Seating Space Group

$$C_{seat} = 1 + [0.0077\,(63 - w)^2 + 0.16\,(30 - l)^2]^{1/2} \quad (\text{for } 30 < w \leq 63 \text{ and } 18 < l \leq 30) \qquad (C)$$

Appendix B: Nomenclature

- a = Acceleration
- C = Comfort rating on a seven point scale
- dB(A) = A-weighted noise level, dB
- E = Event (a given ride situation)
- g = Acceleration of gravity, 9.8 m/s²
- h = Rate of change of altitude, m/min
- l = Seat legroom, cm
- p = Roll rate, deg/s
- s = Satisfaction
- T = Temperature, °C
- V = Indicated air speed, knots
- w = Seat width between armrests, cm
- γ = Flight path angle, deg
- δ = Kroneker delta
- θ = Pitch angle, deg
- σ = Standard deviation of acceleration, g
- ϕ = Roll angle, deg

Subscripts

- cm = Compound maneuver
- dc = Descent or climb maneuver
- E = Event
- env = Environmental (factors other than maneuvers and seating)
- h = Rate of change in altitude
- l = Longitudinal direction
- man = Maneuver
- max = Maximum
- mot = Motion
- no = Noise
- po = Pitchover
- seat = Seating space
- T = Temperature
- t = Transverse direction
- trip = Total trip
- turn = Turning maneuver
- v = Vertical direction
- z = Normal direction to cabin floor

Appendix C: Flight Profile

An example of a more complex flight profile composed of maneuvers and straight/level flight can also be obtained from the SEGMENT program. As will be shown, there are 21 ride segments, 11 of which are straight/level flight. This profile represents a typical flight with maneuvers at the beginning and end for take-off and landing. There are also maneuvers in the middle of the profile for the altitude change. The flight profile is summarized below:

Segment	Segment Description
1	Maneuver--steady descent/climb
2	Maneuver--compound maneuver
3	Maneuver--longitudinal deceleration with pitchover
4	Maneuver--simple turn or S-turn
5-10	Straight-level flight--terrain flat; altitude = 5000 ft
11	Maneuver--steady descent/climb
12	Maneuver--steady descent/climb
13-17	Straight-level flight--terrain water; altitude = 5000 ft
18	Maneuver--simple turn or S-turn
19	Maneuver--longitudinal deceleration with pitchover
20	Maneuver--steady descent/climb
21	Manuever--steady descent/climb

Since all the segments must be of equal time duration, a common denominator for the time of a segment must be found. For example, the maneuver or straight/level flight with the shortest duration could be picked as the denominator if all other periods of flight characteristics are integer multiples of this segment.

Structural Models of Attitude-Behavior Relations for Intercity Rail Travelers

PETER M. ALLAMAN AND TIMOTHY J. TARDIFF

The interrelationship of various attitude and behavioral measures of intercity rail travel within a simultaneous equation, multiattribute formulation is examined. The overall structure of perception influencing preference, preference influencing activity, and activity influencing perception has been established, although not for all dimensions of user evaluation. Satisfaction with the schedule, cost, speed, and physical design of the train seems to be the most important determinant of an overall positive evaluation of train travel, although the social environment inside the car and pretrip experiences also have an impact. Overall evaluation of train travel has a positive relationship to frequency, and frequency in turn influences satisfaction with schedule, and (very slightly) perception of the physical dimension of train travel. Satisfaction with schedule is influenced not only by frequency of travel but also by travelers' general evaluation of the train regarding cost, schedule, and comfort. Satisfaction with design aspects of the train is influenced by perception of the physical qualities of the ride, as well as perception of the train's comfort. The image of the train tends to influence evaluation of the food and facilities available on the train. The major negative finding is the lack of significance of frequency in predicting more aspects of traveler perceptions or dimensions of satisfaction, in contrast to its pivotal role for urban travel. These results indicate the role of traveler style, demographics, and trip characteristics in the formation of perceptions, the translation of perceptions into specific dimensions of satisfaction, and the translation of these components of satisfaction into overall effect and frequency. The use of a methodology such as this can aid decisionmaking for service offerings, advertising campaigns, and design studies.

Over the past few years, transportation planners and researchers have been exploring ways to integrate consumer needs into the design process. A prime motivating factor behind these efforts has been the desire to make cost-effective trade-offs among system features. Implicit in this approach is the assumption that the quality of trade-off decisions required in designing these systems may be improved by a fuller understanding of which system features are important to users. There is a general consensus among researchers that it is necessary to obtain

consumer ratings about the characteristics of systems. However, there is disagreement about how to combine these ratings of features with user demographic characteristics and other data into a theory of travel behavior.

This paper presents one form of a multiattribute, non-recursive system of equations. This system links the perceptions, preferences, and behavior of intercity rail travelers with their demographic characteristics and trip characteristics. The approach has its origins in similar studies performed in the urban travel field (1-3). These studies and others (4-6) have demonstrated the importance of attitudinal variables for transportation research. In addition, the existence of feedback relationships between attitudinal variables and behavior has been investigated (1-3). Not only are the users who rate features more favorably more likely to use the system frequently, but frequent users of the system are likely to rate its features more favorably. This implies that attitudes affect behavior and, in turn, behavior affects attitudes. In addition, it has been shown that user preferences constitute more than a simply weighted combination of ratings of features. That is, user preference predicts frequency of use over and above the predictive ability of perceptions of a system's particular features.

The present study extends this approach in two principal directions. One emphasis is to establish more clearly the nature and determinants of user preference (termed "modal effect") and its relationship to other attitudinal and demographic variables. This will not only enlarge our understanding of this theoretically important variable, but will also enable us to focus on the design and evaluation of transportation services in a manner consistent with the desires of users or potential users.

The second principal focus of this paper is on Amtrak intercity rail travel. The approach is to apply the theory and methods developed within the context of urban travel to a study of intercity travel by a particular mode and for an organization that must design its service offerings to suit the needs of its clientele. Such an approach will test the robustness of the concept across domains of content (urban versus intercity travel) and is intended to develop conclusions relevant to the planning needs of an organization that is providing these services.

As in all marketing research, two approaches are possible to transportation research. One is a dollars-to-sales approach that concentrates on inducing current travelers to travel more and on attracting new travelers who are most like current users. The contrasting dollars-to-opportunity approach concentrates on winning over the users of other modes of transportation. This study adopts the first approach--the emphasis is not on mode choice but rather on dimensions of user satisfaction. To focus on mode choice is to examine aspects of service that are applicable to the comparative desirability of alternative modes, whereas this study seeks information on effective service designs for a particular mode. This affects both the populations of interest for study and the applications of the resulting information. Rather than focusing on the entire traveling population, this study emphasizes specific groups of users and a specific mode.

MODELING ORIENTATION

The conceptual structure from which this work draws is discussed in detail elsewhere (7,8). The general structure is discussed briefly here. Demographic variables are seen as influencing traveler attitudes; these attitudes (or evaluations), both general and specific, then determine a traveler's liking (or effect) toward the service offerings. This liking is then hypothesized as determining travel frequency. Travel frequency is assumed to determine attitudes. This feedback relationship may be stronger for some types of attitudes than others. The fundamental point, however, is that not only do attitudes influence the behavior of travelers, but this behavior itself may also act to influence attitudes. Most commonly, this occurs when users gain a greater familiarity with the service and modify their attitudes accordingly. Other mechanisms may be involved as well. The purpose of this research is not to clarify the sociopsychological mechanisms that produce such feedback relationships, but simply to investigate whether they exist or not, and their relationship with other attitudinal constructs.

DATA SOURCE

A series of focus groups was conducted to generate an understanding of the problem and to aid in questionnaire development. The data used for the modeling came from approximately 2200 questionnaires administered on various parts of the Amtrak system in the summer and early fall of 1980. The questionnaire was one that respondents completed on board the train and implemented the major aspects of the modeling approach set forth above.

The trains sampled and the returns received are given in Table 1. Six train types and potential trip distances of between 3 and 50 h are included in the sample. The interviewing was conducted by Amtrak personnel. Interviewers boarded the trains at prearranged points and passed out the questionnaires according to the sampling design. A set of instructions was supplied in order to standardize the procedures. Questionnaires were gathered on six different types of equipment operating on the system: Superliner, Metroliner, Turboliner, long-distance steam, headend power, and Amfleet equipment. Each is distinctive in some way.

The Superliners are bilevel cars that have many amenities and boast a new image. The facilities are such that one can envision taking a long-distance trip across country purely for the enjoyment of the trip and not for some more practical purpose. The Metroliner runs between Washington, D.C., and New York City in the heavily traveled Northeast Corridor. Its service characteristics and equipment characteristics are distinctive, as is the image that is promoted. The Turboliner sampled is a turbine-powered train that runs between New York City and Syracuse, New York. The relatively short distances of these last two types bias the ridership toward business travel.

The long-distance steam cars are the older cars that have been used on the system for several decades. Their heating and cooling systems are powered by steam, which tends to be less reliable than the more modern "headend power" arrangement. However, they are very comfortable cars, designed for long-distance travel. Headend power cars are completely renovated and derive their heating and cooling power from a power car at the head of the train, a more reliable technology than steam. Although renovated from the same chassis as the long-distance steam cars, they are modern cars. The Amfleet cars are newly developed and are also used on a good part of the system. They have different ride characteristics from the others, but offer modern amenities and a new image.

STRUCTURAL SYSTEM

The overall concept previously described was imple-

Table 1. Returns by equipment type and route.

Equipment Type	Train Name	Route	Distance (miles)	Scheduled Time (h)	Avg Speed (mph)	Returns Obtained
Superliner	Empire Builder	Seattle-Chicago	2281	49:34[a]	46	664
Amfleet	Palmetto	Savannah-New York	828	15:45	53	212
	Inter-American	Houston-Chicago	1333	20:05[b]	46	208
Total						420
Steam cars	Silver Meteor	New York-Miami	1379	26:25[b]	52	122
	Crescent	New Orleans-New York	1378	30:59[b]	44	112
	Southwest Limited	Los Angeles-Chicago	2240	43:35[a]	51	111
Total						345
Headend power	Broadway Limited	Chicago-New York	909	20:48[b]	44	213
	Lake Shore Limited	New York-Chicago	959	19:55	48	170
Total						383
Turboliner	Salt City Express	New York-Syracuse[c]	286	5:10	55	190
Metroliner	Metroliner	New York-Washington[c]	224	3:45	60	182
Total returns						2184

[a]Two-night trip. [b]Overnight trip. [c]Sampled in both directions.

mented as a set of 12 simultaneous equations. The general perceptual attitudes are represented by four scales. Specific perceptions and components of preference are represented by the six satisfaction scales. Effect is represented by the answer to the question: "Overall, how satisfied are you with your train trip today?" Frequency of travel is a function of preference and in turn is a predictor of the general perceptual attitudes. Two-stage least squares were used to estimate the interrelationships among the jointly dependent variables.

SATISFACTION SCALES

The six dimensions of user satisfaction were developed from 32 items by factor analysis. Two factors measure aspects of service provided before the trip or at the beginning of the trip. One dealt exclusively with pre-trip assistance, correlating highly with luggage assistance and assistance in boarding. The other related to trip cost and terminal access. Clean and safe terminals had a marginal correlation with both of these factors.

The third factor had more to do with the speed and performance of the train, as the highest loadings were obtained for on-time performance and speed of the trip. The fourth factor correlated highly with the measures relating to food service and on-board facilities. The price of food, the quality of food service, clean restrooms, and facilities for washing up and comfortable sleeping correlated highly with this factor.

Two factors represented the on-board environment. One related primarily to the social environment on board, as well as the service provided by on-board personnel. Indeed, the highest loading variable was service to passengers, followed by friendliness of other passengers, friendly and helpful train personnel, as well as passing interesting scenery, and information provided on board. The final factor related to the physical environment and design of the cars. Variables with high loadings included amount of space per passenger, comfort of the seating area, choice of places to sit, interior design of the car, luggage storage areas, a feeling of luxury, and amount of privacy available. Other variables that had moderately high loadings included temperature and ventilation, separation of smoking and non-smoking areas, and provisions for comfortable sleeping.

GENERAL PERCEPTIONS

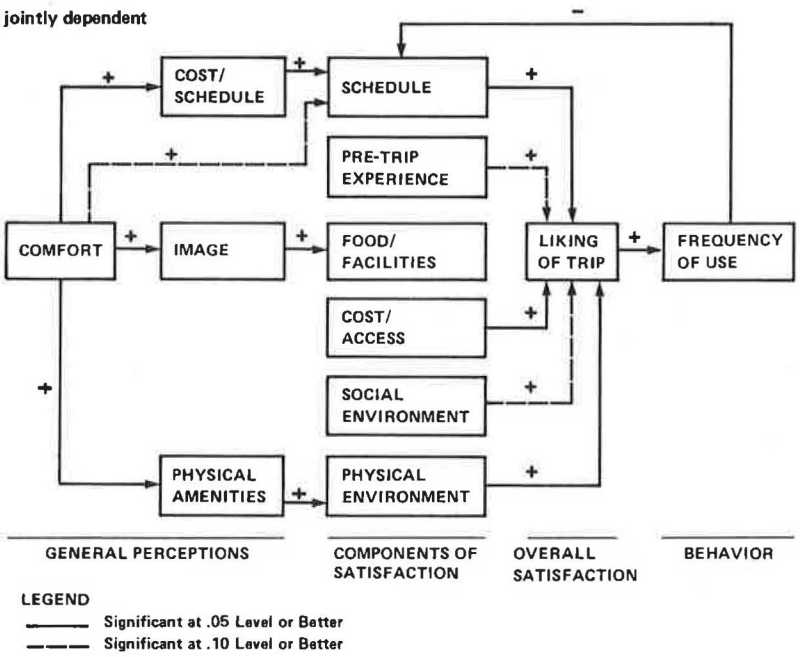
Perceptions of train travel for trips like the current trip were assessed by means of a factor analysis of 15 semantic differential items. The first factor relates to physical aspects of the trip, such as cleanliness, noise, comfort, and amount of space, as well as evaluative items, such as the trip's being pleasant and impersonal. The second factor dealt more with the image of the trip, such as being interesting, smooth, uncrowded, and fashionable. The third factor related to aspects of service, such as reliability, expense, convenience, and speed. The three general perceptions were thus physical amenities, image, and cost/schedule aspects. Finally, a comfort score was developed from the standardized scores to seven comfort items.

There are a large number of independent variables used in the system. These include variables dealing with aspects of service such as trip time (total trip time as well as the period of time from the beginning of the trip up to the time of the interview), trip and terminal access mode, time, and problems. The alternative mode (plane or car) for this trip is also represented, as is the equipment type on which the traveler is making the trip. Attributes of the trip include trip purpose, number in the party, and type of party, including whether the traveler is alone or traveling with children. The traveler's age, family income, employment status, educational attainment, and household type are also included in the models. Except for length of time on the train, number of pre-trip troubles, access time, and number in party, all of the above variables are dummy variables for the presence or absence of the characteristic.

TRAVEL STYLE

Another aspect of travelers is their travel style, or how they approach the travel experience; these are represented as continuous variables. Riders' approaches to and views of the travel experience were explored with a series of 26 items in a Likert scale format. The set of questions was developed from analysis of focus group responses and, to a limited degree, from other questionnaires. The set of questions is similar in purpose to "attitude, interest, and opinion" batteries used in psychographic research; however, the set of questions used here is oriented specifically to dimensions of travel style and is not related to other aspects of consumption, as are the typical psychographic batteries. These

Figure 1. Structural system: interaction of jointly dependent variables.



questions, with some modification, could be used to study the travel style of users on any mode. Indeed, the focus group results suggested that users of different modes would score differently on these dimensions, although that is a topic for future research.

The first factor appears to be a sociability factor, having high correlation with enjoyment of being seated next to a stranger and, usually, starting a conversation when traveling. The second factor, labeled "destination orientation," consists of strong agreement with the statement, "Getting to my destination quickly is very important to me." It also encompasses a tendency to be in a hurry or to become upset when the schedule is not met. Third was a family orientation factor, accounting for people with travel plans dependent on others in the household and leading lives centered around others in the household or family. The fourth factor represented a Spartan travel style, characterized by packing only essentials and not demanding much when traveling. The fifth factor measured the amount of peer support or pressure experienced in the respondent's social environment either through friends' behavior or reactions to train travel. The sixth factor related to the dining style that respondents preferred, either eating a hot, sit-down meal on the train, or bringing one's own food on board the train. The seventh factor indexed the respondents' travel orientation, involving a willingness to enjoy the trip for its own sake, rather than as a means to an end. The eighth factor related to a tendency for the respondent to spend the time alone when traveling, not traveling in a group, and leading a hectic life. The final factor had a high correlation with the variable, "The best kind of trip is one without many plans." This measures orientation toward trip planning.

Jointly Dependent Variable Interrelationships

The interrelationships among the jointly dependent variables are displayed in Figure 1. This figure summarizes the coefficient estimates.

It is natural to begin with the determinants of the overall liking of the train trip (effect). Three of the factors are strongly related to user preference. These include satisfaction with cost and access, satisfaction with schedule, and satisfaction with the physical environment in the cars. Pre-trip experiences and the social environment on board are also marginally related to overall satisfaction, and satisfaction with food and facilities bears little relationship.

Preference has a strong positive relationship to frequency of taking the train in the past year for this type of trip. Frequency itself is significantly related (negatively) only to satisfaction with the schedule. Whether this lack of relationship is due to statistical reasons inherent in the estimation procedure or to an actual lack of relationship could not be determined in the research.

Although frequency of use is not related to the general perceptual factors, perception of comfort is. A high evaluation of comfort is associated with a positive evaluation of physical amenities. Comfort is positively related to the second factor, which represents a positive image perception of train travel as being interesting, smooth, uncrowded, and fashionable. Comfort is related to a positive evaluation on the third dimension, which measures the reliability, expense, convenience, and speed of train travel. Comfort thus plays a pivotal role in these models.

The general factors are related to several of the components of satisfaction as well. Evaluation of comfort and the general evaluation along the cost and schedule dimension are both related to satisfaction with the schedule. The positive image perception of the train as being interesting, smooth, uncrowded, and fashionable is positively related to the satisfaction with food and facilities. Finally, the perception of the train as possessing physical amenities is significantly related to satisfaction with the physical design and environment dimension of satisfaction factors.

It would appear that on-time performance is a very important component of the attitude-behavior feedback relationship; however, this component is supplemented by aspects of the physical and social environment aboard the train.

Contributions of Independent Variables

A listing of significant variables for the satisfaction component equations is reported in Figure 2; those for the other variables are found in Figure 3. The variables for the jointly dependent variables are represented in Figure 1 and have been discussed in the previous section, but they are also presented in Figures 2 and 3. This section describes primarily the other influences identified

Figure 2. Significant variables in satisfaction equations.

Schedule	Pre-Trip	Cost-Access	Food & Facilities	Social Environment	Physical Design
Frequency (-) Cost/Schedule General Perception (+) Time Onboard (-) Superliner (+) Age 25-54 (-) Age over 64 (-) Some College (+)	Amfleet; Headend Power; Steam (+) Age over 64 (+) Pretrip troubles (-)	Alternative Mode Plane (+) Superliner (+) Amfleet, Headend Power; Steam (+) Age over 34 (+) Number of pretrip troubles (-) Terminal Access Time (-) Income under $15,000 (-) Respondent employed full or part time (+) Spartan Travel Style (-)	Perception of General (+) Image Time onboard (+) Dining Style (+)	Time onboard (+) Superliner (-) Amfleet; Headend Power; Steam (-) Female (+) Family with Children (-) Number in party (+) Sociability Travel Style (+) Dining Style (+) Spartan Travel Style (+) Travel Orientation (+)	Perception of Physical Amenities (+) Time Onboard (-) Superliner (-) Number in Party (-)
Comfort (+) Family income under $15,000 (+)	Alternative Mode Plane (-) Superliner (+) Female (-) Terminal Access Time (+) Access by Public Transit (-) Spartan Travel Style (+)	Alternative Mode Car (+) Traveling with Preschoolers (+) Number in party (+) Dining Style (+)	Superliner (+) Traveling Alone (-) Income under $15,000 (-) Respondent employed part or full time (-) Spartan Travel Style (+)	Work trip (-) Vacation trip (-) Family Orientation (+)	Travelling alone (+) Age 25-34 (-) Destination Orientation (+) Dining Style (-) Peer Pressure (+)

NOTE: "+" denotes positive relationship and "-" denotes negative relationship. Variables above the dashed line are significant at $p < .05$ and those below the line are significant at $.052 < p < .2$.

Figure 3. Significant variables in other equations.

		General Perception Factors			
Modal Affect	Frequency	Cost-Schedule	Image Perception	Physical Amenities	Comfort Perception
Satisfaction with: Cost-Access (+) Schedule (+) Design (+) Non-work Trip (-) Age 55-64 (-) Destination Orientation (-)	Modal Affect (+) Superliner (-) Amfleet; Steam; Headend Power (-) Work Trip (+) Recreation - Vacation Trip (+) Visiting Trip (+) Travelling Alone (+) Income more than $30,000 (+) Destination Orientation (+) Peer Pressure (+)	Comfort (+) Total Trip Time (-) Age over 64 (+) Income under $15,000 (-) Income greater than $30,000 (-) Dining Style (-)	Comfort (+) Time Onboard (-) Female (-) Family Orientation (-) Retiring Travel Style (+)	Comfort (+) Time Onboard (-) Amfleet; Steam; Headend Power (-) Peer Pressure (-)	Amfleet; Steam; Headend Power (+) Female (+) Sociability (+) Destination Orientation (-) Family Orientation (+) Dining Style (+) Peer Pressure (+) Spartan (+) Travel Orientation (+)
Pre-trip Satisfaction (+) Social Environment (+) Travelling with Child under 18 (+) Retiring Travel Style (+)	Female (-) Terminal Access Time (-) Family Orientation (-)	Superliner (-) Amfleet; Steam; Headend Power (-) Pretrip Troubles (-) Access Time (-) Travel Orientation (-)	Superliner (+) Age over 54 (+) Sociability Travel Style (-) Spartan Travel Style (-)	Frequency (+) Superliner (+) Age 18-24 (+)	Preschooler Along (+) Child Under 18 Along (-) Age over 54 (-) Number in Party (-) Income under $15,000 (+)

NOTE: "+" denotes positive relationship and "-" denotes negative relationship. Variables above the dashed line are significant at $p < .05$ and those below the line are significant at $.052 < p < .2$.

from the models. Available space does not permit a presentation of the coefficient estimates themselves; these are available from the authors or in the report (8).

SATISFACTION COMPONENTS

This discussion begins with the six satisfaction factor scores. Each was modeled separately; the results are displayed in Figure 2.

Satisfaction with speed and schedule is a negative function of frequency of travel; that is, the more experience the traveler has with train travel, the less satisfied he or she is with this dimension. However, the more comfortable the ride, and the greater the general perception of cost and schedule, the greater the satisfaction with this specific dimension. Satisfaction with speed declines as a function of length of time on the train but is higher for travelers on the Superliner than for other types of equipment. Low-income persons are more satisfied with this dimension, as are persons who have attended college. With other factors controlled, however, older people are less satisfied with this dimension than younger people.

Pre-trip satisfaction tends not to be related to frequency or aspects of the on-board experience, as one would expect. The best pre-trip experience seems to be associated with Amfleet, steam, and headend power cars and Superliner cars to a lesser extent. Females are very slightly less satisfied with this aspect of travel. However, senior citizens are well satisfied. Travelers with the plane as an alternative mode are slightly less satisfied with the pre-trip experience. Several variables were included to measure aspects of the pre-trip experience directly as related to pre-trip satisfaction. The number of troubles encountered before the trip is negatively related to pre-trip satisfaction, as would be expected. Somewhat paradoxically, the length of time it took travelers to get to the station, the greater the pre-trip satisfaction, although this may signify trouble-free access by automobile. To a slight extent, users of public transportation to the terminal are less satisfied than others, and those who score highly on the Spartan travel scale are somewhat more favorably disposed toward the pre-trip experience.

As with pre-trip experience, the cost and access satisfaction score is not related to either frequency or the general satisfaction variables. Those whose alternative mode of travel is by plane rate the train much more highly on this dimension and those whose alternative mode is by car have a slight tendency to rate the train higher. The Superliner, Amfleet, steam, and headend power cars are rated quite highly on this dimension compared with other types of equipment. Those who have a pre-schooler along on the trip also evaluate this dimension highly, as do persons of middle age and above. Again, the number of troubles encountered is negatively related to satisfaction on this dimension, as is access time. The larger the party, the greater the satisfaction with cost and access. High-income individuals are more satisfied with cost and access than are low-income persons, however, and those who are employed rate this dimension more highly than the unemployed. Of the travel style variables, the higher the Spartan travel score, the lower the satisfaction; the higher the preference for a hot, sit-down meal, the greater the satisfaction with cost.

Although frequency is not related to satisfaction with food and facilities, the general evaluation dimension relating to the trip image is strongly and positively related. Those who have traveled a greater distance tend to rate this aspect of train travel more highly. The Superliner is rated slightly higher than other equipment types for this dimension, while those traveling alone rated it slightly lower than those not traveling alone. The food and facilities are rated somewhat lower by low-income people, perhaps because high-income people are not constrained by price. Employed persons rate the service low. Those who favor a hot, sit-down meal rate the train very highly on this dimension, as do those favoring Spartan travel style.

Travelers' satisfaction with the social environment aboard the train is not affected by frequency of travel, or by perceptions of the physical environment. However, this factor is positively related to length of time on the train, perhaps because of a process of adjustment and getting to know other passengers. Train types other than Metroliner or Turboliner scored lower on this variable. Females were more satisfied with the social environment aboard the train than males. Those in a larger party were more satisfied. However, those traveling with children or those traveling on business or vacation were less satisfied. A number of travel style variables were positively related to satisfaction with the social environment, as might be expected. The stronger variables included the sociability, family orientation, eating, Spartan style, and travel orientation variables.

Satisfaction with the physical design of the cars, again, was not related to frequency of travel but to the general evaluation of the physical environment aboard the train. With regard to train type, satisfaction with Superliners was lowest. Satisfaction with car design deteriorated with length of time on board, but was somewhat more positive for those traveling alone. The larger the number in the party, the lower the satisfaction with car design; perhaps this is because of the two-by-two arrangement on most trains that prohibits large parties from sitting together as a group. People aged 25-34 were slightly less satisfied with this dimension. Three travel style variables were significantly related to design satisfaction. Those who were destination-oriented were more satisfied with the design than those who were not. Those who preferred a hot, sit-down meal were less satisfied with the physical design of the car. Those who perceived support from peers were more satisfied with physical design.

OVERALL SATISFACTION

The other components of the system are detailed in Figure 3. The most important of these variables is effect, the overall satisfaction with the trip itself. This was modeled as a function of all of the satisfaction variables as well as other independent variables. As noted in the preceding section, satisfaction with the schedule, cost, and the physical design were the most important determinants of overall satisfaction. There are weaker contributions from the social environment on board the train and the pre-trip experience as well. In general, satisfaction regarding recreation, vacation, visiting, and personal business trips was lower than for work trips or other types of trips. Families traveling with children under 18 tended to be slightly more satisfied overall. Persons aged 55-64 seemed to be significantly less favorably disposed toward the train, other considerations being equal. Those who were destination-oriented were less satisfied with the train trip overall than those who were not. For the other travel style variable tested, those who scored most highly on the retreatist orientation (spending time alone when traveling) had a weakly positive relationship with overall satisfaction.

TRIP FREQUENCY

Overall satisfaction was used with other variables to predict a frequency of travel for this purpose in the previous year. Overall satisfaction had a strong positive relationship to trip frequency. Those persons on trains outside the Northeast Corridor had significantly lower trip rates than did those riding Metroliner or Turboliner equipment. Likewise, those taking work trips had a significantly greater number of trips than others, although both recreation/vacation and visit/personal business trips were taken with greater frequency than school travel, the omitted category. Females had a slightly lower trip rate than males, and those traveling alone a significantly higher trip rate. There was a slight tendency for those with longer access times to travel less frequently. High-income individuals tended to travel more frequently than others. Regarding travel style variables, persons with a destination orientation and those with peer support traveled more frequently than others. Family orientation had a negative but very weak impact on travel frequency.

GENERAL PERCEPTIONS

The evaluation of cost and schedule aspects of train travel in general is not significantly affected by frequency of travel, but it is affected by perceived comfort. The longer the trip overall, the more negative the evaluation of cost and schedule aspects of the train. Likewise, non-Northeast Corridor trains are viewed in a slightly negative light. Senior citizens rate the cost and schedule aspects of train travel more highly than do other groups. Not surprisingly, a larger number of pre-trip troubles and greater access time promote a slightly more negative evaluation of train travel. Middle-income persons have a more positive evaluation than do lower- or higher-income persons. Of the travel style variables tested, those who favor a hot, sit-down meal and those with a travel orientation are less favorably disposed toward the cost and schedule aspects of train travel.

Frequency of travel has a slightly significant positive relationship to a traveler's evaluation of the physical aspects of train travel--whether it is pleasant, clean, quiet, personal, spacious, comfortable, or the reverse. Apparently, this is a dimension on which the behavioral feedback mechanism has a slight effect. In addition, the greater the rating of the comfort scale, the higher the evaluation of the physical attributes of the train. Having been on the train for a longer time prompts a more negative evaluation, however. The Superliner has a slight positive evaluation, and the other non-Northeast Corridor cars a negative evaluation. Youths have a slightly more positive orientation. Persons receiving peer pressure have a more negative evaluation along this dimension than do others.

The scale that measures image aspects, such as how interesting, smooth, uncrowded, and fashionable train travel is perceived to be, are not subject to behavioral feedback. However, those scoring high on the comfort scale also score more highly on this scale. Persons who have been on the train longer perceive this dimension in a more negative manner. The Superliner is slightly more positively regarded than other train types. Females tend to rate the train lower for this dimension, while older people tend to rate the train somewhat more highly. In terms of travel style, those who score highly on sociability, family orientation, and Spartan orientation viewed the train more negatively than did others, while those who wish to retreat from a hectic life pace viewed the train more positively along this dimension.

The comfort dimension, so important in predicting other evaluations of train travel, is not itself influenced by trip frequency. Amfleet, steam, and headend power cars are seen as somewhat more comfortable than other types. Females view the train as more comfortable than males. There is a slight tendency for those with a pre-schooler along to view the train as comfortable, but there is also a slight tendency for those traveling with family members under 18 to view the train as relatively uncomfortable. Older persons view it more negatively, as do those in larger parties. Low-income persons view the train as comfortable. Although those with a destination orientation view the train as less comfortable, those scoring high on sociability, family orientation, eating style, peer pressure, Spartan style, and travel orientation score the train highly on comfort.

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