Stated and Reported Route Diversion Behavior: Implications of Benefits of Advanced Traveler Information System

ASAD KHATTAK, ADIB KANAFANI, AND EMMANUEL LE COLLETTER

Advanced Traveler Information System (ATIS) user benefits are estimated from a survey of commuting behavior undertaken in the San Francisco Bay Area in 1993. Reported and stated responses to unexpected congestion are used to determine the commuters who would directly benefit from qualitative, quantitative, predictive, and prescriptive ATIS information. Under incident conditions, ATIS quantitative delay information may induce about 40 percent of the commuters to change their route to work, mostly the people with greater diversion opportunities, knowledge of more alternative routes, and lower congestion levels on their best alternative route. The travel time savings achieved by ATIS-induced route diversion (with quantitative information) is calculated and translated into monetary benefits. The value of time used is a function of personal income and of the time savings. The frequency of annual diversion is estimated from the time elapsed since the last incident. The potential annual benefits from ATIS route diversion, applicable to about 40 percent of commuters in the Golden Gate Bridge corridor, range from $124 to $324 per person, depending on the weight assumed for delay.

Advanced Traveler Information Systems (ATIS) are intended to help people make more informed travel decisions. Computerized information systems could support pre-trip decisions, such as departure time, destination choice, and trip chaining sequence, as well as route selection and diversion while en route.

The successful introduction of ATIS in the market depends on the net benefits to users. Time savings achieved when a user changes routes to avoid incident-induced bottlenecks will probably be among the most tangible benefits of ATIS. This study intends to evaluate the extent of such benefits, using the results of a survey about commuting behavior. The survey is used to determine who would divert when prompted to do so by an ATIS device, how these people value their time, how much time they would save by diverting, and consequently, how much they would benefit from a route change.

CONCEPTUAL STRUCTURE AND SYNTHESIS OF LITERATURE

Benefits of ATIS

ATIS benefits can accrue to users and nonusers of the device, as well as to the transportation system as a whole.

User Benefits

The main user benefits of ATIS will be travel time savings from fewer errors when driving in unfamiliar areas and from avoiding unexpected congestion by changing travel decisions such as destination, mode, departure time, route, en route diversion, parking, and trip chaining. There are also many less tangible, but important, benefits:

- Increased knowledge of travel options (e.g., yellow pages information),
- Reduced anxiety—even if travelers do not change their travel decisions,
- Greater likelihood of arriving on time at destination,
- Enhanced ability to avoid congestion,
- Improved ability to communicate during emergencies, and
- Reduced possibility of getting lost.

System Benefits

Transportation system benefits of ATIS may include reductions in trip time, air pollution, and energy consumption, as well as greater safety. System benefits are more than the aggregate of user benefits. Indeed, certain impacts, such as reduced energy consumption, less air pollution, and lower probability of accidents, might be too small to be perceived at the user level but become very important at the system scale.

This study focuses on the *user* benefits of route diversion. Although a wider definition of ATIS user benefits is possible, only time saving for people with access to ATIS devices is considered.

Propensity to Divert

The extent to which user and system benefits of ATIS can be achieved is a function of how travelers respond to information. Researchers have found that drivers are willing to divert in response to prescriptive and descriptive traffic information and that this propensity increases with delays and congestion (*1–7*). In addition, longer trips, fewer traffic stops on alternative routes, and familiarity with alternative routes encourage diversion. Drivers who are young, male, or unmarried are more likely than others to divert.

Studies on diversion behavior conducted so far are insightful, but there is a need to quantify the effect of the type of information provided on drivers' diversion behavior. Is descriptive information enough? Are drivers willing to follow prescriptive information?

Institute of Transportation Studies, 108 McLaughlin Hall, University of California at Berkeley, Berkeley, Calif. 94720.

Does information about future travel time increase the propensity to divert? These are some of the questions addressed in this paper.

SURVEY CONTEXT

This paper is based on a survey about commuting behavior undertaken in the San Francisco Bay Area in 1993 (*8*). The questionnaires were distributed to peak-period commuters crossing the Golden Gate Bridge during morning and afternoon rush hours. There might have been a self-selection bias among respondents, because they had to mail back the questionnaire. Money incentives for completing the survey were successful in achieving a good response rate: more than a third of the 9000 copies distributed were returned [see Khattak et al. (*8*) for details]. Half the questionnaires were concerned with en-route responses to unexpected congestion, and the other half looked at pre-trip response. The questionnaires inquired about normal travel patterns, unexpected congestion, willingness to pay for different ATIS features, and socioeconomics (*9*).

General Characteristics and Representativeness of Sample

Three-fifths (63 percent) of the 1492 respondents to the en-route questionnaire were male, and the average age of the sample was 43 years. Seventy-three percent of the respondents had at least a college degree; their major occupational fields were professional/technical (36 percent) and management (30 percent). The average annual personal income was $65,500, with 36 percent of the respondents earning more than $80,000 per year. Sixteen percent of the sample lived in one-person households, and 44 percent reported two-person households. Most respondents (57 percent) lived in Marin County and worked in San Francisco. The sample represents a middle-aged, well-educated, and wealthy segment of the population.

To evaluate the representativeness of the sample, it was compared with census data (*10*) and the Bay Area Travel Study (1990). Minor differences were found for the ratio of solo drivers to carpools, the average trip time to work, and the number of cars and persons per household (*11*). The differences were expected, given the method chosen to distribute the questionnaires. It was concluded that the sample, although it did not reflect the whole population of the area, provided a clear picture of the population commuting by car in the Golden Gate Bridge corridor.

Commuting Behavior of Respondents

Fifty-six percent of respondents stated that they selected their route to work before getting in the car; the remaining 44 percent chose it while on the road. A majority (97 percent) used at least some portion of a highway as their usual route. More than half of the respondents (53 percent) stated that they had at least one alternative route; for 37 percent of them, this route was an arterial. A third (33 percent) of those who had an alternative route did not use it in the past month, 19 percent used it once because of traffic congestion, 16 percent used it twice, and the remaining third (32 percent) used it three times or more.

Three-quarters (74 percent) of the respondents reported that they experienced unusual congestion on their usual route to work in the past three months; these people constitute the sample for the rest of this study. Information about the length and cause of delay, the weather at that time, and the way respondents learned about the congestion was obtained. Only 17 percent of the people could not give the cause of the delay. Forty-eight percent of the respondents learned about the incident by observing the congestion, and 11 percent learned through radio reports only. Twenty-four percent first observed the congestion and then received a confirmation from the radio, and 23 percent obtained the information in the opposite sequence. Respondents were asked how much they thought the congestion would add to their trip when they first learned about it (expected delay), and how much it actually added (experienced delay). On average, respondents expected a delay of 21.1 min but actually were delayed for 25.6 min. There is nevertheless a wide discrepancy between the expected and actual delay for a given respondent: the difference between the two values ranges from −70 to +75 min, and only 52 percent of the respondents were able to correctly estimate their delay within ±5 min. This suggests that an ATIS device giving accurate length of incident-related delays can fill a need.

Respondents were then asked about how they responded to this unexpected congestion while on the road; results are shown in Table 1, with the corresponding average delays. Only 21 percent of the respondents reported that they had an opportunity to divert. Most of those (78 percent) did divert.

Table 1 shows that about 9 percent of the total respondents modified their trip chaining sequence by adding or canceling some intermediate stops as a response to the unexpected congestion. Thus, a significant portion of commuters facing unexpected events responded by changing their activity sequencing. ATIS may be able to support such decisions by providing travelers with information about relevant activities (e.g., shopping places in the vicinity). For the remainder of this paper, respondents were simply divided into two basic categories: those who stayed on their usual route and those who diverted to the best alternative route.

REPORTED AND STATED PREFERENCES ABOUT DIVERSION PROPENSITY

The questionnaire was designed to use reported diversion behavior (a measure of the true behavior) as the basis of a sequence of stated

TABLE 1 Response to Unexpected Congestion on Usual Route and Corresponding Delays

Response	Proportion of Respondents[a]	Average Delay (min.) Expected	Experienced
Did not change travel plans	78.3%	20.3	24.9
Took alternate route	16.3%	22.8	24.4
Canceled intermediate stops	4.7%	18.8	26.5
Added unintended intermediate stops	4.0%	26.7	42.1[b]
Used public transportation after parking the vehicle	0.5%	20.0	28.0

[a]The numbers do not sum up to 100% because more than one answer is possible.
[b]Including the extra stops

preference questions about the propensity to divert with a future in-vehicle ATIS device. This methodology increases the validity of the stated preferences technique by relating the response to ATIS technology to a specific incident that was actually experienced by the respondent. The objective of the stated preference questions was to determine how incremental amounts of information provided by an ATIS device would influence the propensity to divert.

Travelers were asked to imagine starting once again, on the same day, the trip during which they experienced their most recent unexpected congestion. They were told not to be aware of any unexpected congestion before they got in their vehicle, until an in-vehicle ATIS device provided them with accurate traffic information. For each question, that is, for each level of information provided, respondents were asked whether they would divert to their best alternative route. They were asked to report this on a 1–4 scale, where 1 meant "I definitely take my usual route" and 4 meant "I definitely take my best alternative route." Respondents who answered either 3 or 4 were taken as showing a preference for diversion; results are shown in Table 2.

In the qualitative information question, the ATIS device does not provide more details than what was available to the driver when he or she first learned about the congestion. Qualitative traffic information equivalent to "unexpected congestion on your usual route" is available in the Bay Area; it is gathered by the commercial media and disseminated almost in real-time through radio traffic reports. Because the qualitative information context is comparable to the situation for which the behavior was reported, this question can be used to relate stated preferences to reported behavior (see Table 3). The sample size here is 895 because only respondents who faced unexpected congestion are included, and missing responses are eliminated on a listwise basis.

It appears that respondents overstated their propensity to divert when compared with reported behavior. One-fifth (22 percent) of the respondents stated that they would divert even though they reported not having diverted. On the other hand, only 5 percent of the people stated that they would not divert even though they actually diverted when they faced the unexpected delay. The correlation between the two variables is only 0.32. Some of the difference, however, might be explained, because respondents had more opportunities to divert in the stated preference questions, since they were asked to imagine that they were just starting their trip. Also, some respondents might have regretted not having diverted in the original trip; their expectation of the delay was later influenced by hindsight.

As seen in Table 2, the largest stated propensity to divert (69.3 percent of respondents) is obtained when the ATIS device also gives real-time information about traffic conditions on the alternative route. This result suggests that some respondents might be currently restrained from diverting by not knowing the conditions on their alternative route. When the complete picture is given, respondents might be more confident and consequently more inclined to divert.

TABLE 2 Route Diversion Behavior under ATIS

Type of information	Question	Proportion of Respondents Stating a Preference for Route Diversion
Current	Reported diversion behavior	16.3%
ATIS Qualitative	*The device knows your usual route and gives you the following message:* << Unexpected congestion on your usual route >> *but does not tell you how much of a delay this congestion is causing*	32.9%
ATIS Quantitative	Usual route, real-time *The device tells you the expected length of delay on your usual route at the present time (your initial estimate of delay)*	57.4%
	Usual route, forecast *The device tells you the length of delay at the present time, and accurately predicts the length of delay it will cause 15 to 30 minutes into the future*	61.6%
	Alternate route, real-time *The device tells you the length of delay at the present time, and provides information regarding present travel time on your best alternate route*	69.3%
ATIS Prescriptive	*The device tells you* << Unexpected congestion on your usual route >> *and suggests that you take your best alternate route*	67.5%

TABLE 3 Stated Preference versus Reported Behavior

		REPORTED BEHAVIOR		
		Does not divert	Diverts	Total
STATED PREFERENCE	Does not divert	555 62.0%	46 5.1%	601 67.2%
	Diverts	197 22.0%	97 10.8%	294 32.8%
	Total	752 84.0%	143 16.0%	895 100%

A high proportion of respondents (67.5 percent) also stated that they would divert when provided with simple prescriptive information, that is, when the device suggests taking the best alternative route. Prescriptive information may be interpreted differently from other forms of information because it implies that the alternative route is the best option. Consequently, it may appear surprising that less diversion is obtained with this type of information (67.5 percent) than with detailed quantitative information (69.3 percent). This indicates that compliance rates may differ for prescriptive and quantitative information. Nevertheless, the relatively high diversion rate for prescriptive information indicates that, under incident conditions, some drivers are responsive to clear directions about the route to take (although they might still like to know details regarding the incident). Surprisingly, the decision to comply with prescriptive information does not appear to be influenced by the potential time savings. Indeed, people who stated they would comply to the prescriptive information were expecting to save, on average, as much time as those who did not.

The answers to the last four stated preference questions are closely correlated, indicating consistency in driver behavior. Indeed, people stating a preference either to divert or to stay on their usual route generally kept the same preference throughout the last four questions. However, the possible bias due to the ordering of the questions is recognized.

To explore further the correlation between reported behavior and stated preferences, a linear regression model relating the answers to each question was developed. The 1 to 4 scale of the stated preference questions was used. Reported diversion behavior was consequently recoded as 1 or 4 (no 2 or 3). All observations from the reported behavior and from the five stated preference questions were stacked in a single column vector, which thus contained six times the sample size. This vector was then related to a sequence of five dummy variables, flagging one when the observation was from the specific stated preference question. Reported preferences thus served as the base. The equation used is

$$DP = a_0 + \sum_{i=1}^{5} a_i SP_i$$

where:

DP = vector of observations on diversion propensity,
a_0 = constant,
a_i = coefficient to be determined by regression,
SP_i = 1 when the observation in DP is obtained from i and 0 otherwise.

The coefficients obtained reflect the influence of each stated preference variable in explaining the vector of observations and the increase in the probability of diversion given the additional information provided. The coefficients obtained are shown on Table 4; to account for correlation among responses of the same individual, the t-statistics should be reduced by a factor of 0.4. The constant reflects the base diversion propensity, that is, the reported diversion propensity. The value of a_1 corresponds to increased propensity of diversion with qualitative information. An even higher propensity of diversion is observed when drivers are provided quantitative information (a_2). However, additional details and prescriptive information do not induce significantly more diversion as reflected in the uniformity of coefficients a_2 to a_5.

TABLE 4 Coefficients of Stated Preferences Model

Coefficient	Value	t-stat. (p)
a_0 Constant term	1.36	44.6 (0.00)
a_1 Qualitative information	0.70	14.2 (0.00)
a_2 Quantitative information (usual route, real-time)	1.33	27.3 (0.00)
a_3 Quantitative information (usual route, forecast)	1.44	29.4 (0.00)
a_4 Quantitative information (alternate route, real-time)	1.58	31.6 (0.00)
a_5 Prescriptive information	1.56	32.1 (0.00)
Summary statistics:	R^2 = 0.47 Sample size = 1492	

WHO WOULD DIVERT UNDER ATIS?

The personal and contextual factors determining diversion propensity are explored and the consistency of the stated responses verified. Respondents were divided into four categories, according to their reported and stated diversion behavior (Table 5). The stated response was taken from the question generating the highest diversion rate, that is, when the device provides the most complete quantitative information, including travel times on the alternative route.

ATIS will benefit primarily the 54 percent of the sample who would change route when provided with the device. This figure applies only to the 74 percent of the sample who experienced unexpected delay; therefore, the proven percentage of commuters in the corridor who would change route with ATIS under unexpected congestion is actually around 40 percent.

To explore the characteristics distinguishing the first three groups (the fourth group is marginal and was ignored), discriminant analysis was performed by estimating two independent discriminant functions. These functions assign separate discriminant scores to each observation; both scores are then used to classify observations. The sample size here is only 376 respondents because missing cases are deleted on a listwise basis. The five variables best characterizing diversion behavior are presented in Table 6. The standardized coefficients assigned to each variable and their correlation with each function are indicated. Positive coefficients indicate a higher propensity to divert.

The existence of diversion opportunities is critical in determining diversion behavior. Furthermore, diversion propensity increases with the number of alternative routes known. Undivertable respondents know on average only 1.50 routes; those who could divert with ATIS, 1.73; those who currently divert, 1.94. The number of alternative routes known to travelers increases their possibilities of diversion; however, drivers also know more alternative routes because they tend to divert often. In this case, causality can actually work in both directions. Another important variable, the frequency of recreational trips, was found in previous research (*12,13*) to be a proxy measure of such personality characteristics as extroversion, achievement, and need for stimulus or adventure. The frequency of recreational trips does influence the propensity to divert with ATIS: nondiverting respondents travel on average 1.63 times per week for recreational purposes, and the people who could divert with ATIS do so 2.08 times per week. More diversion is also observed under bad weather conditions, as can be concluded from the sign of the weather coefficient. Finally, the presence of congestion on the alternative route acts as a deterrent to diversion. Nondiverting respondents have more congestion on their alternative route, using the

TABLE 5 Categories of Diversion Behavior

Category	Reported Diversion	Stated Diversion	Proportion of Respondents
1 Undivertable	NO	NO	29.3%
2 Could divert with ATIS	NO	YES	54.0%
3 Already diverts with current information	YES	YES	15.5%
4 No longer diverts with ATIS	YES	NO	1.3%

TABLE 6 Characteristics Determining Diversion Behavior

Variable	p value of F-statistic	Coeff. in 1st Function	Coeff. in 2nd Function	Corr. with 1st Function	Corr. with 2nd Function
Diversion opportunities (1 = yes, 0 = no)	0.00	**+1.00**	-0.02	**0.99**	0.00
Number of alternate routes known	0.00	+0.02	**0.69**	0.07	**0.71**
Frequency of recreational trips (times/week)	0.02	-0.08	**0.59**	-0.03	**0.62**
Weather (0 = good, 1 = bad (rain or fog))	0.01	0.01	**0.29**	-0.08	**0.23**
Congestion on best alternate route (1 = not congested, 2 = congested, 3 = heavily congested)	0.03	-0.11	**-0.24**	-0.07	**-0.32**
Summary statistics:					
Canonical correlation:		0.86	0.21		
% correctly classified: 65%					
Sample size: 376					

following scale: 1 = not congested, 2 = congested, 3 = heavily congested (their average congestion was 1.88), followed by the people who would divert with ATIS (1.72), and by the people who already divert (1.51). Although not significant at the 5 percent level, the number of stops on the usual route was also found to decrease with the propensity to divert: as expected, people constrained to stop on their usual route have less flexibility in changing route.

All these findings are consistent with what was expected and increase the confidence in the validity of the stated preference technique.

CALCULATION OF ATIS BENEFITS FROM ROUTE DIVERSION

Time Savings

The potential time-saving benefits achieved by diverting under ATIS are calculated here, using responses to the most complete quantitative information (highest stated diversion rate). The calculation applies to the 40 percent of respondents who would change their commuting behavior when provided with ATIS (N = 597). It does not include the potential time saving that other road users may experience or the extra delay that may occur on alternative routes once a larger number of vehicles are diverted.

The saving from route diversion is simply the delay minus the time difference between the alternative and usual routes. To account for the fact that time spent in a bottleneck is usually more onerous than normal in-vehicle travel time, a weight has been associated with delay. Because this weight is a subjective measure and has a direct influence on the final result, a sensitivity analysis was performed using weights ranging from 1.0 to 2.0.

Figure 1 presents the distribution of travel time savings that would accrue to people who stated they would divert to their alternative route. With a delay weight of one, 14 percent of the diverters would actually lose time by taking their best alternative route, 9 percent would see no change in their total travel time, and 77 percent would save some time. The average time savings is summarized in Table 7.

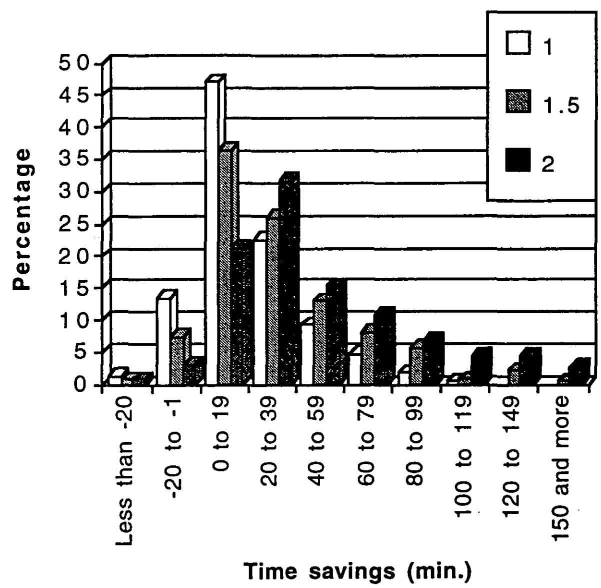

FIGURE 1 Distribution of travel time changes among people who stated they would divert to alternative route under ATIS, as a function of weight of delay.

TABLE 7 Route Diversion Benefits of ATIS under Incident Conditions

Weight of Delay Compared to Travel Time	Average Time Savings from Diversion (min.)	Proportion of People with Negative Savings	Monetary Savings per Trip with Diversion	Potential Annual Benefits of ATIS-induced Route Diversion
1.00	17	14.4%	$4.80	$124
1.25	24	12.9%	$6.60	$174
1.50	30	8.1%	$8.40	$224
1.75	37	6.3%	$10.20	$274
2.00	43	3.7%	$12.00	$324

Monetary Value of Time

To attach a monetary value to time saving, an estimate of the value of time for each respondent is needed. This value was taken as a fraction of the personal hourly income (*14*) to account for personal differences in the valuation of time. The value of travel time saving also depends on the amount of time freed for other purposes: a saving of a few minutes might not be important because it is too small to be used productively (*15*). Consequently, to avoid aggregating a large number of negligible time savings, the value of time was assumed to increase with greater time saving.

The function used is presented in Figure 2; it is adapted from a method presented by AASHTO (*15*). Travel time variations of ±5 min are valued at 10 percent of the personal hourly income. Those larger than 15 min are evaluated using a value of 50 percent of the hourly income. Negative time saving (increases in travel time) is valued similarly.

Money Benefits of Route Diversion

Figure 3 presents the distribution of monetary savings that would be achieved through route diversion under unexpected congestion. This was calculated by combining the time saving with the values of time for every respondent. The average savings for the sample is $4.80 per trip; this value includes the 14 percent of people who lose time by diverting. These people have been kept in the average to reflect that (a) any ATIS will not be perfectly accurate and might advise a small proportion of travelers to take routes that are actually longer and (b) some people are willing to lose travel time to avoid bottlenecks.

Annual Frequency of Route Diversion

The values presented in the previous section apply to a single trip with route diversion. To evaluate the annual benefits of such diversions, it is necessary to estimate how frequently they would occur. A precise measure of diversion frequency could be obtained using traffic and incident data in the corridor. For every origin-destination pair and time-of-day combination, it would be necessary to estimate how often an incident on the usual route would induce a route switch. However, all respondents differ in the minimum length of unexpected delay (threshold) that justifies a modification to the intended travel plans. The calculation would thus have to account for these different (and unknown) threshold values and for the fact that potential diverters are not on the road daily. All these obstacles make it difficult or impossible to know how often each respondent would divert to his or her best alternative route.

To overcome these difficulties, a proxy variable was used for the potential frequency of route diversion. When asked to report specifics of their recent unexpected congestion, respondents mentioned how long ago the incident occurred. If it is assumed that the occurrence of incidents follow a Poisson process, the time elapsed since the last incident is actually just the mathematical expectation of the time period between two incidents of at least the same size. The number of weeks between two incidents can then be translated into an annual frequency of incidents experienced, assuming that respondents work about 48 weeks a year. Table 8 presents the results and the corresponding frequencies of route diversion.

The weighted average frequency of diversion is 29 times a year. As seen from the table, the majority (77.4 percent) of respondents would divert between 8 and 32 times a year. About one sixth (15.7 percent) of respondents would divert as often as twice a week (out

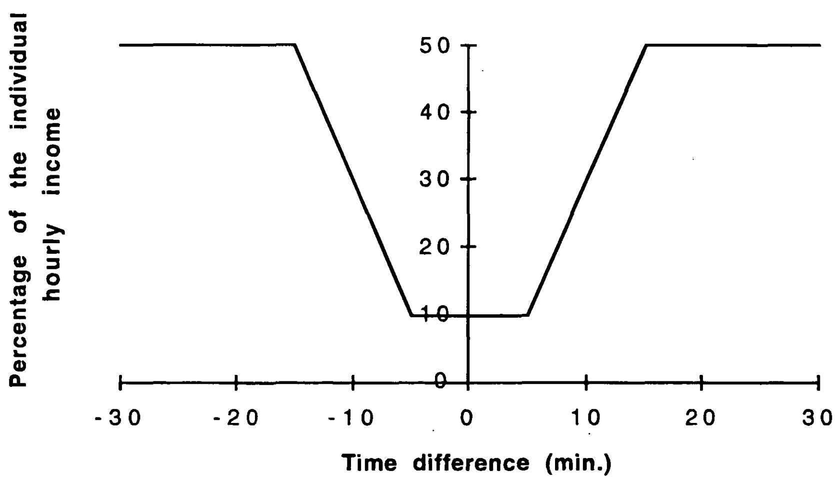

FIGURE 2 Function used for monetary value of time.

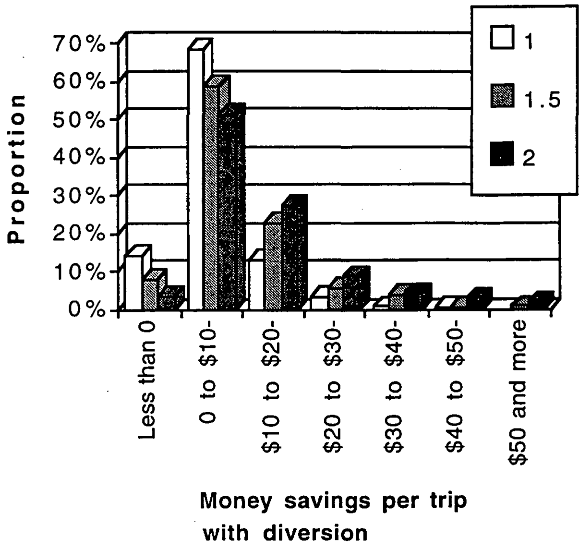

FIGURE 3 Distribution of monetary savings for people who stated they would divert to best alternative route, as a function of delay weight.

of 10 possible trips). These people might have a high variability in their route choice decision and are likely to divert as soon as traffic conditions deteriorate on their usual route.

The measure used for the frequency of route diversion might have a seasonal bias and is only approximate. Its correlation with the monthly frequency of diversion without ATIS is 0.14. However, it has two important advantages. First, it incorporates the threshold value of all respondents, because they are free to report the most recent unexpected delay they find worth mentioning. It is unlikely that smaller unexpected delays would be considered for route diversion. Respondents who faced their incident relatively longer ago apparently have larger threshold values, because they experienced longer delays (Table 8); they were accordingly assigned a smaller frequency of diversion. Second, commuters who are not on the road daily, because they also use transit or carpool, are less likely to face unexpected delays than others and are thus less likely to divert. The proxy measure used takes this into account by assigning these people a smaller annual frequency of diversion.

Annual Benefits of Route Diversion

By combining the annual frequency of unexpected delays and the monetary savings per trip, it is possible to calculate the annual benefits of route diversion under incident conditions (see Figure 4). The average annual benefit of ATIS-induced route diversion is $124 per year per diverter, when the weight of delay is one. Table 7 summarizes the results of the calculation for different weights of delay and shows the average time savings under each assumption. Note that the percentage of people with negative savings (i.e., with an alternative route longer than the travel time plus the delay on the usual route) dwindles as the weight attached to delay increases. This suggests that the apparently irrational behavior of longer diversion time could be partly explained by a high cost associated with queuing delays.

For our subset of the population, the annual benefits of route diversion through ATIS under incident conditions range from $124 to $324 per person, depending on the weight of delay. Recall that this value applies to about 40 percent of the automobile commuters in the corridor and that high values of time were used because of the large average income of the sample. It appears that the time-savings benefits of ATIS from route diversion under incident conditions are limited.

SUMMARY AND CONCLUSION

Three-quarters of the respondents reported that they faced unexpected congestion on their usual route to work at least once in the past 3 months. Twenty-one percent of them reported that they then had an opportunity to divert, and 16 percent did divert. Thirty-three percent stated they would divert if provided with ATIS qualitative information (roughly equivalent to currently available information) at the beginning of their trip. More diversion is obtained in the stated preference case, partly because respondents had the benefit of hindsight and had more opportunities to divert because they were starting their trip over. There might also be a tendency to overstate diversion behavior.

The stated preference questions showed that the more complete the travel information, the higher the proportion of commuters diverting under unexpected congestion. Almost 70 percent of the people stated they would divert when the device provided quantitative real-time information on their usual route plus travel times on their alternative route. Moreover, under incident conditions, prescriptive information might be sufficient to achieve high diversion rates. However, driver compliance with prescriptive information will be conditional on the effectiveness (reliability and accuracy) of ATIS in suggesting better routes.

Potential annual monetary benefits from ATIS-induced diversion in the Golden Gate Bridge corridor range from $124 to $324 per person, varying linearly with the weight assumed for delay. These figures apply to about 40 percent of the commuting population in the corridor.

The estimate of benefits is only preliminary, and a more reliable frequency of diversion under ATIS is needed from field operational

TABLE 8 Potential Frequency of Route Diversion Using Time Since Most Recent Incident

How long ago did the most recent unexpected congestion occur?	**Correspond. Frequency of Incidents Experienced**	**Potential Annual Freq. of Route Diversion**	**Proportion of Potential Diverters**	**Average Expected Delay (min.)**
Less than one week	Twice a week	96	15.7%	19
1-2 weeks	Every 1.5 week	32	22.6%	18
2+-4 weeks	Every 3 weeks	16	28.6%	22
1-2 months	Every 6 weeks	8	26.2%	24
More than 2 months	Every 12 weeks	4	6.9%	22

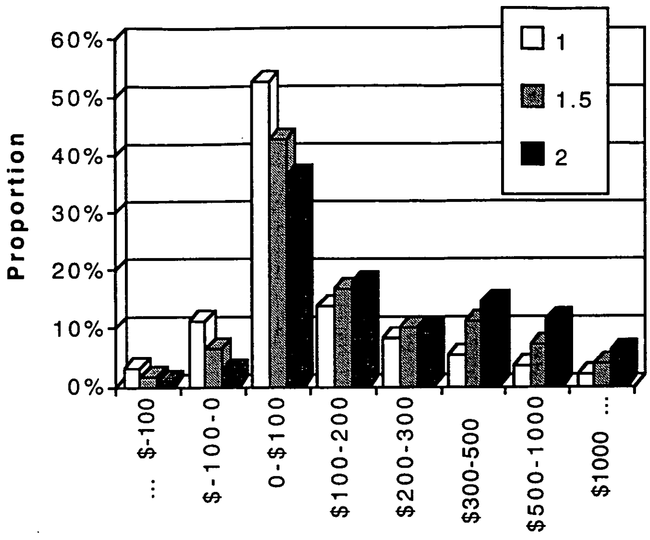

FIGURE 4 Annual monetary benefits of ATIS-induced route diversion, as a function of delay weight.

tests currently underway. Because the Golden Gate Bridge corridor offers limited route diversion opportunities and has a relatively high-income population, research should also be performed in other corridors to obtain more generalizable estimates.

This project has demonstrated that, even in a corridor with limited opportunities to divert, ATIS could bring about significant time savings to a certain portion of commuters by inducing route changes. Although the calculated benefits per driver may appear limited when translated into annual dollar figures, they account for only a subset of total ATIS benefits. Changes in other travel decisions such as departure time and mode may allow commuters to save time as well. Research is underway to estimate the extent of pre-trip ATIS benefits. Other less tangible benefits such as easier wayfinding, increased confidence in unfamiliar areas, increased ability to modify trip chaining, and the availability of general traveler information will also have to be summed up in the final analysis. Finally, greater benefits may be achieved by broadening the scope of ATIS through the development of an Advanced Activity and Travel Information System. Such a system is a logical extension, because it would provide information to support not only travel decisions but also activity participation.

ACKNOWLEDGMENTS

This research was sponsored by the California Department of Transportation through the PATH Program, and by the Fonds FCAR from Quebec. We are grateful to Robert Ratcliff and Pat Conroy for their input. Randolph Hall provided very useful suggestions in refining the questionnaire. Robert Warren of the Golden Gate Bridge Highway and Transportation District and Joy Dahlgren were instrumental in distributing the survey forms. Finally, we would like to thank David Gillen and Haitham Al-Deek for their advice. Four Transportation Research Board reviewers provided constructive criticism for which we are grateful.

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Publication of this paper sponsored by Committee on User Information Systems.