranged from 1 to 5, the authors reasoned that a rating of 3.5 or higher would constitute an acceptable design, and a rating of 4.5 or higher would constitute a highly desirable sign. By using these criteria, the acceptability of a particular design could be evaluated.

Displays on the Major Street (Case I)

The results of the ratings and the rankings of the signs for Case I are shown in Figures 1 and 2 respectively. Frequency distributions for the ratings and rankings are shown in Figures 3 and 4 respectively.

The results clearly show that the basic designs that were simple in nature were preferred over those that displayed a diagram of the area. The design that contained words and color indications (Design 1) and the design that used only color indications (Design 2) to describe the freeway traffic condition were rated relatively high, whereas the designs that included a diagram of the area were rated relatively low. The mean ratings for Designs 1 and 2 were 4.0 and 3.5 respectively, whereas the mean ratings for Designs 3 and 4, which contained diagrams of the area, were 2.5 and 2.4 respectively. On the basis of the preestablished criteria, only Designs 1 and 2 were above the acceptable mean limit.

The data were further analyzed to determine whether there was consistency in the rankings among the participants. Kendall's Coefficient of Concordance, W, was computed for this purpose (4). The coefficient detects the consistency (or lack of consistency) in the ranking of ordinal data. The significance of the coefficient was then tested using the chi-square, χ^2, statistic. The test does not reveal the degree of preference

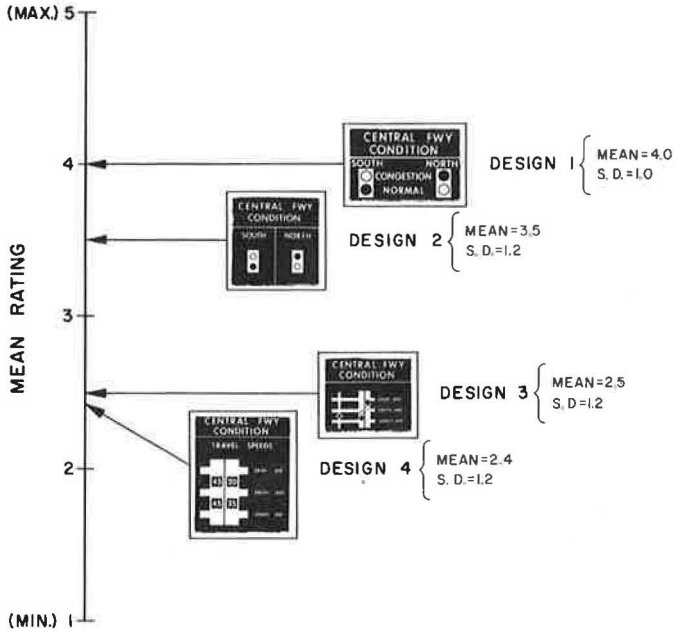
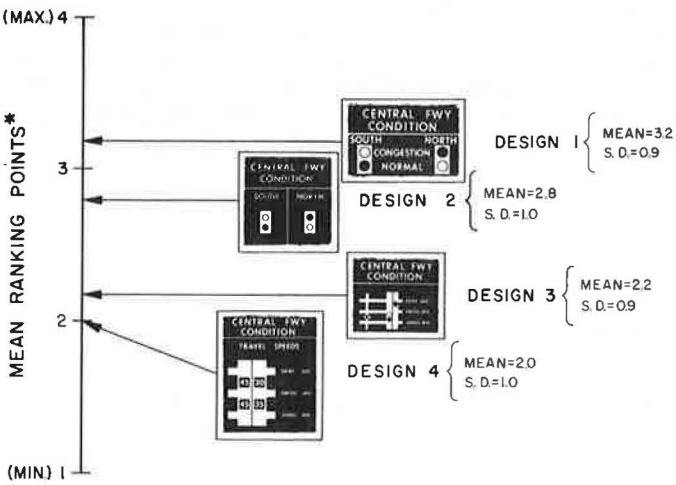


Figure 1. Ratings of sign design alternatives for display on major streets–Case I.

but does determine whether the ranking was consistent among the participants and provides a basis for determining the best estimate of the "true" ranking according to consensus based on the R_j values. The results of the analysis are summarized in Table 2.



*BASED ON ASSIGNING 4 POINTS TO EACH FIRST CHOICE, 3 POINTS TO EACH SECOND CHOICE, 2 POINTS TO EACH THIRD CHOICE, AND 1 POINT TO EACH FOURTH CHOICE. MAXIMUM POSSIBLE MEAN=4.0; MINIMUM POSSIBLE MEAN=1.0

Figure 2. Rankings of sign design alternatives for display on major streets–Case I.

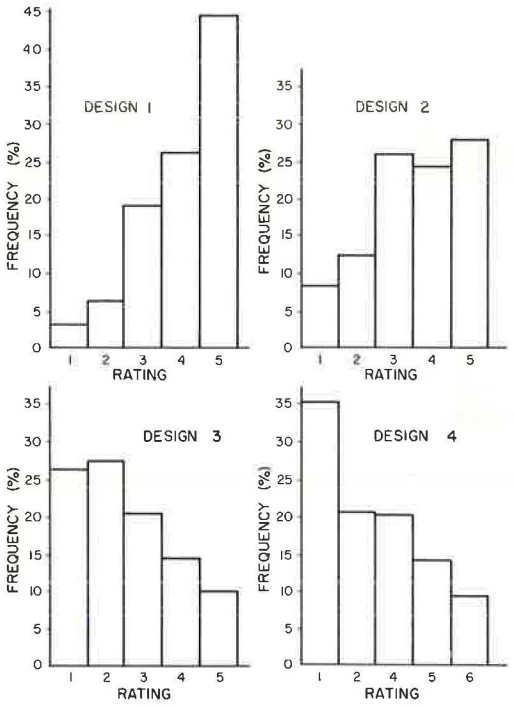


Figure 3. Frequency distributions for ratings of sign design alternatives–Case I.

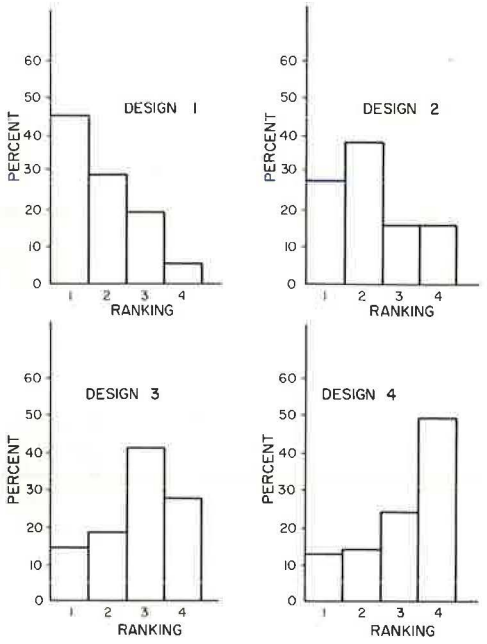


Figure 4. Frequency distributions for rankings of sign design alternatives–Case I.

The results of the test revealed that the coefficient, W, was 0.1841, and the chi-square value of 224.3 was highly significant at the 0.01 level. This means that the respondents had ranked the signs consistently. Based on the values of R_j, the preference for the signs was in the following order: Design 1, Design 2, Design 3, and Design 4.

The results suggest that word messages describing the freeway conditions would be slightly more desirable than a design that was void of qualitative messages. They also reinforce the results of the ratings of each sign. The participants preferred the simple designs over the designs that displayed a diagram of the area.

TABLE 2

SUMMARY OF KENDALL'S TESTS FOR RANKING OF SIGN DESIGN ALTERNATIVES

Alternative	Case I		Case II		Case III	
	R_j Value	Order of Ranking	R_j Value	Order of Ranking	R_j Value	Order of Ranking
Design 1	1,270	1	1,337	1	1,317	1
Design 2	1,127	2	1,049	2	1,220	2
Design 3	890	3	883	3	870	3
Design 4	773	4	861	4	823	4
Kendall Coefficient, W	0.184		0.170		0.206	
Chi Square, χ^2	224.3[a]		210.3[a]		260.8[a]	

[a]Significant at 0.01 level.

Displays at the Entrance Ramps (Case II)

The results of the analysis of the visual displays for use at the entrance ramps are shown in Figures 5 and 6, and frequency distributions are shown in Figures 7 and 8.

It should be noted that one of the basic designs for Case II was slightly different from the pattern listed previously. The second design incorporated color indications to reflect the traffic conditions as well as a diagram of the area to assist the motorist in orienting himself to the facility. In Cases I and III the diagram was not used for this design.

The results again clearly demonstrate that the design that was simple in nature was preferred over the designs that contained a diagram of the area. The mean rating for the design showing a color signal indication and word messages (Design 1) was 3.9, whereas Designs 2, 3, and 4, all of which contained a diagram of the area, had mean ratings of 2.8, 2.7, and 2.4 respectively. Only Design 1 was ranked above the acceptable mean limit of 3.5. The rankings of the alternate signs were consistent with the ratings of the individual signs. The mean ranking for Design 1 was 3.3, whereas the mean rankings for Designs 2, 3, and 4 were 2.6, 2.2, and 2.1 respectively.

The results of Kendall's Coefficient of Concordance for the consistency of ranking of these four signs are given in Table 2. The results again establish that the participants were consistent in the manner in which the signs were ranked. Kendall's coefficient, W, was computed as 0.1697, and the chi-square test was highly significant at the 0.01 level. The tabulated order of ranking for Case II was as follows: Design 1, Design 2, Design 3, and Design 4.

Displays on the Freeway (Case III)

The results of the ratings and the rankings of the sign display alternatives for use on the freeway are shown in Figures 9 and 10. Frequency distributions of the participants' responses to the ratings and rankings are presented in Figures 11 and 12 respectively.

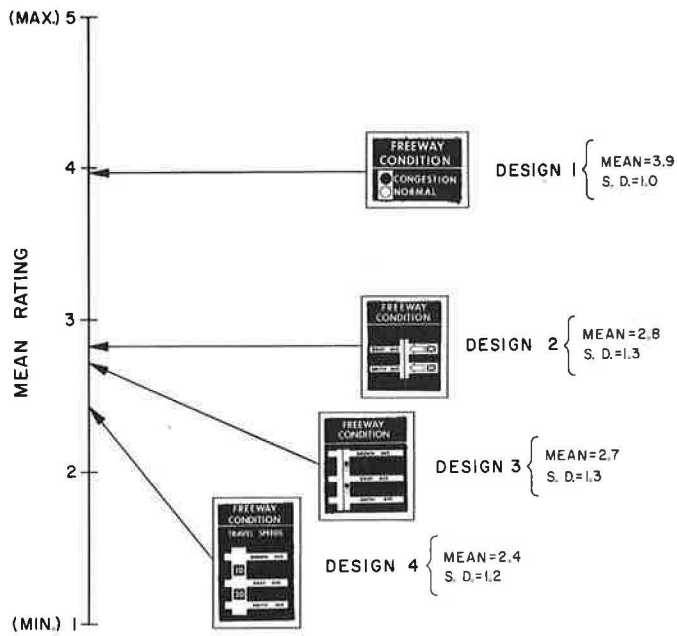


Figure 5. Ratings of sign design alternatives for display at entrance ramps–Case II.

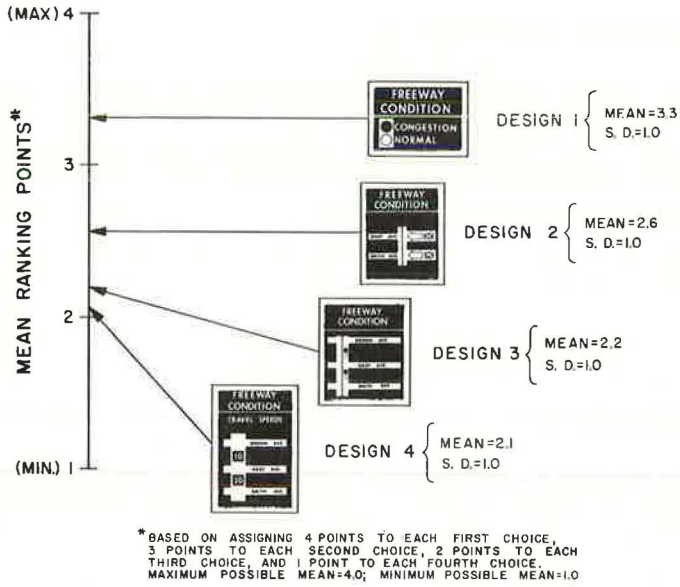


Figure 6. Rankings of sign design alternatives for display at entrance ramps–Case II.

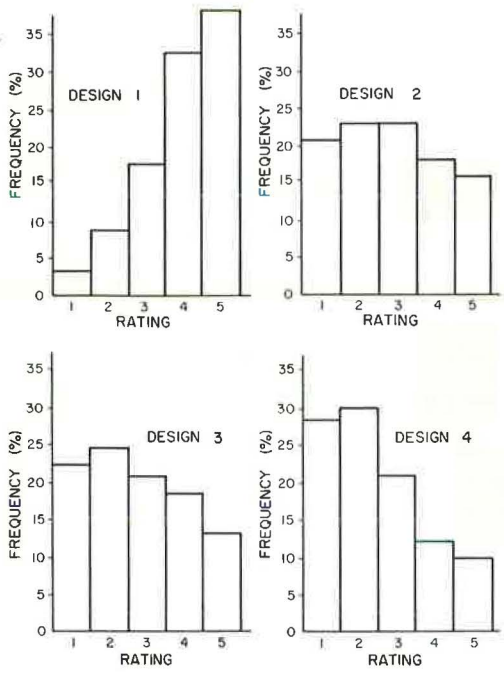


Figure 7. Frequency distributions for ratings of sign design alternatives–Case II.

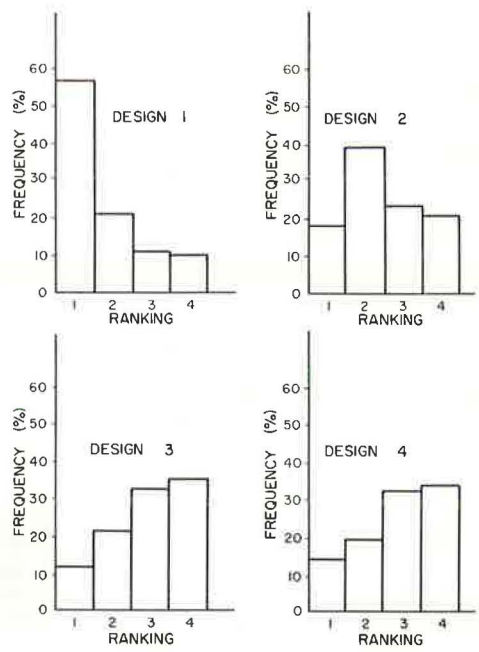


Figure 8. Frequency distributions for rankings of sign design alternatives–Case II.

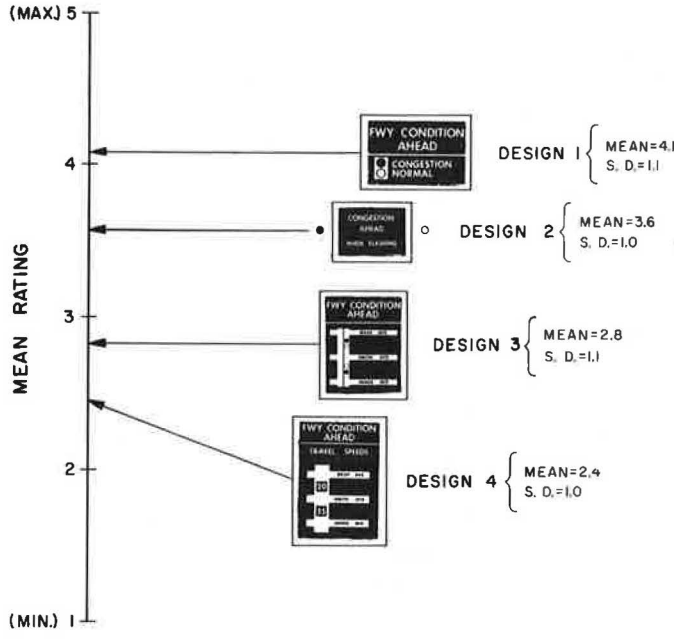


Figure 9. Ratings of sign design alternatives for display on the freeway–Case III.

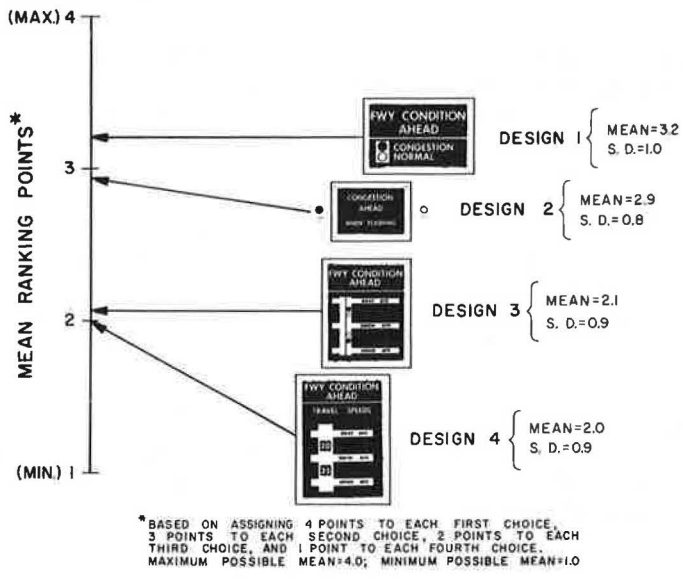


Figure 10. Rankings of sign design alternatives for display on the freeway–Case III.

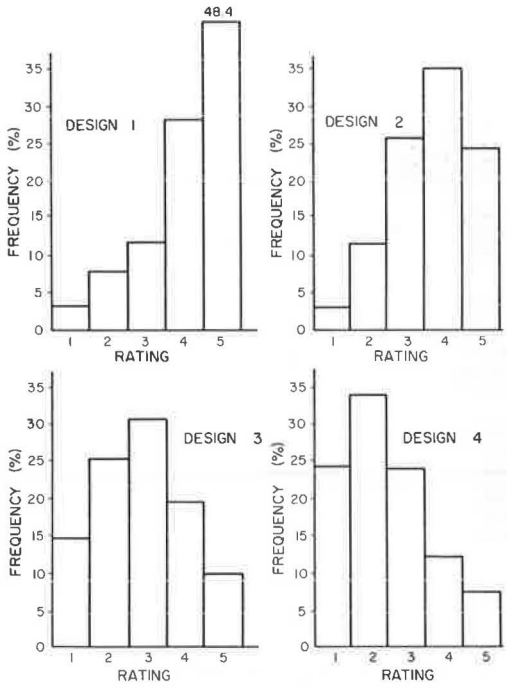


Figure 11. Frequency distributions for ratings of sign design alternatives–Case III.

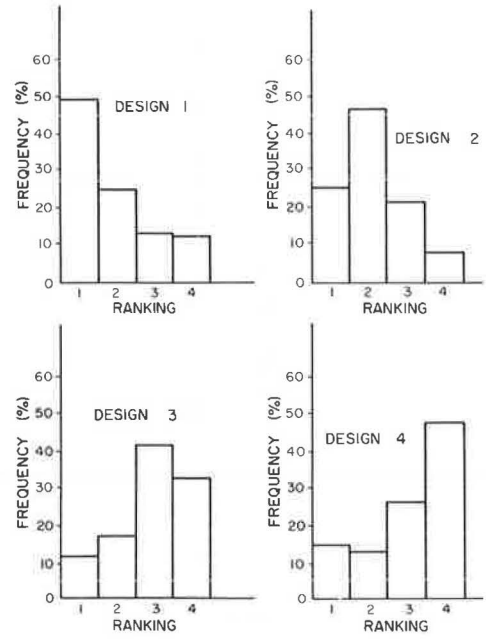


Figure 12. Frequency distributions for rankings of sign design alternatives–Case III.

The results again show a preference for simplicity in design. Designs 1 and 2 had mean ratings of 4.1 and 3.6 respectively, both of which were above the acceptable mean limit. The two designs that incorporated a diagram of the freeway and streets had mean ratings of 2.8 and 2.4. The results of the rankings again show Design 1 to be preferred, followed by Design 2, Design 3, and Design 4 in that order. A summary of Kendall's coefficient test is given in Table 2. The results reveal a consistent pattern in the rankings of the four signs. The ranking of the designs was in the following order: Design 1, Design 2, Design 3, and Design 4.

Summary of Ratings and Rankings of Basic Visual Displays

The mean ratings and rankings for Cases I, II, and III are given in Table 3 to provide a better understanding of the results concerning the design alternatives for a total system. The comparison is made for the purpose of showing the consistency of the four basic designs. There was definite consistency in the ratings and rankings for all three cases.

The results of the ratings and rankings of the four basic designs indicate the preference of the motorist for a simple design. Although it had been conjectured that diagrams providing the driver with an orientation to the freeway and streets would be a valuable asset, the results of the study indicate that this type of display is the least preferred of all the alternatives.

SPECIAL DISPLAYS

A portion of the questionnaire and slide presentation was designed to obtain inputs regarding some special features of visual displays. In one group of questions, the participants were asked to make comparisons among three pairs of signs. Only one

TABLE 3

COMPARISON OF THE PARTICIPANTS' EVALUATION OF VISUAL DISPLAYS FOR ALL THREE HYPOTHETICAL SITUATIONS

Design	Case I		Case II		Case III	
	Mean Rating[a]	Mean Ranking[b]	Mean Rating[a]	Mean Ranking[b]	Mean Rating[a]	Mean Ranking[b]
1	4.0	3.2	3.9	3.3	4.1	3.2
2	3.5	2.8	2.8	2.6	3.6	2.9
3	2.5	2.2	2.7	2.2	2.8	2.1
4	2.4	2.0	2.4	2.1	2.4	2.0

[a]Mean determined by assigning 1 point for rating of 1 (low), 2 points for rating of 2, 3 points for rating of 3, 4 points for rating of 4, and 5 points for rating of 5 (high). Maximum possible mean = 5.0.
[b]Mean determined by assigning 4 points to each first choice, 3 points to each second choice, 2 points to each third choice, and 1 point to each fourth choice. Maximum possible mean = 4.0, minimum possible mean = 1.0.

different feature existed between each pair. The alternatives that were compared are shown in Figure 13. In each of the three comparisons, the participants were asked to indicate their selection from the following choices:

1. Alternative A is best;
2. Alternative B is best; or
3. Alternatives A and B are equally good.

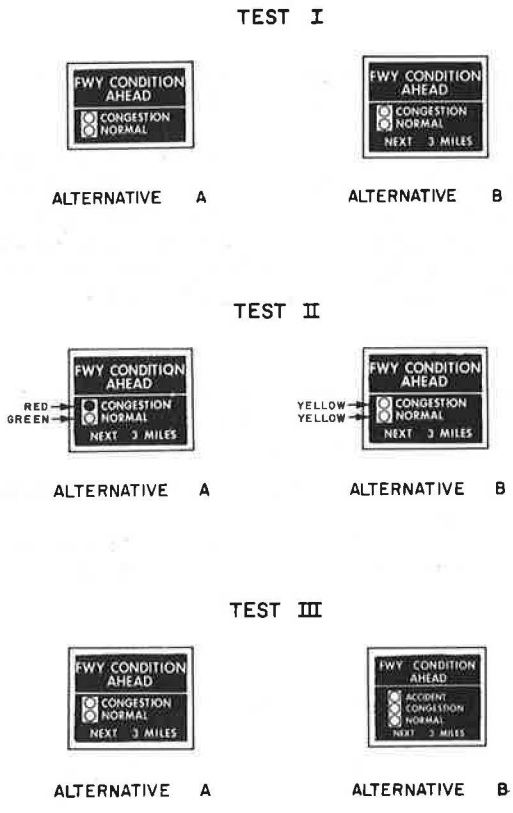


Figure 13. Special feature alternatives for visual display.

Test I was a comparison to determine whether the participants would like to receive information regarding the location of congestion. Test II was used to establish whether the color of the lamps in the visual display would affect the choice of signs. This in essence was one means of measuring the desire for distinct colors to indicate varying degrees of traffic operation. Test III was intended to measure the desire of the motorists to know the nature of the incident that causes the congestion. A summary of the results is given in Table 4.

The results revealed that 87 percent of all respondents preferred information regarding the location of the congested area in addition to the qualitative description of the traffic condition. The results also showed that 7 percent of the respondents were indifferent about receiving the added information concerning the location of the congestion.

TABLE 4

PERCENTAGE OF PREFERENCES FOR SPECIAL VISUAL FEATURES

Test	Alternative A	Alternative B	No Choice
I	6	87	7
II	69	21	10
III	26	57	17

A comparison of the color of the signals in Test II showed that a majority of the respondents preferred the red and green signals in contrast to all yellow ones. A total of 69 percent indicated their preference for the red and green combinations, 21 percent preferred all yellow signals, and 10 percent were indifferent. This result suggests the desirability of color or some other unique characteristic to distinguish the degree of traffic conditions on the freeway.

An analysis of the desirability for knowing the occurrence of an incident in Test III indicated that only slightly more than half of the respondents desired to know that an accident had occurred, in addition to the freeway traffic condition and the length of the congested area: 57 percent of the respondents favored the display that indicated the occurrence of an accident, 26 percent did not desire this added information, and 17 percent were indifferent.

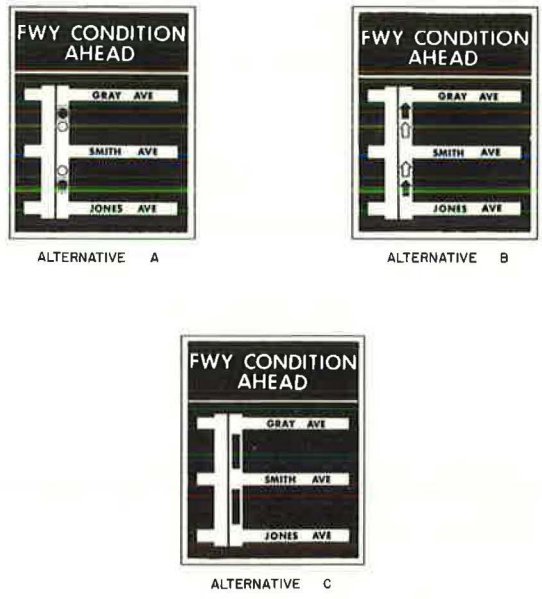


Figure 14. Special symbol alternatives for visual display.

Symbols

It was also of interest to determine the desirability of certain types of symbols that could be used on visual displays. Three alternatives, as shown in Figure 14, were presented to the participants for ranking. The results of this analysis are given in Table 5.

Kendall's Coefficient of Concordance was again employed to determine whether there was a definite degree of consistency of ranking. The coefficient was computed to be 0.0113, and the test of significance revealed a chi-square value of 7.60. The results were not significant at the 0.01 level. The interpretation of the results revealed no meaningful pattern or consistency in the ranking of the three symbols; therefore, there was no reason to believe that an order of preference existed among the symbols.

Color

The participants were asked for their opinions concerning the possible color combinations of a sign giving information about the freeway traffic condition. They were presented the following choices:

1. White letters on a green background, as used for guide signs;
2. Black letters on a yellow background, as used for warning signs;

TABLE 5

PERCENTAGE OF PREFERENCES FOR SYMBOLS ON VISUAL DISPLAYS

Symbol	First Choice	Second Choice	Third Choice	Average Ranking Points[a]	Standard Deviation
Circle	52	25	23	2.3	0.8
Arrow	27	53	20	2.2	0.7
Bar	21	22	57	1.7	0.8

Note: Kendall's Coefficient of Concordance, W = 0.0113; chi-square, χ^2 = 7.60; d.f. = 2.

[a]Based on assigning 3 points for each first choice, 2 points for each second choice, and 3 points for each third choice. Maximum possible mean = 3.0, minimum possible mean = 1.0.

TABLE 6

DRIVER PREFERENCES OF COLORS FOR VISUAL DISPLAYS

Choices	Percentage of Respondents
White letters on green background	22
Black letters on yellow background	9
New color combination	62
No preference	7

3. A new color combination to distinguish these particular signs from all others; or
4. No preference.

Table 6 gives the results, which indicate that the drivers preferred a unique device that clearly distinguishes real-time freeway information from other types of freeway signing.

SUMMARY OF FINDINGS

Based on the analysis of the questionnaire survey administered to 505 licensed drivers, the following findings may be drawn:

1. The respondents preferred real-time freeway information sign displays that were simple in nature. Simple types of displays were consistently preferred over designs containing a diagram that provided the motorists with an orientation to the freeway and streets. Designs 1 and 2 were consistently rated high. Designs 3 and 4 were consistently rated low.
2. A preference was shown for unique design features, such as the use of color, on visual displays to distinguish between usual and abnormal traffic conditions.
3. The respondents indicated a preference for a unique design that distinguishes real-time visual displays from other types of freeway signing.
4. Information with respect to the freeway traffic condition and the location of congestion was preferred over knowledge of only the freeway traffic condition.
5. There was no reason to believe that a preference existed for any of the following symbols that could be used on a real-time visual display: circle, arrow, or bar.

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DISCUSSION

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The inventory of Freeway Surveillance and Operational Control Activities prepared by the Committee on Freeway Operations and issued in June 1970 as Highway Research Circular 108 indicates that 25 agencies in 16 states reported some form of freeway operational and control activity. Sixteen of the reporting agencies indicated that changeable message signs are being used to provide travel information or variable speed limits. In all probability an inventory of the same activities taken 3 years from now would show an increase of 100 percent or more in actual mileage of freeways utilizing similar concepts.

The continuing use of surveillance and control concepts for improvement of urban freeway operation dictates the necessity for the development of standards for the application of real-time visual information displays. To be effective these displays must inform the motorist in a manner most easily comprehended by him. The research that this paper describes is directed toward a subject that can be immediately applied, a factor of critical importance.

The evaluation procedure was apparently well designed to accomplish the goals effectively. The various design alternatives were such that the subject drivers were asked to indicate preference or lack of preference on the basis of conceptual differences

in information forms. The findings seem to indicate clearly that the top preferences were for (a) simplicity of design; (b) use of combination word and color symbol messages; (c) use of red and green color symbols to denote traffic congestion and normal movement respectively; and (d) use of a unique design for the real-time visual display device. Additional preferences of lesser priority were indicated for information regarding the location of congestion and whether or not it is caused by an accident. Diagrammatic displays indicating congestion or travel speeds in certain areas and preferences for a specific symbol received relatively low priority.

The findings indicate that drivers prefer display concepts similar to those that have evolved over a period of time into standards. These concepts, which are now standard, include three-color vehicular traffic signals, two-color pedestrian signals utilizing word messages, and unique shapes or other design features for various signs. Designs of these standard devices have evolved over periods of time during which features of the individual displays have undergone various changes. However, we are now at a stage of development of standards where certain shapes and colors have been reserved for specific uses. In that connection it is suggested that, because there was no clear-cut preference for circular or arrow symbols over bars, future efforts should consider the use of red and green bars or other unique shapes rather than circular or arrow symbols.

As a general statement, it is my opinion that this report describes the results of an effective research effort. It represents an early stage in what should be a multi-stage research effort to develop effective real-time visual displays for urban freeways. The proper follow-up of this study can accelerate the development of standards for these devices. To promote this accomplishment the following suggestions are offered:

1. Similar evaluations using the identical or slightly revised designs should be made by using subjects from different geographical areas.
2. If the findings of this work are correlated in previous or future studies, designs of low priority should be dropped from consideration and prototypes of the high-priority designs developed and tested for driver reaction.
3. Following successful testing, recommendations for development of standards should be made.

As indicated earlier, this subject is one for which there is an opportunity for immediate practical application. The proper response from the research community can accelerate the transition from basic research to development of application and design standards.

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The authors have made a notable contribution in this paper by pointing out the importance of driver involvement in and acceptance of traffic control devices. Their conclusions seem quite consistent with driver response to other types of highway signs.

Driver acceptance and/or credibility is of course a major concern in the decision to spend public funds for real-time information displays. From experience in California and New Jersey, there is apparently a large credibility gap in real-time speed control displays used on freeways. Unfortunately, this situation has a long history founded on unreasonably low posted speed limits in many small towns.

In New Jersey real-time synchronized signal-ahead signs have met with good acceptance. One reason, no doubt, is that they have been judiciously placed where the driver needs the information for proper control. Although no quantitative measurements have been made, there is the general belief that the potential for rear-end collisions has been reduced and traffic flow has been improved.

Although the authors state that the designs used were similar to those in use in other cities, it would seem to be in order to state what the design requirements should be and then to compare driver preferences with how the given designs fit the design requirements. Essentially, the requirements are the five given in the Manual on Uniform Traffic Control Devices. Implied in the requirement of commanding attention is that of ease of differentiation among other points of attention.

From the general requirement of ease of comprehension it is quite apparent that Designs 1 and 2 are superior to Designs 3 and 4. There is more information conveyed in Designs 3 and 4, but this information is more difficult to sort out from the diagrams. This is particularly true on first presentation. Greater familiarity with this latter type of sign may well improve its rating by the driver.

It was tacitly assumed by the authors that a design is "good" if a majority of drivers perceive it as such. Yet according to the philosophy of design applied to roadway elements it is usually assumed that the design will normally accommodate all drivers. This suggests the criterion that the design should be operationally satisfactory for all drivers under normal driving conditions. This would mean that no driver would give a poor rating to an acceptable design. In the sample used by the authors about 3 percent of the drivers gave a poor rating to Design 1, which was judged best by the majority. Considering, however, the particular purpose of this type of sign, the low percentage is not very important.

On the subject of testing procedures, several questions might well be raised. The main one is how closely the test situation approximates actual driver behavior. In terms of conclusions, would the differences between the real situation and the simulated conditions be expected to change appreciably the test findings? Out of these come other questions: How does the participant's viewing time during the slide presentation compare with viewing time in the driving situation? How does the apparent size in the slide presentation compare with the apparent size of the real display as viewed by the driver? Again, greater familiarity with the displays used could possibly change the participant's preferences.

A final question is concerned with how to determine what constitutes "good" from the participant's response. The authors themselves made that judgment by selecting a lower bound of 3.5 in their rating scale of 1 to 5. Would it not be simpler and more meaningful to have participants make the judgment by allowing them to select from a four- or five-part attribute scale such as very good, good, fair, poor? Then assigned numbers can be applied later to the selected attributes for the purpose of obtaining an average rating.

AUTHORS' CLOSURE

The authors appreciate the reviews by Marshall Jacks and Fred Lehman.

Jacks has pointed out the analogy of the development of real-time information displays to the highway display concepts that have evolved over the years into present standards. He has challenged the research community to accelerate the transition of real-time information systems development from basic research to an operational reality and has offered sound suggestions toward this goal. As part of our continuing research program, prototype changeable message signs will be installed in the Gulf Freeway corridor to complement the existing computer-controlled facilities. Field studies will then be conducted to evaluate their effectiveness under the real situation. Similar programs are under way in other parts of the country.

Lehman has raised several important questions relating to the acceptance criterion and the testing procedures. An acceptance criterion was established so that the features of each design that are acceptable to the motorists could be evaluated. These features will then be incorporated into the prototype designs for further evaluation in the field.

Because the visual displays were projected on a screen, the physical size of the displays was consequently smaller than the signs that will be erected on the highway. However, because of the close proximity of the participants to the screen, the relative sizes of the projected displays were approximately the same as typical changeable message signs as viewed from the automobile.

The participants were required to look at and evaluate each display within 10 seconds. The actual observation time of the display would, therefore, compare favorably with the expected viewing time in the driving situation.

A numerical scale ranging from 1 to 5 was used in the questionnaire to rate the various sign designs. A "low" was affixed to the number 1 and a "high" to the number 5 to give direction to the scale. This method was used for two reasons: In the first place, this type of scale does not require that all subjects agree on the definition of a stated attribute. For example, the word "fair" may be considered to be a positive response by some, whereas others may consider it negative. This problem is somewhat negated when a numerical scale is used. Secondly, the results of a questionnaire survey using the numerical scale are easily quantified, and group scores may be directly compared to a given individual's response without transcribing or otherwise converting the scale.