sit, strong incentives will be required.

Table 4 summarizes the impacts of various constraints to automobile use on potential bus ridership. Of the energy-environmental constraints listed in the attitude survey, the measures with the strongest impacts reflect gasoline cost or supply. Parking-related measures, with or without free bus service, had little impact on respondents' choice of mode unless coupled with a gasoline price increase or rationing.

1. Gasoline related—The most effective single public policy incentive to transit use would involve increasing the price of motor fuel to over $0.25/L ($1.00/gal) in 1975 dollars. This incentive could be implemented through a federal motor fuel tax comparable to those levied in most Western European countries. The revenue from such a tax might be used to reduce other federal taxes or might be rebated to the cities and counties where the taxes were collected, in order to reduce their property tax burdens.

Gasoline rationing that set a 40-L (10-gal)/week limit on driving would also have a strong impact on transit use. However, rationing involves many more administrative and enforcement costs than do fuel-tax measures, which can be collected from relatively small numbers of refiners and distributors.

2. Parking related—Parking surcharges were seen as much less effective than fuel taxes or rationing as incentives to transit use. An increase in parking fees of $1.00/d in 1975 was seen as influencing modal choice by less than 1 percent of the survey respondents who indicate a willingness to change mode in response to public policy measures. To be effective in diverting automobile users to transit, parking surcharges would have to be coupled with motor fuel constraints.

CONCLUSIONS

The Greater New Haven Transit Study research used a relatively simple, unsophisticated questionnaire and analysis to point the way to a public transit service with increased consumer marketability. Its methods and findings have potential application for transit service planning in medium-sized communities throughout the United States—in adapting service to tap markets, developing transportation-system management programs, and restraining automobile use.

The survey showed that existing transit riders have much lower expectations about bus service attributes than do automobile drivers. Thus, radically improved service concepts and levels will be necessary to divert motorists to transit use and may be feasible only in selected corridors. If energy, environmental, or public policy considerations require large-scale diversions of commuters to transit, then selected automobile disincentives may be necessary. Increased motor fuel taxation appears to be a more effective disincentive than parking taxes and controls, at least in medium-sized cities.

REFERENCES

1. Greater New Haven Transit Study. Wilbur Smith and Associates, May 1956.
2. Demand Estimation Techniques—Haddonfield Dial-a-Ride. Wilbur Smith and Associates, New Jersey Department of Transportation, May 1974.
3. K. W. Kloeber and S. M. Howe. Marginal Weighting Procedures for Expanding Small Sample Surveys. New York State Department of Transportation, Albany.

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Abridgment

Marketing Approach Using Product Diffusion Knowledge to Measure Consumer Transit Attitudes

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This paper suggests a method that can be used to develop a measuring instrument that will (a) determine specifically why shoppers do not use the urban bus system, and (b) be sufficiently sensitive to identify whether the problem is a bus system design problem or a promotion problem.

A measuring instrument that provides these capabilities could be used by transit marketing managers to more effectively allocate their resources toward the goal of increasing bus patronage. Marketing managers will always be constrained by limited resources. Consequently, they must decide how to allocate corporate funds so as to maximize the return on their investment. Transit marketing managers are expected to make trade-offs between (a) methods of removing the barriers to adoption of the bus system, (b) the capital investment required to effect their removal, and (c) the number of potential customers who would be affected by the removal. The measuring instrument should be capable of providing information on all of the items used in the trade-off except the capital investment. The instrument should be capable of identifying the barriers to adoption, of determining whether those barriers can be removed by advertising alone or whether system redesign is also required, and it should be capable of identifying the number of individuals affected by each barrier identified.

THEORETICAL CONSTRUCT

Communication knowledge, integrated by Rogers and Shoemaker (1, pp. 102 and 158), was used as the theoretical construct to identify the criterion and predictor variables of a measuring instrument with sufficient sensitivity to meet these objectives. The theoretical construct used to obtain the predictor variables assumes that adoption rate is a function of perceived attributes of innovation, the type of innovation decision to be made, the nature of the social system, and the extent of change agents' promotion efforts. Only perceived attributes need to be measured since the other variables can be assumed to be constant or can be constrained by the sampling procedure.

The nature of the social system can be constrained by selecting only one market segment for participation in a study. The market segment used in this study consisted of middle-class, suburban women shoppers. This particular segment was selected because it is the key to using bus capacity more efficiently during off-peak hours. At present, buses run almost empty when work commuters are not using them. The other variables—the type of innovation decision used, the type of communication channels used, and the extent of change agents' promotion efforts—are also assumed to be constants.

The theoretical construct used to obtain criterion variables is discussed by Schwartz in another paper in this Record. The construct connotes that an individual passes through a number of stages prior to adopting or finally discontinuing (or both) the use of a product or service. Individuals within each of these stages have been categorized as nontriers, triers, rejecters, adopters, and discontinuers of the bus system. The reasons that urban transit has not been tried, the causes of rejection, and the causes of discontinuance can be determined by randomly measuring and comparing the extent to which individuals in the various stages of the decision process perceive that urban transit possesses specific attributes.

QUESTIONNAIRE DESIGN

The questionnaire developed here has several attributes that differ from most previous questionnaires used to determine the barriers to the adoption of transit. First, it is targeted toward the very specific market segment of middle-class female shoppers. Second, the independent variables are developed from Rogers' five perceived attributes of innovation. Third, the independent variables are designed to be very product specific. Fourth, the dependent variables operationalize five of the stages of the Rogers and Shoemaker individual innovation decision process (1, p. 102).

The taxonomy to develop pertinent and product-specific questions to be asked of respondents was based on the Rogers and Shoemaker perceived attributes of innovation (1, p. 158) (relative advantage, compatibility, complexity, observability, and trialability) to ensure that they were adequately represented in the questionnaire. When they were not adequately represented by transit attributes studied previously, new questions were formulated.

Bus transit was treated as the entire system and not as only the bus when these attributes were developed. Obtaining bus route information and traveling to the bus stop are as much a part of the bus system as are the attributes of the bus itself.

The final list of attributes is shown by Schwartz in another paper in this Record. These attributes were converted to questions and scaled using a five-point semantic differential. Possible answers ranged from not at all to extremely. Observability was the only variable that was not directly measured by an interval scale (for purposes of this study, the semantic differential was assumed to be intervally scaled). It was measured instead by an I don't know category. If a respondent indicated I don't know for an attribute, it was assumed to mean that she had not observed it or that she did not remember having observed it (which is the same thing as not having observed it in a study that assumes that decisions are made cognitively).

VALIDATION OF THE QUESTIONNAIRE

Validation of the measuring instrument was obtained by using factor analysis, Student's t-test, chi-square tests, discriminant analyses, and classification analyses to ensure that the attitudes measured by the questionnaire conformed to the theory on which the questionnaire was based.

Validation by Factor Analysis

A factor analysis using the varimax method was performed to determine the extent to which three of the five attributes of innovation—relative advantage, compatibility, and complexity—were represented by clearly identifiable factors in the minds of respondents. Observability was not included in the analysis because it was measured in a different manner from the other attributes. Willingness to try was not included because it was used in this study as an effect rather than as a cause. (This study attempted to determine why shoppers did not use the bus on a trial basis rather than determining the extent to which shoppers preceived the bus to be triable.)

The factors obtained indicate that respondent thought patterns fall into factors that can be interpreted as relative advantage, compatibility, and complexity. The concepts of compatibility and relative advantage were represented not by one factor, but by several factors, each reflecting a different facet of the attribute. For example, compatibility consisted of several factors that included (a) compatibility of the bus with culturally derived structural needs such as shopping with friends, combining shopping with other social activities, and time orientations; (b) compatibility of the bus with aesthetic, proxemic, and comfort needs such as closeness of the bus seats, the odor of the bus, the dirtiness of the bus, the bumpiness of the ride, and the possibility of having to stand while on the bus; and (c) compatibility of the bus with societal needs such as reducing air pollution, traffic congestion, and highway accidents and conserving natural resources.

Relative advantage consisted of several factors including the speed of the car as compared to that of the bus, the cost of taking the bus, the inconvenience of going to or from the bus stop, the risk of criminal assault, and the convenience of not having to park a car.

Complexity consisted of one factor that was composed of the inconvenience of finding out which bus to catch and where and when to catch it, the difficulty of obtaining bus route information and bus schedules, the difficulty of understanding route maps, the difficulty of identifying the proper bus to board, the difficulty of finding out where to catch the bus when shopping, and the difficulty of remembering bus numbers, bus stops, and bus schedules when shopping. The factors obtained in this analysis support the validity of the measuring instrument.

Validation by Student's t-Tests and Chi-Square Tests

To determine whether adopters are significantly more probus in their perceptions of 60 attributes of the bus system than are nontriers, rejecters, and discontinuers, either in combination or alone, Student's t-tests and chi-square tests were used to test the following null hypotheses: (a) Adopters of the bus system for shopping are not significantly more probus than are nonusers (nontriers, rejecters, and discontinuers), either in combination or alone; (b) adopters of the bus system for any purpose are not significantly more probus than are nonusers (nontriers, rejecters, and discontinuers), either in combination or alone; and (c) attributes of the bus system are not significantly more observable to users of the bus system (adopters, occasional users, and triers) than they are to nontriers of the bus system.

The first two hypothesis tests on a sample of 159 respondents resulted in the following percentage of attributes for which adopters of the bus are significantly more probus than are nonusers:

Group	Percentage of Attributes
Adopters versus nonusers for shopping	53
Adopters versus nonusers for any purpose	60
Adopters versus nontriers for shopping	50
Adopters versus nontriers for any purpose	35
Adopters versus rejecters for shopping	30
Adopters versus rejecters for any purpose	35
Adopters versus discontinuers for any purpose	27

At a 0.001 level of significance, all of the null hypotheses were rejected. There were no attributes for which nonusers were significantly more probus than adopters. Adopters were significantly more probus for relative advantage, compatibility, and complexity attributes than were nontriers, rejecters, and discontinuers, either in combination or alone. There was not one bus system attribute for which nonusers of the bus system were significantly more probus than were adopters of the bus system, either for shopping or for nonshopping purposes.

The third hypothesis was also rejected. At the 0.05 level of significance 92 percent of the attributes were significantly more observable to users of the bus for shopping than they were to nontriers of the bus for shopping. None of the attributes was more observable to nontriers than to users of the bus system.

Validation by Discriminant and Classification Analyses

To determine the degree of sensitivity of the measuring instrument to differences between adopters and nonusers, discriminant and classification analyses were performed. One attribute from each of the five factors was selected by trial and error for incorporation into the discriminant and classification models. The classification analysis results indicated that 85.7 percent of the respondents can be correctly classified by their perceptions of bus system attributes.

The canonical correlation squared was used to estimate the proportion of variance of bus user or nonuser behavior explained by the attributes of the bus system. Forty-six percent of the variance between adopter and nonuser behavior can be explained by the five attributes selected for inclusion in the discriminant model. These results are acceptable for the purpose of validating the questionnaire, especially since the number of discriminating variables that could be incorporated into the model was limited by missing data constraints.

CONCLUSIONS

The measuring instrument developed and tested in this paper can be used to

1. Identify why many consumers have never tried to use an urban bus;
2. Identify the specific causes for consumer rejection after having tried the bus;
3. Identify the specific causes for consumer discontinuance after having adopted the bus for an extended period of time;
4. Identify why occasional users do not use the bus more frequently;
5. Identify whether individuals who are trying to use the bus are predisposed to become adopters or predisposed to become rejecters of the bus system;
6. Determine which barriers to adoption of the bus system can be removed by promotion alone and which require system redesign; and
7. Assist in determining how to best allocate resources in order to increase bus patronage.

REFERENCE

1. E. Rogers and F. F. Shoemaker. Communication of Innovations. The Free Press, 1971.

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