DEVELOPMENT OF A DIAL-IN TELEPHONE SYSTEM BASED ON OPINIONS OF URBAN FREEWAY MOTORISTS

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A dial-in telephone system is being installed in Dallas, Texas, to inform motorists of traffic conditions on a major expressway leading to the central business district. This paper summarizes the findings of a questionnaire administered to over 300 motorists in 7 central business firms. The questionnaire was designed to establish the degree of interest in the service and to help develop design and operational criteria for the phone messages. The results of the survey indicate that 75 percent of the respondents stated that they would use the service. Their greatest interest was in information regarding location and degree of congestion, alternate routes, the reason for congestion, and whether a lane was blocked. Messages based on the survey results were recommended for various situations, and other design and operational criteria were specified. A follow-up study is planned to be conducted after the system is in use to determine motorists' evaluation and use of the system.

•PREVIOUS research (1, 2) has indicated that an effective, real-time, freeway-driver information system should include, in addition to visual communication, various modes of audio communication. Dudek and Carvell (1) explored 3 proposed methods: commercial radio, low-powered radio, and dial-in telephone. They concluded that all 3 modes may be necessary to satisfy the preferences of motorists.

This paper is about a dial-in telephone system, which, as a part of an integrated system, appears to be useful in trip planning. The telephone, like a low-powered radio system, has several advantages.

1. Freeway traffic information is presented in real time and can be specific to local interest.
2. The message can be varied easily as conditions change.
3. The cost of implementation is nominal compared with that for visual modes of information.

In addition, telephones are usually available to office workers.

The present conceptual design for the telephone system is that each origin zone would have a separate call number to provide local rather than wide-area coverage. Separate records would provide taped broadcasts of the local area freeway traffic conditions based on data from the traffic control center. The telephone answering service would be equipped with enough extensions to handle the anticipated volume of calls during peak periods.

The area to which this paper is directed relates to quantitative and qualitative aspects of the message that is to be reported over the telephone. The message can be most effective if it presents the traffic information that motorists can most readily interpret in terms of their particular needs. It should provide the necessary information for the driver to voluntarily make the appropriate traffic planning decision that will

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be compatible with redistribution of demand and will ameliorate traffic congestion. This paper deals with motorists' preferences with regard to the message and their acceptance of the dial-in telephone system.

OBJECTIVES

The objectives of the research reported in this paper were as follows:

1. To determine the types of messages that should be transmitted to freeway motorists over a dial-in telephone system. Traffic information may be described in different ways, but the criterion of driver opinion or preference was the primary consideration in message selection.
2. To determine from motorists' responses their interest in the telephone dial-in system and, more specifically, when they would most likely use it.

The results of this survey were to be used in the development of a set of message packages for common traffic situations. A follow-up study is planned to assess motorist acceptance and use of the dial-in system after it has been in operation for a period of time.

PREVIOUS WORK

Three studies have been reported in recent literature that deal specifically with driver preferences for certain types of traffic descriptor messages. Heathington, Worrall, and Hoff (4) investigated driver preferences for descriptors of heavy, moderate, and no congestion. Descriptors were presented as overhead sign messages followed by the message NEXT 3 MILES (4.8 km). They found for heavy congestion the most preferred descriptor was ACCIDENT—HEAVY CONGESTION; second choice was SPEED—5 to 15 MPH (8 to 24 km/h); third and fourth choices were HEAVY CONGESTION and STOP AND GO TRAFFIC. Least preferred were EXTRA DELAY—10 to 20 MINUTES, TRAVEL TIME—15 to 25 MINUTES, and a blank sign. Similar results were found for moderate congestion except that the ACCIDENT and STOP AND GO TRAFFIC descriptors were not used.

Dudek and Jones (3) conducted a questionnaire survey of 505 drivers from Houston and Dallas. When they were asked to select the information that was most helpful in determining freeway traffic conditions, 70 percent preferred information on either location and length of a congested area or degree of congestion.

Case, Hulbert, and Beers (5) conducted an extensive study of changeable messages for freeway signing. They found a different order of priority. Most drivers preferred knowing which lanes were blocked. Knowing the distance from the problem ranked second.

The following indicates the ranking given to the descriptors in the 3 studies:

Heathington, Worrall, and Hoff	Dudek and Jones	Case, Hulbert, and Beers
1. Cause and congestion level	1. Location of congestion	1. Lane blockage
2. Speed	2. Congestion level	2. Distance to problem
3. Congestion level only	3. Cause of congestion	3. Delay time
4. Stop and go	4. Speed	4. Cause for delay
5. Delay time	5. Travel time	5. Location
6. Travel time		
7. Blank sign		

Heathington, Worrall, and Hoff did not investigate preferences for location or length of a congested area because this was indicated in all messages by NEXT 3 MILES. Dudek and Jones did not investigate delay and stop and go. Only Case, Hulbert, and Beers investigated lane blockage. The first 2 studies suggest that motorists have a strong preference for information on level of congestion; information on travel time was less preferred. The results are contradictory on the importance of speed information as well as on several other areas. The 2 studies are principally relevant to visual modes of presentation, and a different ranking sequence may apply to audio modes. Therefore, one of the major questions in our survey related to freeway driver preferences when the mode of presentation was a dial-in telephone system.

METHOD

Motorist Sample

The sample was selected from the central business district because all of the employees in it worked a day shift and typically faced a daily trip planning problem. They would be involved in traffic congestion and, hence, might have occasion to use the service.

A sample of 303 employees was selected from 7 different businesses: 3 life and health insurance companies, 2 banks, and 2 oil companies. These businesses were selected because they hired a large number of employees. The number of participants from each organization ranged from 33 to 62.

Instructions on general criteria for participant selection were given to the personnel departments of the various companies. Only those employees who drove or rode in a privately owned vehicle to or from work were included. Passengers in car pools could be respondents.

Questionnaire Description

A questionnaire was developed that had 4 major parts:

1. Instructions to the respondents and a brief description of the proposed system;
2. Request for general information on age, sex, education, and use of a freeway for commuting;
3. Request for information on availability of a telephone, expected frequency and times of use, and strength of interest measured by willingness to call back if the line is busy; and
4. Request for preferred 5 out of 12 messages.

The 20-question form that was administered to those in the sample is presented in an appendix.[1]

RESULTS AND DISCUSSION

Informational Descriptors

The most important question was that on preferred descriptors. Table 1 gives a summary of the results.

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[1] The original manuscript of this paper included an appendix, Dial-In Telephone Questionnaire. The appendix is available in Xerox form at cost of reproduction and handling from the Transportation Research Board. When ordering, refer to XS-57, Transportation Research Record 536.

Table 1. Rank order of descriptors.

Rank	Descriptor Subject	Number Selecting	Percent Selecting
1	Location of congestion	217	75.1
2	Degree of congestion	206	71.3
3	Recommended alternate routes	176	60.9
4	Lane blockage	142	49.1
5	Reason for congestion	137	47.4
6	Delay expected by congestion	101	34.9
7	Delay at ramp and alternate ramps	99	34.3
8	Time saved by alternate routes	87	30.1
9	Recommended safe speed	79	27.3
10	Travel time to exit ramp	74	25.6
11	Average freeway speed	54	18.7
12	Average speed on parts of freeway	45	15.6
13	Other	10	3.5

Over 70 percent of the respondents preferred messages on location of congestion and degree of congestion, which is consistent with the findings of Dudek and Jones (3).

Sixty percent of the respondents wanted to know recommended alternate routes. This alternative was not investigated in the visual mode studies of Dudek and Jones (3) or Heathington, Worrall, and Hoff (4), but Case, Hulbert, and Beers (5) found that 78.5 percent wanted advice on alternate routes.

Slightly over a third of the respondents were interested in the delay to be expected on the freeway compared to the normal traffic speed. The relatively low importance associated with time delay was also found by Dudek and Jones (3), and Heathington, Worrall, and Hoff (4).

Less than 20 percent were interested in the average speed of traffic on either the freeway or parts of the freeway. This finding came even though these alternatives were placed in the first and second positions in the sequence of alternatives. Dudek and Jones (3) also found speed ranked fourth out of 5 descriptors.

Telephone Service Information

All respondents had access to a telephone where they worked, and all but 2 percent had access to a private telephone. Approximately 75 percent of the respondents indicated that they would use the service often or occasionally; only 25 percent would have little or no use for it. Over 90 percent of the respondents said that they would use the service 1 to 10 times per week. Infrequent users often left the remainder of the questions on dial-in service unanswered.

Slightly over 50 percent of the respondents were interested in the service both before they went to work and before they went home; slightly less than 25 percent of the respondents were interested in it only before going to work or only before they went home. As expected, about 75 percent of the respondents would dial in either between 6 and 9 a.m. or 4 and 7 p.m. Only 12 percent would use it on weekends, and only nominal interest was expressed in using it during other times of the day.

Of considerable note was the finding that almost 50 percent of the respondents would not dial again if the line was busy, which suggests that they viewed their time as being at a premium. Therefore, the service should not delay the user.

Although a great majority of the respondents now listen to traffic reports on radio, only a few believed that the reports were always timely and accurate. Fifty-eight percent said the reports were sometimes timely and accurate, but 25 percent of the respondents stated that they were not. This would suggest a need for an additional service such as a dial-in telephone system.

Driver Information

In response to the questions regarding driving habits, 89.4 percent of the respondents indicated that they normally drove or rode in a vehicle to and from work. The remainder of the respondents stated that they drove or rode sometimes. Approximately 89 percent stated that they always traveled on a freeway; the remainder responded that they sometimes traveled on a freeway.

The results indicate that 55.8 percent of the respondents took the North Central Expressway to and from work in the central business district.

The frequency of freeway trips each week was as follows:

Trips/Week	Respondents (percent)
1 to 5	14.8
6 to 10	50.2
11 to 20	32.7
More than 20	2.3

A final question related to the time that freeway users took to go from their places of work to their vehicles. Responses indicated how old the telephone message would be by the time the motorists started on their homeward trip. These results were as follows:

Work to Vehicle (min)	Respondents (percent)
1 to 3	8.4
3 to 5	26.4
5 to 10	38.1
More than 10	27.1

These findings suggest that even the most timely telephone system may need to be supplemented with radio advisories or changeable message signs because the telephone information will in many cases be more than 10 min old when drivers reach their vehicles.

General Information

Three hundred and twenty-seven persons from 7 downtown Dallas businesses responded. Twenty-four persons were deleted because they did not meet the criterion of using a Dallas freeway. Thirteen respondents indicated that they would never use the service, and they omitted several questions that presumed use of the service. Their responses were included in the results. Table 2 gives a breakdown of the number of respondents in each of the 7 groups.

Table 3 gives a summary of the respondent sex, age, and education characteristics. The sample consisted of an approximately equal male-female division; the age range of 25 to 44 years had the most subjects. As expected, the respondents were well educated.

RECOMMENDATIONS

The following design and operational recommendations will be evaluated in phase 2 of this study:

Table 2. Number of respondents.

Group	Number Used	Deleted	Incomplete
1	36	3	1
2	49	5	3
3	33	3	1
4	62	3	0
5	35	5	2
6	45	6	3
7	43	1	3
Total	303	24	13

Table 3. Sex, age, and education of respondents.

Item	Number	Percent
Sex		
Male	167	55.1
Female	136	44.9
Age		
24 or younger	46	15.2
25 to 44	199	65.7
45 or older	58	19.1
Education completed		
Grade school	0	0.0
High school	86	28.4
Business college or trade school	23	7.6
Two years of college	49	16.2
Senior year of college	101	33.3
Graduate or professional school	44	14.5

1. Telephone messages should include the 6 major traffic descriptors preferred by the urban motorists.
2. When there is no incident, construction, or maintenance, the first information should be on the level of congestion (heavy, moderate, light), and the location of the heaviest congestion should be expressed in terms of 2 cross-street names.
3. Both inbound and outbound conditions should be given, but the information of greater demand should be given first, that is, inbound in the mornings and outbound in the afternoons. Busy listeners then can decide whether to continue listening after their informational needs are satisfied. Those times when there are no incidents on the freeway should be mentioned also.
4. When an incident has occurred, this information takes priority. Its general nature (stalled car, accident, unidentified blockage) should be identified. Its exact location, whether it is inbound or outbound, and the lanes blocked should be mentioned. Locations should refer to the nearest cross streets. Lanes blocked should be referred to as right, middle, or left (inside or outside are ambiguous terms).
5. The message should indicate how far the traffic is backed up and the estimated duration of the blockage in minutes. The latter information should be updated whenever there is any change in status, such as when a wrecker appears on the scene. Both information on the onset of the stoppage and delay information should be updated as often as possible.
6. When an incident occurs, the message should also indicate recommended alternative routes and entrance ramps. Motorists should be told where they should leave the freeway to avoid an incident. If the freeway is quicker than other alternatives, this advisory should be given.
7. The traffic advisory should indicate when an incident has been removed and traffic congestion begins to subside. It should also state how far traffic is backed up and level of congestion. Repeating which lane was blocked is desirable because the backup may still be greater in this lane.
8. Messages for morning and afternoon advisories during peak periods should be similar in format.
9. The message for off-peak periods will be similar to peak periods with no incidents.
10. Although the greatest demand from commuters on Monday through Friday will be between 6 and 9 a.m. and 4 and 7 p.m., the system should operate during off-peak periods throughout the day. When the system is not in operation, a taped message should provide this information.
11. The success of the operation depends on the brevity of the messages because demand on the telephone system will come primarily during 2 short periods each day. Messages should never exceed 60 s and normally should be held to 15 to 20 s. There should be enough extensions that a caller does not receive a busy signal during peak periods.
12. The messages should be delivered by trained speakers with easily understood voice qualities and diction. They should emphasize the key words in the messages.

13. A brief introductory statement is recommended to inform the listener about 4 key pieces of information: (a) the traffic advisory itself, (b) the expressway to which it applies, (c) that the information is based on traffic control center data, and (d) the time the data were last updated. An example would be: This traffic advisory for the North Central Expressway is based on traffic control information received at 7:25 a.m. The time of update assures the listener that the message is current and can be relied on. The listener should not be delayed by lengthy acknowledgments on who provides the public service.

SUMMARY

The city of Dallas at present is installing a dial-in telephone system to provide motorists with real-time information on North Central Expressway traffic conditions. The objective of this study was to determine from a large sample of urban freeway motorists the types of messages that they felt should be transmitted and other requirements for system design. The major findings of the questionnaire are as follows:

1. The types of traffic descriptor information ranked most important were location and degree of congestion, recommended alternate routes, whether a lane was blocked, and reason for congestion. Fifty percent or more of the respondents stated that they preferred this form of information. Expected delays (minutes of time lost) and time saved by taking other routes were next in importance. Little interest was shown in estimated travel time to destination, recommended safe speeds, or expected average speeds.
2. Seventy-five percent of the sample stated that they would use the service often or occasionally. About 93 percent stated that they would use it 1 to 10 times per week. Fifty percent of these would use it both mornings and afternoons. Twenty-five percent would use the service only in the mornings; the other 25 percent would use it only in the afternoons.
3. Peak demand for the service was from 6 to 9 a.m. and 4 to 7 p.m. Little interest was reported in weekend and evening service.
4. Half of the respondents stated that they would not dial again if the service line was busy. This underscores the importance of the user's time and the need for multiple extensions and brief call times.
5. Over 70 percent of the sample listen to radio traffic reports at present, but 25 percent stated that the reports were not timely or accurate. This finding supports the need for real-time information.
6. A telephone system needs to be supplemented with radio advisories and changeable message signs because the telephone information often will be more than 10 min old when the motorist reaches his or her vehicle.
7. The respondents consisted almost entirely of freeway drivers, 55 percent of whom take the North Central Expressway and 85 percent take the freeway more than 5 times a week.
8. The sample contained an approximately equal number of men and women. Ages of most respondents ranged from 25 to 44 years. Their educational level was well above the high school level, and almost half claimed a college education.

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The contents of this paper reflect the views of the authors who are responsible for

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REFERENCES

1. C. L. Dudek and J. D. Carvell. Feasibility Investigation of Audio Modes for Real-Time Motorist Information in Urban Freeway Corridors. Transportation Institute, Texas A&M Univ., Dallas Freeway Corridor Study, Rept. RF 953-8, April 1973.
2. C. L. Dudek, J. D. Friebele, and R. C. Loutzenheiser. Evaluation of Commercial Radio for Real-Time Driver Communications on Urban Freeways. Highway Research Record 358, 1971, pp. 17-25.
3. C. L. Dudek and H. B. Jones. Real-Time Information Needs for Urban Freeway Drivers. Texas Transportation Institute, Texas A&M Univ., Research Rept. 139-3, Aug. 1970.
4. K. W. Heathington, R. D. Worrall, and G. C. Hoff. An Analysis of Driver Preferences for Alternative Visual Information Displays. Highway Research Record 303, 1970, pp. 1-16.
5. H. W. Case, S. F. Hulbert, and J. Beers. Research Development of Changeable Messages for Freeway Traffic Control. Univ. of California, Los Angeles, UCLA-ENG-7155, Aug. 1971.