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ABSTRACT

This paper presents the findings of a survey conducted among callers of a San Francisco Bay Area telephone information service. A Bay Area traveler information system, TravInfo, has been in operation since September 1996. In April 1997, a survey of TravInfo callers was conducted over a two-week period. The paper compares the call making and demographic characteristics of those who asked for traffic information and of those who asked for transit information. Changes in travel behavior after the calls were made were also investigated. The key findings of the study were that the people who called for traffic or transit information were satisfied with the service. About one-third of the people who made a trip after calling TravInfo modified their travel behavior, of which the majority took an alternate route or changed their departure time. There was no significant difference between the call making characteristics and the demographic profiles. A greater proportion of repeat TravInfo customers consisted of people who drive their own vehicles and check on traffic conditions than of those who were inquiring about transit information.

KEYWORDS: traveler advisory telephone system, caller survey, traffic information

EXECUTIVE SUMMARY

This paper presents the survey findings of how callers of the TravInfo Traveler Advisory Telephone System (TATS) changed their travel behavior based on the information and to what extent they retrieved the information. This study is based on the survey conducted among those who called TravInfo during two weeks in April 1997. TravInfo calls were intercepted and follow-up telephone interviews were conducted among those who agreed to participate in the survey.

As part of the evaluation of the TravInfo Field Operational Test, the present study examined the characteristics of TravInfo callers and the manner in which travel decisions were made based on the information.

The TATS caller sample was over-represented by high incomes and young people when compared with the Broad Area survey conducted in 1995. This could mean that these groups were more concerned with transportation issues and are therefore more likely to participate in the survey. On the other hand, these groups may simply call for information more often than the average population. The sample consisted of 283 transit callers, 173 traffic callers, and 55 callers who sought other information.

The key finding of the study was that the perception of the TravInfo TATS traffic information was significantly different from that of transit information. The majority of the participants found that the TravInfo traffic information service is quite reliable and accurate, and gave high marks. On the other hand, the transit information service was thought to be less efficient in its delivery, even though the majority of the respondents rated the service above average.

Furthermore nearly 90% of the traffic information callers made trips subsequently while only 50% of those who asked about transit information made trips. This suggests that the net benefits of traffic information to users are perceived differently from the benefits of transit information. The perceived benefits of traffic information were to avoid congestion but the benefits of transit information was to make a trip without getting lost.

Finally, the majority of participants among drivers indicated that they are willing to pay $2 per week for the TravInfo traffic information service. Although the value of information cannot be measured solely on the willingness to pay for information, our survey results concur with the results of the SmarTraveler caller surveys in the Boston region (Multisystems, 1996).

The results presented in this paper are based on a small sample of traffic information callers. To improve the results significantly, it is necessary to increase the sample size for this type of survey research. It should be noted that approximately 80% of the calls were directed to transit information during the month of April, 1997. Although the ratio between transit and traffic information inquiries varied by area code, only 6,870 calls were for traffic information while 33,200 were for transit. The evaluation of the Traveler Information Center (TIC) where the TravInfo information service operates, found that the call characteristics of three subregions, north (area code 707), south (area code 408) and peninsula (San Francisco area, area code 415) were significantly different from the call characteristics of the East Bay (area code 510). The call volume in April showed that while 90.7% of the calls in area code 510 were for transit, over 50% of calls in other area codes were for traffic. The call volume data suggest that there is a need for additional surveys after the call volume of traffic inquirers reaches a sufficiently high level in order to measure the impact of TravInfo on travel behavior. The net impact of the TravInfo services on the roadway network performance can be measured most realistically when the TravInfo project is broadly deployed.

1. INTRODUCTION

With the shrinking size of public investments in transportation projects for freeway construction, many cities throughout Europe and the U.S. have adapted public policies to encourage better utilization of the existing roadway infrastructure through advanced traveler information systems (ATIS). In recent years, many European and North American cities have offered telephone-based ATIS services. The effects on travel decisions are yet to be determined (Metropolitan Transportation Commission, 1992; Multisystems, 1995). The purpose of the present study is to investigate the effects of Traveler Assisted Telephone Service (TATS) through the case study of TravInfo. TravInfo is a telephone-based ATIS in the San Francisco Bay Area and has been in operation since September 1996. The objective is not only to provide dynamic (real-time) traffic information to Bay Area travelers but also to offer travel options through mass transit and rideshare information. Therefore, the menu of the telephone information service includes: 1) real-time traffic conditions on major freeways, 2) public transit, para-transit and rideshare/carpooling information, 3) San Francisco airport ground transportation, 4) freeway construction in general, as well as specific locations, and 5) bike ride information.

The effects of TATS were investigated using a survey research method. Two weeks in late April 1997, TravInfo calls were intercepted and follow-up telephone interviews were conducted among those who agreed to participate in the survey. The paper presents the key findings of the TravInfo user survey. As part of the evaluation of the TravInfo Field Operational Test (Hall, et al, 1994), the present study examined the characteristics of TravInfo callers and the manner in which travel decisions were made based on the TravInfo information.

The objectives of the paper are to: 1) understand the demographic characteristics of TravInfo callers, 2) assess the level of satisfaction of the TravInfo services, and 3) identify the benefits of TravInfo to Bay Area travelers. The paper focuses on five aspects of caller evaluation: 1) the demographic characteristics of the callers and the information that they acquired, 2) the frequency of calls made and travel decisions that were made based on the information, 3) the caller perception of the value of the TravInfo service, 4) a comparison of TravInfo with other sources of traffic information, and 5) consumer market issues of TravInfo.

To understand the demographic characteristics of TravInfo callers, a comparison was made between the sample of the TravInfo callers and the Bay Area driver population (Yim, et al, 1996). To assess the level of satisfaction between TravInfo menus, responses of those who inquired about traffic information were compared with responses of those who inquired about transit information. Finally, the monetary value of the TravInfo services was compared with SmarTraveler, the telephone-based ATIS in the Boston region.

The methodology used for collecting and analyzing data is discussed in Section 2 and the survey sample is described in Section 3. Caller perceptions of the TravInfo Traveler Advisory Telephone System is presented in Section 4, which is followed by discussions on the willingness to pay for the telephone service in Section 5. The results of the multiple correspondence analysis of the survey data are presented in Section 6 and conclusions are drawn in Section 7.

2. METHODOLOGY

Bay Area travelers have direct access to TravInfo traffic and transit information over the telephone. Incoming calls to TravInfo were randomly intercepted to obtain a representative sample of the callers. From the pool of individuals who responded to initial intercept calls, a list of potential participants was created for the follow-up telephone interviews. The intercept calls generated the first name of self-selected participants, their phone numbers, and the best time for the follow-up calls to be made within 48 hours. Repeat interceptees were rejected for the follow-up calls in order to prevent multiple surveys for the same individual. Within 48 hours of the intercept, the follow-up telephone interviews were conducted to ensure that participants could respond to questions with clear recollection of their experience about the specific calls that they made and the ways in which TravInfo information influenced their travel decisions. Up to five attempts were made to establish contact with the participants to minimize non-response bias. The follow-up interviews took 15 minutes on average.

The survey was focused on satisfaction with the information service, likelihood that the information will affect travel behavior, benefits based on behavioral changes such as reduced travel time, ability to avoid traffic problems, or ability to arrive at a desired destination on time. A few demographic questions were also asked to develop a consumer profile of TravInfo patrons compared to demographics of the Bay Area population. Bivariate statistical methods such as cross-tabulations, Chi-square and t-test were used to determine distributional profile and to determine association between behavioral and demographic variables such as gender, age, education, and income.

3. DESCRIPTION OF THE SAMPLE

In this section, we describe the characteristics of the sample including its demographic profiles in comparison with the representative sample of the Bay Area population. The sample was limited to those who were 18 years of age or older.

3.1 Comparison of the sample with the Broad Area survey results

The sample consisted of 511 people who agreed to complete a telephone questionnaire about TravInfo. Respondents were 48.5% male and 51.5% female. The rate of acceptance to answer the questionnaire was 87.4% among those who agreed to participate in the survey. About 46% of the intercepts declined to participate in the survey and thus we were unable to evaluate how the refusal to participate in the survey was related to perceptions of the TravInfo service itself.

The results indicate an overrepresentation of people with high incomes as well as of young people as compared with the Broad Area survey conducted in 1995 (Yim, et al, 1996). This could be interpreted to mean that these groups are more concerned with transportation issues and are therefore more likely to participate in the TravInfo survey. On the other hand, one can assume that these groups may simply call for TravInfo information more often than the average population. 61.1% (456) of the 511 callers who accepted a follow up questionnaire were calling for information related to transit and 37.9% (173) were calling for traffic information. The rest of the calls were not clearly related to any of these modes. Table 1 shows the ratio between transit and personal vehicle users for commuting in the Bay Area.

Table 1. Commuter Modal Split Comparison

Mode	1990 Census	1995 PATH N=671	1996 RIDES N=3,450	1996 SF Chronicle N=800
Personal	86.8%	85.7%	87.0%	87.9%
Vehicle	73.8	79.4	69.3	78.0
Drive alone	13.0	5.1	-17.7	9.9
Rideshare				
Transit Users:	12.1%	14.3%	13.0%	12.1%

The TravInfo center is utilized by a disproportionately higher percentage of transit users than is represented in the total population (12% of the total population). Control variables like age (Figure 1), income (Figure 2) and ethnicity (Figure 3) show some differences with the Broad Area survey results. The TravInfo callers were slightly younger, with an overrepresentation of the 18-24 age category, had lower incomes and were more frequently black/African-American than were the Broad Area survey participants. These differences are not important when we consider only the driving population using TravInfo for route information.

The observed differences in age, income and ethnicity are essentially due to the overrepresentation of transit users in the sample. The TravInfo callers were generally more highly educated than the Broad Area survey participants were (Figure 4).

Fig.1

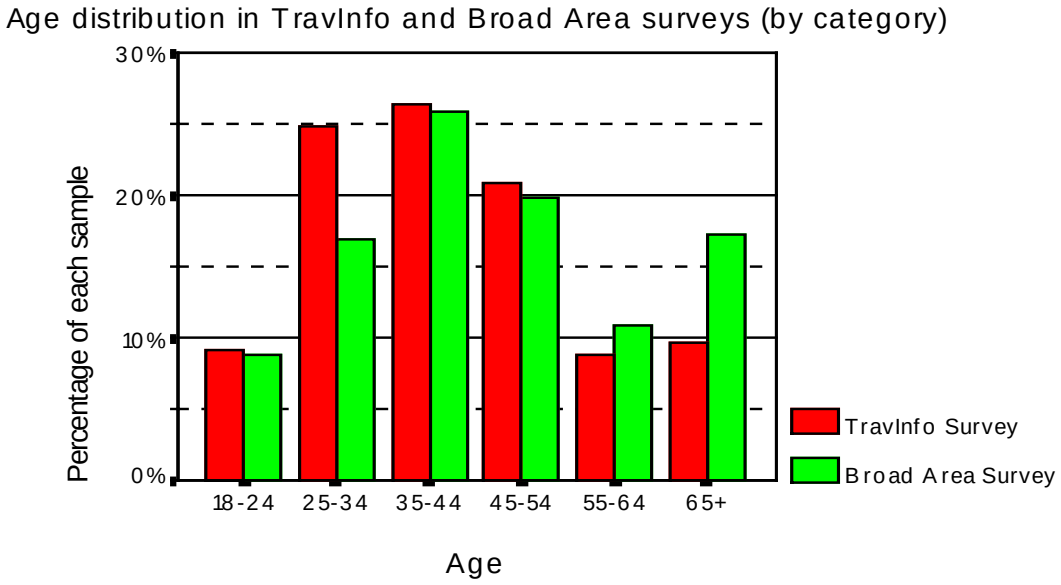


Fig.2

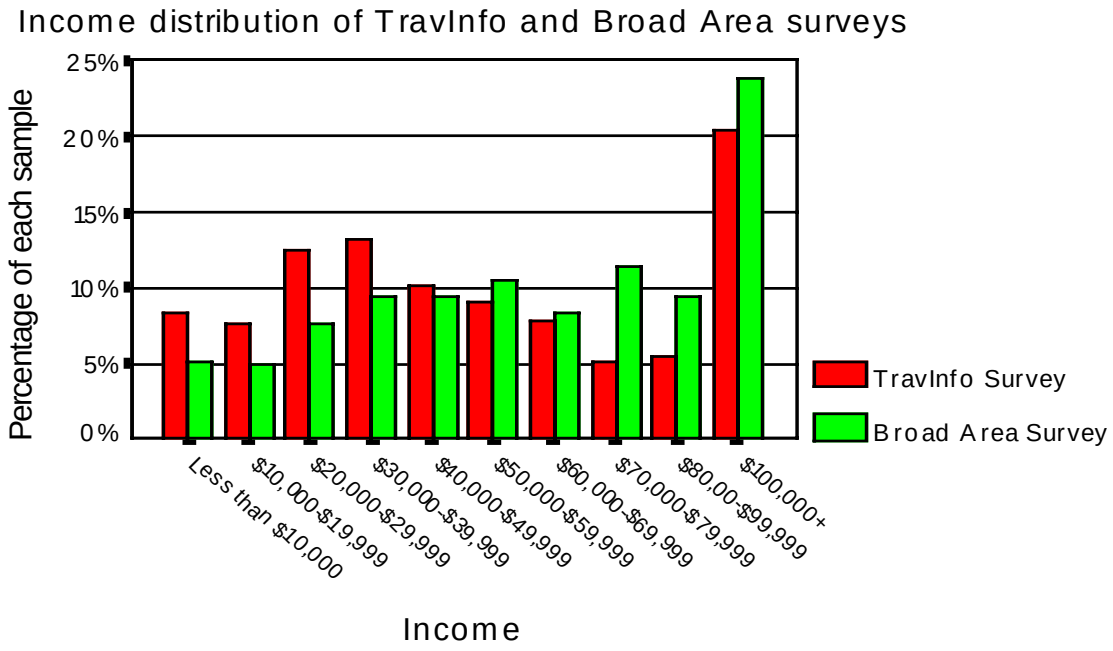

Income distribution of TravInfo and Broad Area surveys
Percentage of each sample
25%
20%
15%
10%
5%
0%
Less than $10,000
$10,000-$19,999
$20,000-$29,999
$30,000-$39,999
$40,000-$49,999
$50,000-$59,999
$60,000-$69,999
$70,000-$79,999
$80,00-$99,999
$100,000+
TravInfo Survey
Broad Area Survey
Income

Fig.3

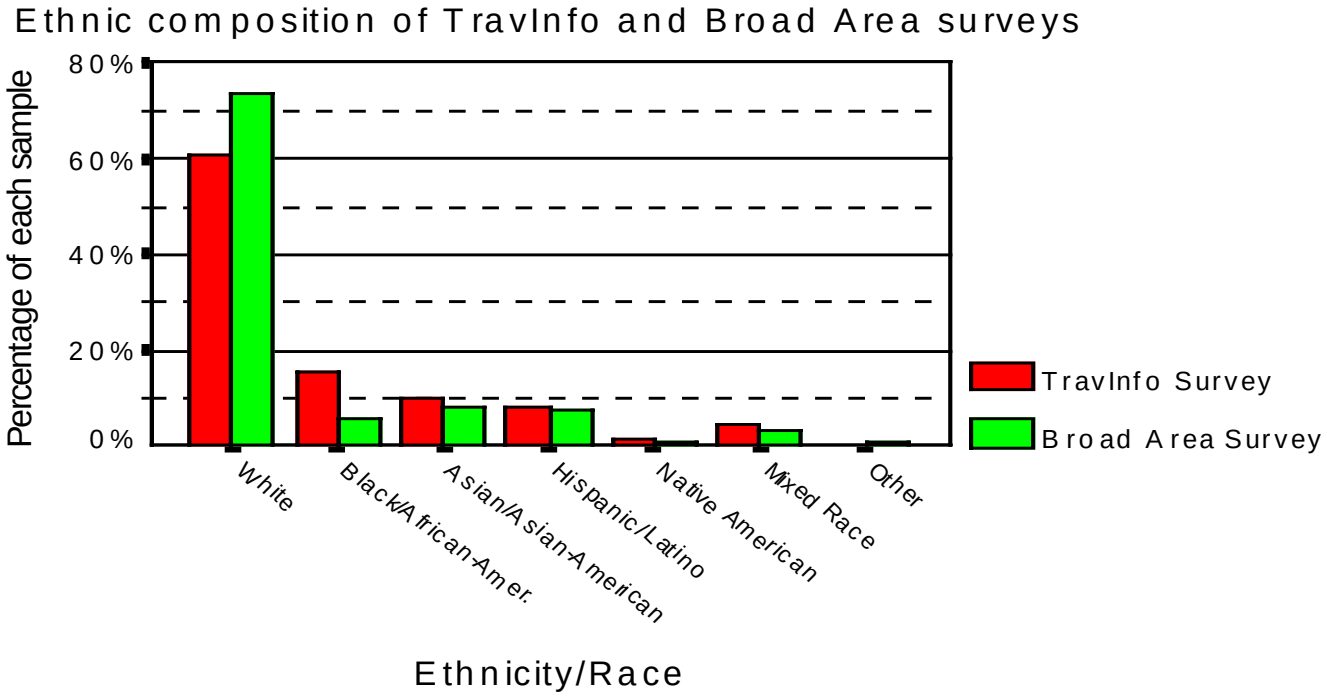
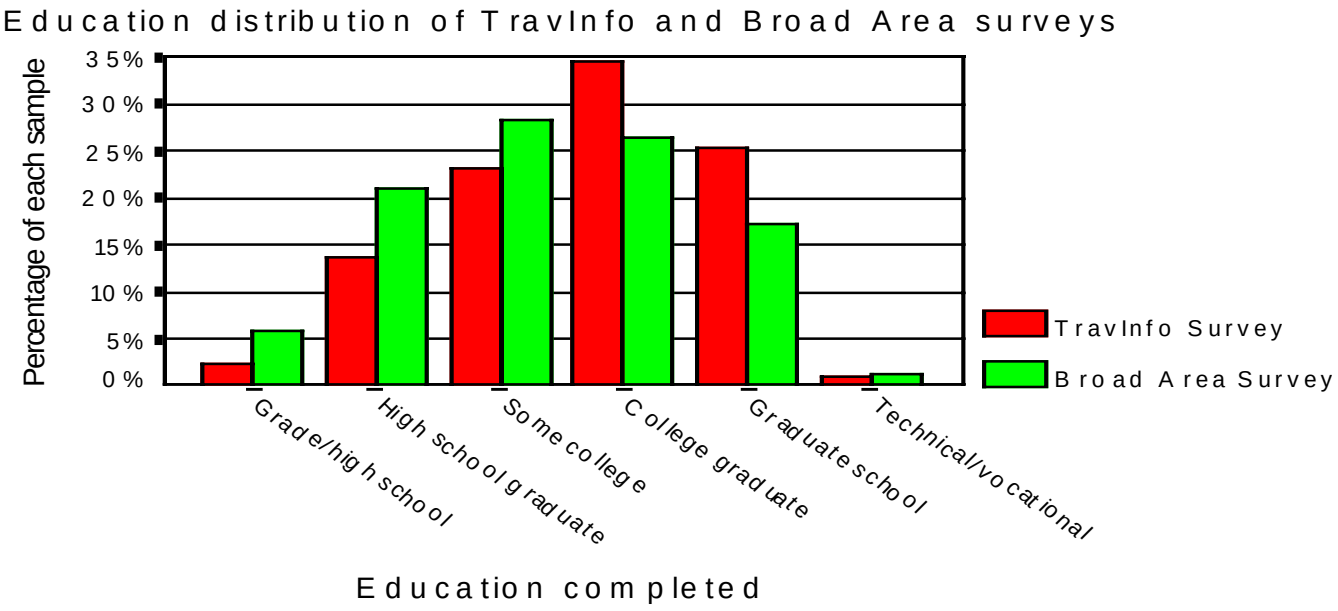

Ethnic composition of TravInfo and Broad Area surveys
Percentage of each sample
80%
60%
40%
20%
0%
White
Black/African-Amer.
Asian/Asian-American
Hispanic/Latino
Native American
Mixed Race
Other
TravInfo Survey
Broad Area Survey
Ethnicity/Race

Fig.4



3.2. Who called, and for what information?

The people who called to obtain information did not necessarily call for themselves, call for a specific trip or even make the trip after the call. This explains the lower number of valid cases for the statistical analysis of the survey.

84.4% of the transit users called for themselves and 88.5% called for a specific trip. Also, only 39.9% of the transit callers actually made the trip. The majority of those who did not make the trip said the trip was scheduled for the future (55.1%), while 13.3% said that the trip would take too long and 14.3% could not remember or were unsure of the reason not to make the trip.

In contrast, 83.8% (146) of the driving population made the trip after calling TravInfo, and the vast majority of the callers were calling for themselves and for a specific trip.

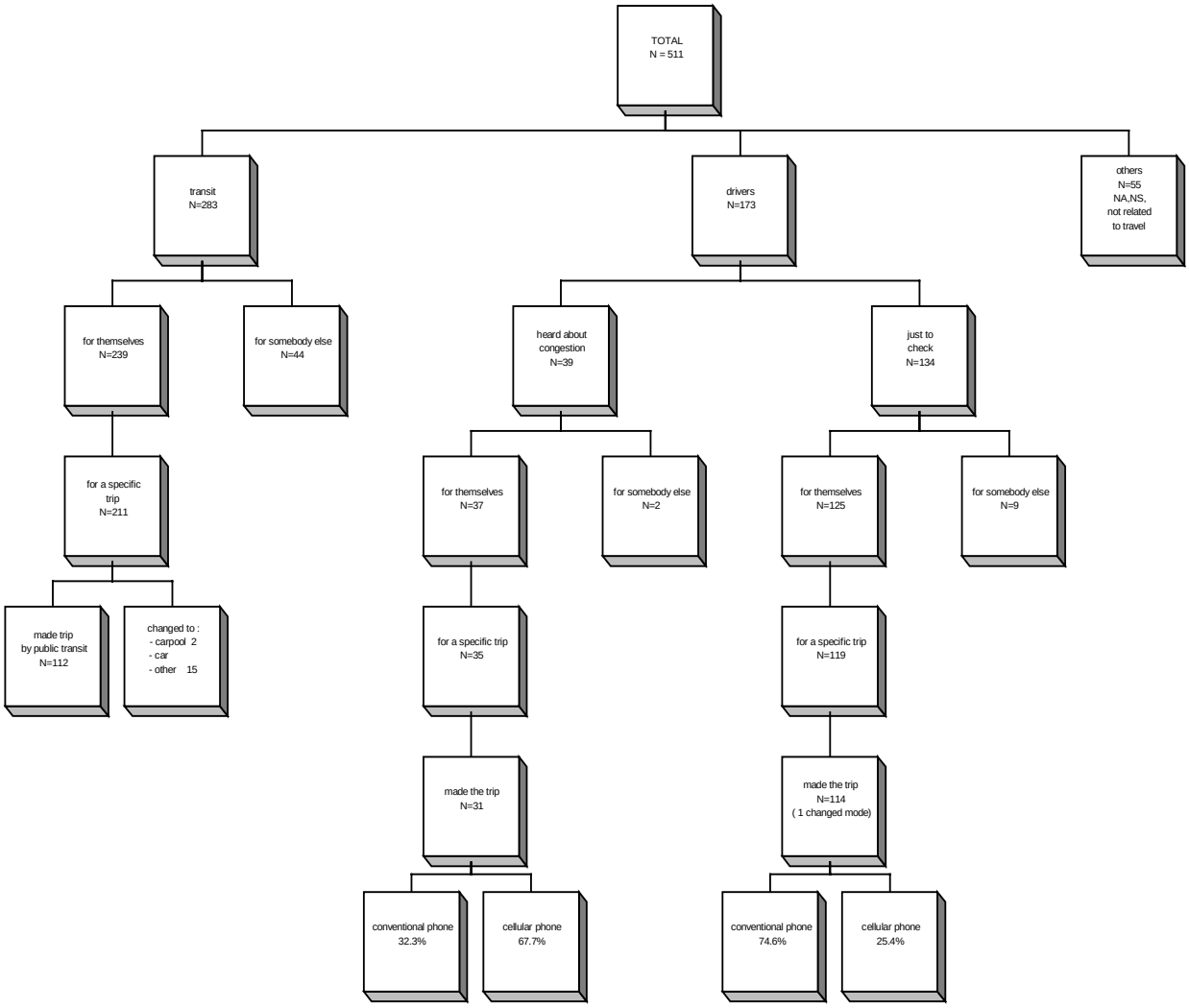
Few callers changed their mode of travel after the call. Among the 18 transit users, two shifted to carpool, one to car and the rest shifted from AC Transit to BART or from BART to AC Transit. One driver changed to transit.

The driving population can be split into two subcategories based on the different manners in which they used TATS: those who called TravInfo because they heard about congestion and

those who called to check about the traffic situation. Thirty-nine drivers were classified in the first category, of which 31 made the trip, and 134 drivers were classified in the second category, of which 114 made the trip.

38.5% of the drivers who declared they had heard about congestion said they were already in the congestion--25.6% heard about it from the radio. On the other hand, 67.7% of those who called TravInfo called because they heard about congestion did so on their cellular phones, while 74.6% called to check the traffic situation by conventional telephone. A summary of these results is presented in Figure 5.

Fig.5
TATS SURVEY
ANALYSIS TREE



3.3 Mobility and TravInfo use

3.3.1 Trip purposes

25.1% of TravInfo users call before leaving for work, 24.6% call while traveling to work and 16.1% call for recreational or social event trips. There are significant trends relating to when users would call and their purpose in calling. Those who called because they heard about congestion
did so mainly while going to work (42.9%); those calling to check on traffic conditions did so mainly while leaving work (48.7%); transit users mainly called for other purposes (49.8%) or while going to work (19.9%) or for recreational or social trips (18.5%) (Table 2).

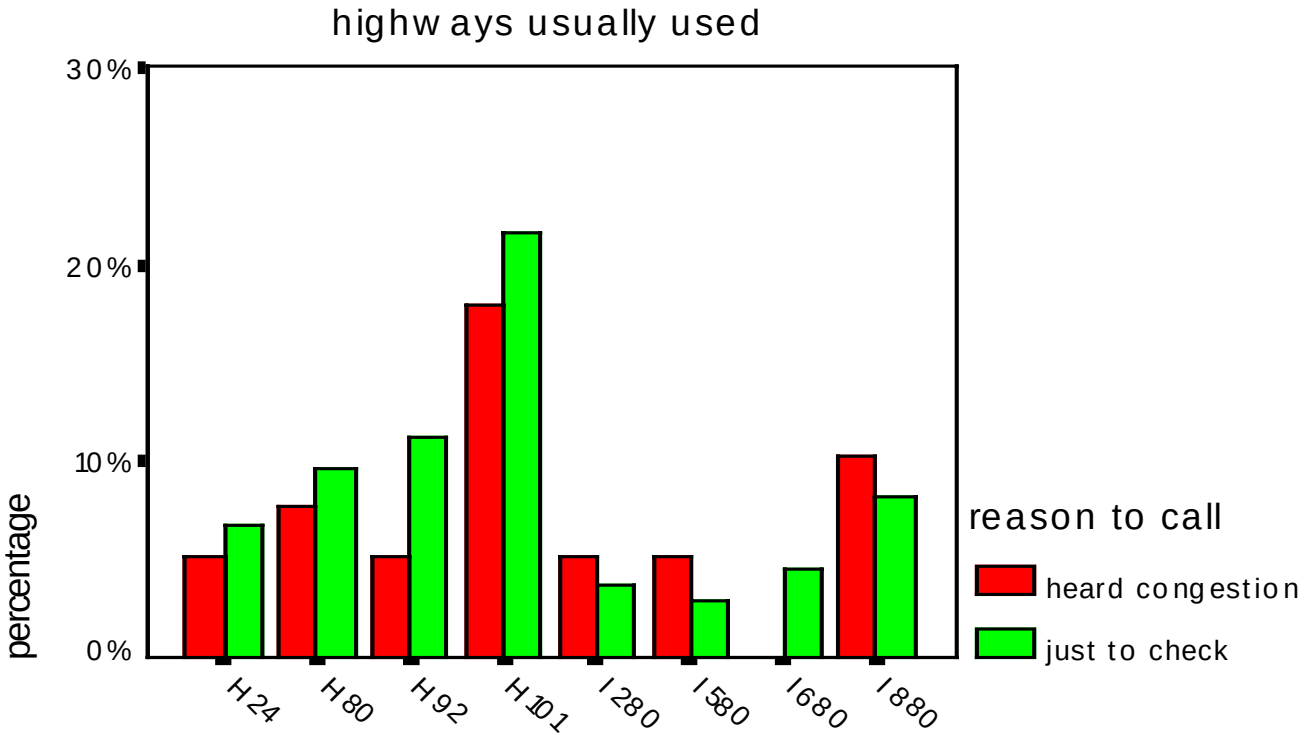
Table 2. Type of trip the users were calling for information about

TravInfo calls	going to work	leaving work	recreational or social event	other
transit users	19.9%	11.8%	18.5%	**49.8%**
those who heard about congestion	**42.9%**	25.7%	11.4%	20.0%
those who wanted to check traffic condition	26.9%	**48.7%**	13.4%	11.0%

3.3.2 Highways usually used

92.2% of the drivers declared they mainly use freeways. By comparison, 50.6% of the Bay Area driving population mainly use freeways--38.4% of non-commuters and 56.9% of commuters shown in the Broad Area survey. This suggests that the TravInfo callers have similar travel patterns. The TravInfo callers most often
utilize Highway 101, I-880 and Highway 80 in decreasing order of use (Figure 6).

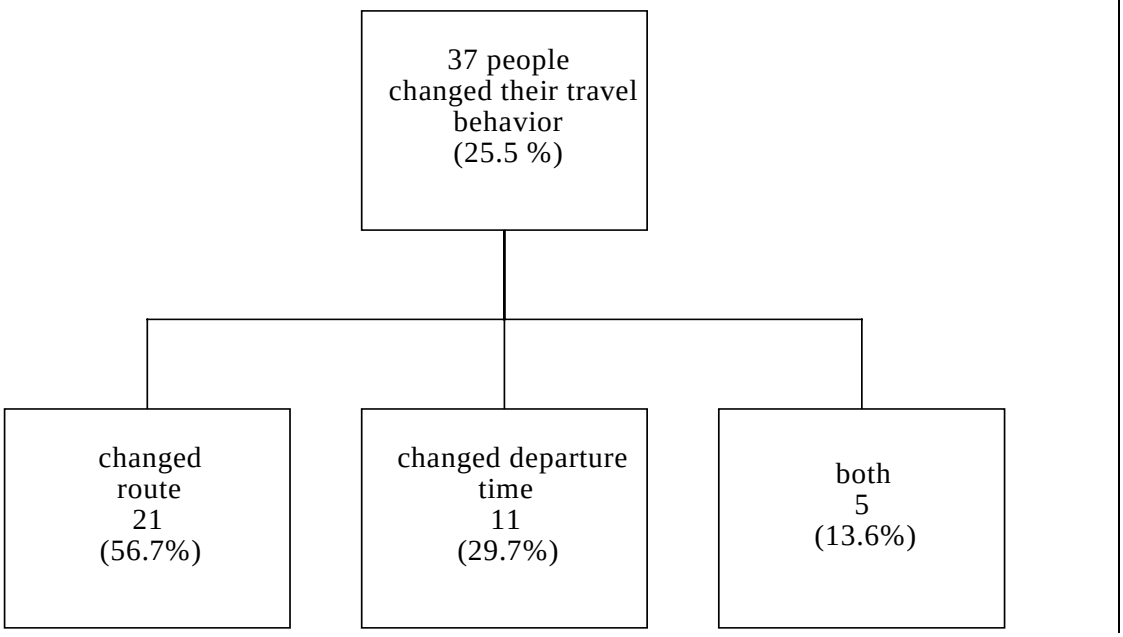
Fig.6



3.3.3 Travel changes

Only 25.5% of the drivers who called TravInfo changed their trip. As Figure 7 shows, 56.7% of these drivers changed their route, 29.7% changed their departure time (57.4% left later and 40.7% left earlier), 13.6% changed both their departure time and route.

Figure 7. Travel changes



The majority of the drivers (93.5%) who called did not change their departure time because there was no indication of congestion or because of other reasons. It seems important to consider the dynamic impact of TravInfo information on travel behavior. Frequent callers tend to change their route more often, and this correlation is even stronger with drivers who call to check on traffic conditions (Figures 8 and 9).

Fig.8

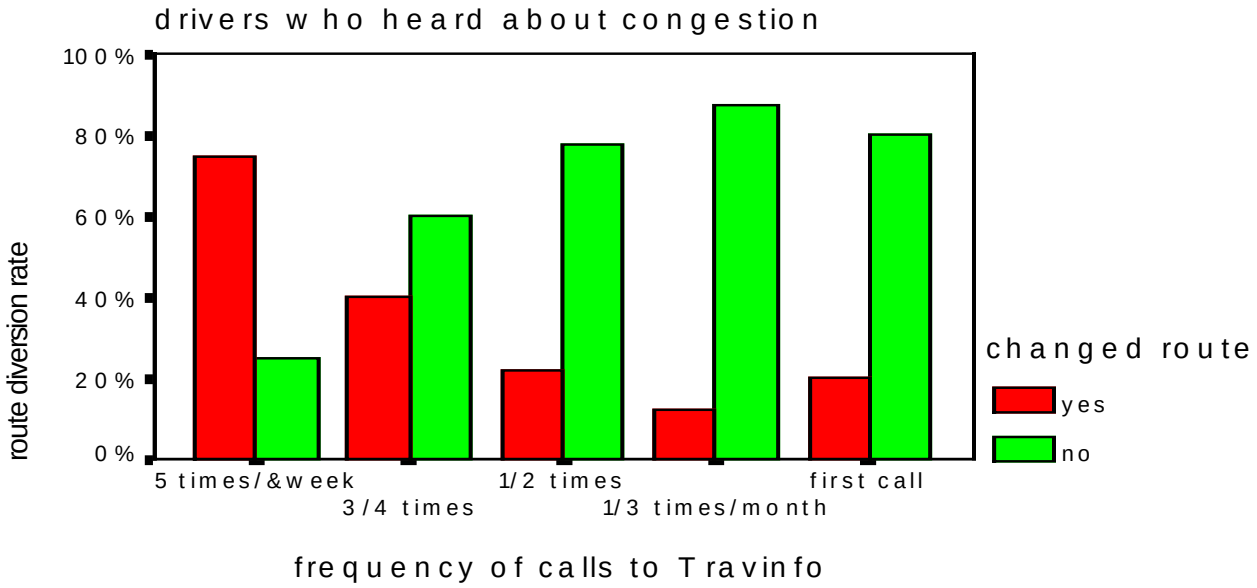
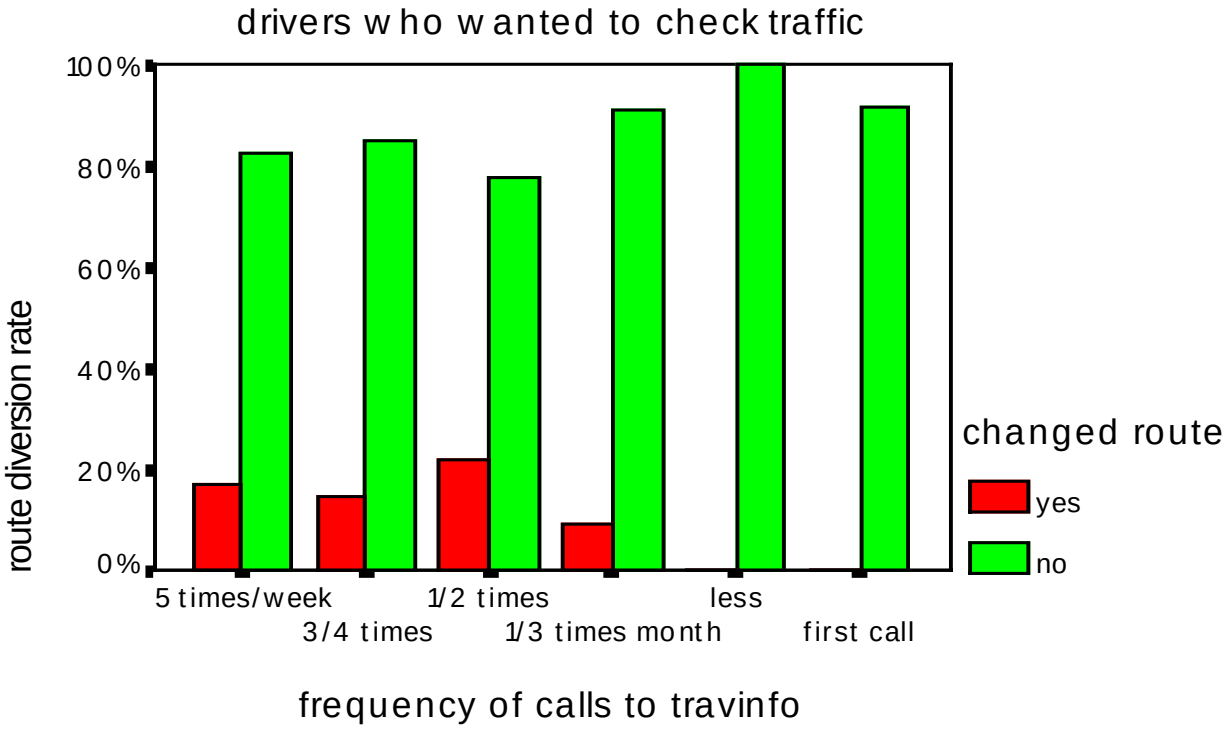

drivers who heard about congestion
100%
80%
60%
40%
20%
0%
route diversion rate
5 times/&week
3/4 times
1/2 times
1/3 times/month
first call
changed route
yes
no
frequency of calls to Travinfo

Fig.9


drivers who wanted to check traffic
100%
80%
60%
40%
20%
0%
route diversion rate
5 times/week
3/4 times
1/2 times
1/3 times month
less
first call
changed route
yes
no
frequency of calls to travinfo

The level of familiarity with TravInfo (i.e. the number of calls per week) has a significant relation to the likelihood that drivers would change their route. The Mantel-Haenzel Chi-square, a commonly-used measure of correlation between ordinal variables is significant at a 90% confidence level among the 144 drivers who called TravInfo (Table 3).

Table 3. Chi-square test of call frequency by route change among drivers

Chi-square	Value	Degree of freedom	Significance
Linear-by-linear association	2.59172	1	0.10742

The same test is significant at a 95% confidence level for the drivers who called TravInfo because they heard about congestion, and it shows a closer association between the two variables for that population (Table 4).

Table 4. Chi-square test of call frequency by route change among drivers who heard of congestion

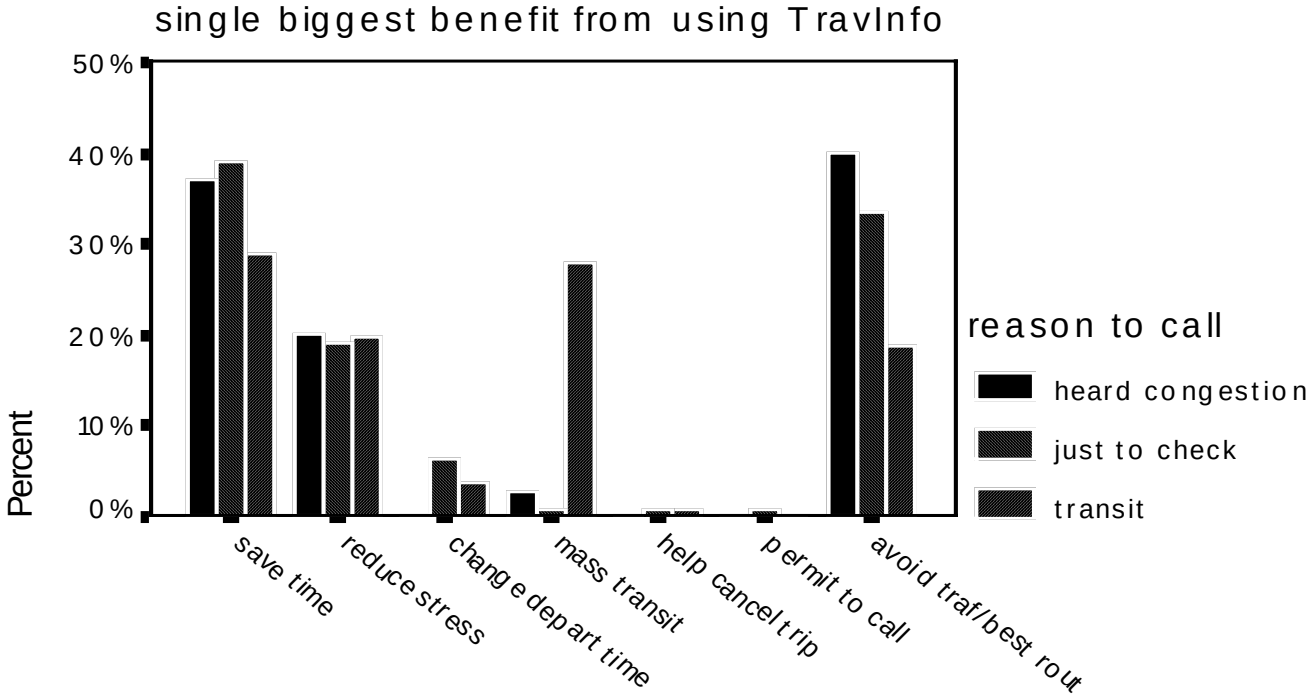
Chi-square	Value	Degree of freedom	Significance
Linear-by-linear association	3.59612	1	0.05791

4 PERCEPTION OF TRAVINFO VALUE

4.1 Perceived benefits

The callers value TravInfo because the service allows them to save time (from 30% of transit users to 40% of drivers), avoid congestion, find the best route (from 20% of transit users to 42% of drivers), and reduce stress (20% among the different categories), in order of decreasing importance (Figure 10). The benefits mentioned by the mass transit users are similar to the benefits cited by the drivers.

Fig.10

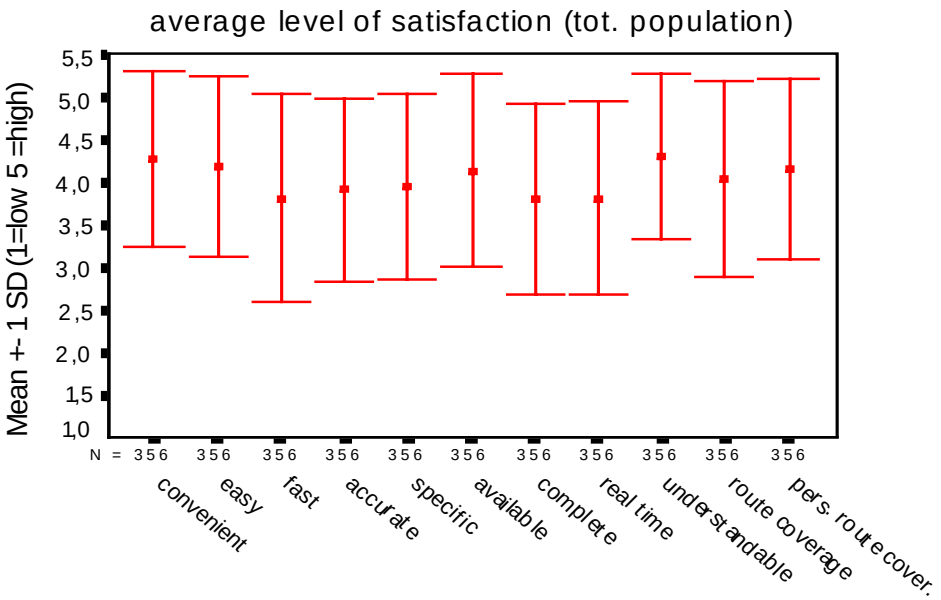


4.2 Level of satisfaction with TravInfo

4.2.1 Drivers vs. transit users

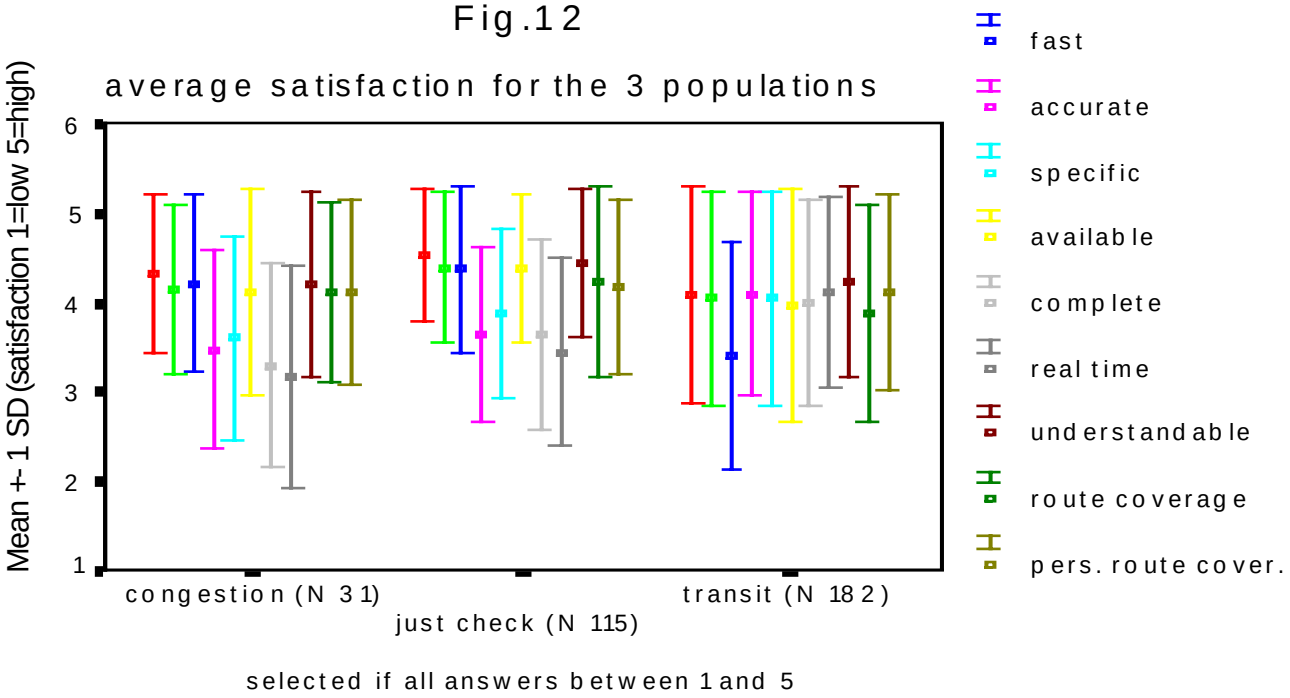
The average level of satisfaction with TravInfo is quite high for the entire population. On a scale of one to five, five being very satisfied, the two highest-ranked aspects of TravInfo were convenience (average score: 4.2) and ease of comprehension (average score 4.3). The lowest marks were given to the time required to obtain the information, the completeness of coverage and the up-to-the-minute accuracy, though these rates remained quite high (around 4) (Figure 11).

Fig.11



There are not significant differences at the 95% confidence level in average scores quoted between drivers who called because they heard about congestion and those who called to check traffic conditions. However, there are important differences between the scores quoted by the drivers and the transit users (Figure 12).

Fig.12



Drivers were more satisfied on average with the information they obtained from TravInfo. The Two-Sample T test was used to test if the mean scores obtained by the two populations for the different variables, drivers and transit users are equal (SPSS/PC+ software v.6). The tests show that the differences in mean are significant at a confidence level of at least 97% for the following variables:

How convenient to use (1 to 5) ----------rated higher by drivers

How easy to use (1 to 5)---------- rated higher by drivers

How fast you can get information (1 to 5) ---------- rated higher by drivers

Having information available when you need it (1 to 5)------- rated higher by drivers

Number of routes covered (1 to 5) ---------- rated higher by drivers

How accurate the information is (1 to 5) ----------rated higher by transit users

How complete the information is (1 to 5) ----------rated higher by transit users

How up-to-the-minute the information is (1 to 5) ----------rated higher by transit users

Table 5. **t-tests for Independent Samples of drivers/transit**

How convenient to use (1 to 5)

Variable	#of Cases	Mean	SD	SE of Mean
DRIVERS	148	4,4932	,778	,064
TRANSIT	182	4,0934	1,202	,089

Mean Difference = ,3998

t-test for Equality of Means					95%
Variances	t-value	df	2-Tail Sig	SE of Diff	CI for Diff
Unequal	3,65	313,22	,000	,110	(,184;,616)

How fast you can get information

Variable	# of Cases	Mean	SD	SE of Mean
DRIVERS	148	4,3378	,937	,077
TRANSIT	182	3,4176	1,279	,095

Mean Difference = ,9203

t-test for Equality of Means					95%
Variances	t-value	df	2-Tail Sig	SE of Diff	CI for Diff
Unequal	7,53	324,63	,000	,122	(,680;1,161)

How easy to use

Variable	#of Cases	Mean	SD	SE of Mean
DRIVERS	148	4,3446	,871	,072
TRANSIT	182	4,0549	1,202	,089

Mean Difference = ,2896

t-test for Equality of Means					95%
Variances	t-value	df	2-Tail Sig	SE of Diff	CI for Diff
Unequal	2,53	323,90	,012	,114	(,065; ,514)

How accurate the information is

Variable	# of Cases	Mean	SD	SE of Mean
DRIVERS	148	3,6149	1,014	,083
TRANSIT	182	4,1044	1,130	,084

Mean Difference = -,4895

t-test for Equality of Means					95%
Variances	t-value	df	2-Tail Sig	SE of Diff	CI for Diff
Unequal	-4,14	324,81	,000	,118	(-,722; -,257)

Table 5. **t-tests for Independent Samplesof drivers/transit -** continued

Having information available when you need it

Variable	# of Cases	Mean	SD	SE of Mean
DRIVERS	148	4,3311	,921	,076
TRANSIT	182	3,9670	1,304	,097

Mean Difference = ,3640

t-test for Equality of Means					95%
Variances	t-value	df	2-Tail Sig	SE of Diff	CI for Diff
Unequal	2,96	322,01	,003	,123	(,122; ,606)

How complete the information is

Variable	# of Cases	Mean	SD	SE of Mean
DRIVERS	148	3,5676	1,083	,089
TRANSIT	182	4,0055	1,154	,086

Mean Difference = -,4379

t-test for Equality of Means					95%
Variances	t-value	df	2-Tail Sig	SE of Diff	CI for Diff
Unequal	-3,55	321,32	,000	,123	(-,681; -,195)

How up-to-the-minute the information is

Variable	# of Cases	Mean	SD	SE of Mean
DRIVERS	148	3,3919	1,104	,091
TRANSIT	182	4,1154	1,073	,080

Mean Difference = -,7235

t-test for Equality of Means					95%
Variances	t-value	df	2-Tail Sig	SE of Diff	CI for Diff
Unequal	-5,99	310,71	,000	,121	(-,961; -,486)

Number of routes covered

Variable	# of Cases	Mean	SD	SE of Mean
DRIVERS	148	4,2162	1,053	,087
TRANSIT	182	3,8901	1,212	,090

Mean Difference = ,3261

t-test for Equality of Means					95%
Variances	t-value	df	2-Tail Sig	SE of Diff	CI for Diff
Unequal	2,61	326,52	,009	,125	(,081; ,572)

4.2.2 Perception of TravInfo and comparisons with other means of traffic information

There is a very significant relation between the overall evaluation of TravInfo and the rating of TravInfo in comparison to television or radio traffic information. Drivers who like TravInfo more tend to consider TravInfo to be better than television or radio traffic information reports.
Table 6 presents the cross tabulations results for the 159 drivers who responded to both questions. The table is read as following: 30.8% of drivers are very satisfied with TravInfo, 18.4% of which say TravInfo is about as good as television or radio information, while 30.6% say TravInfo is somewhat better and 51.0% say it is much better.

Table 6. Association between the overall rate of TravInfo and the comparative evaluation of TravInfo with TV and Radio traffic information

Q65 Overall quality of TravInfo
by Q79 TravInfo compared to TV and Radio infor

	Q79					
Q65	Much worse 1	Somewhat worse 2	About the same 3	Somewhat better 4	Much better 5	Row Total
1 very dissatisfie	2 100,0 50,0 1,3					2 1,3
2 dissatisfied	1 50,0 25,0 ,6			1 50,0 2,1 ,6		2 1,3
3 neutral	1 4,0 25,0 ,6	8 32,0 72,7 5,0	9 36,0 23,1 5,7	6 24,0 12,5 3,8	1 4,0 1,8 ,6	25 15,7
4 satisfied		3 3,7 27,3 1,9	21 25,9 53,8 13,2	26 32,1 54,2 16,4	31 38,3 54,4 19,5	81 50,9
5 very satisfied			9 18,4 23,1 5,7	15 30,6 31,3 9,4	25 51,0 43,9 15,7	49 30,8
Column Total	4 2,5	11 6,9	39 24,5	48 30,2	57 35,8	159 100,0

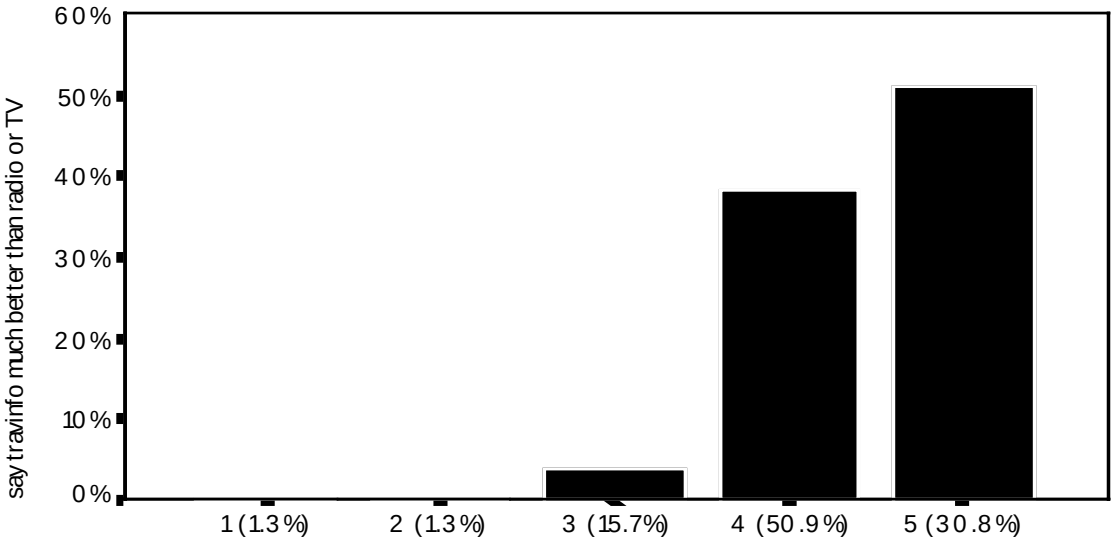
The Mantel-Haenzel Chi-Square is significant at a 99.999% confidence level, which shows a strong statistical association between the two variables. Figure 13 shows the strength of the association.

Table 7. Chi-squire test of association between TravInfo and other information sources

Chi-square	Value	Degree of freedom	Significance
Linear-by-linear association	42.92858	1	0.00000

Fig.13

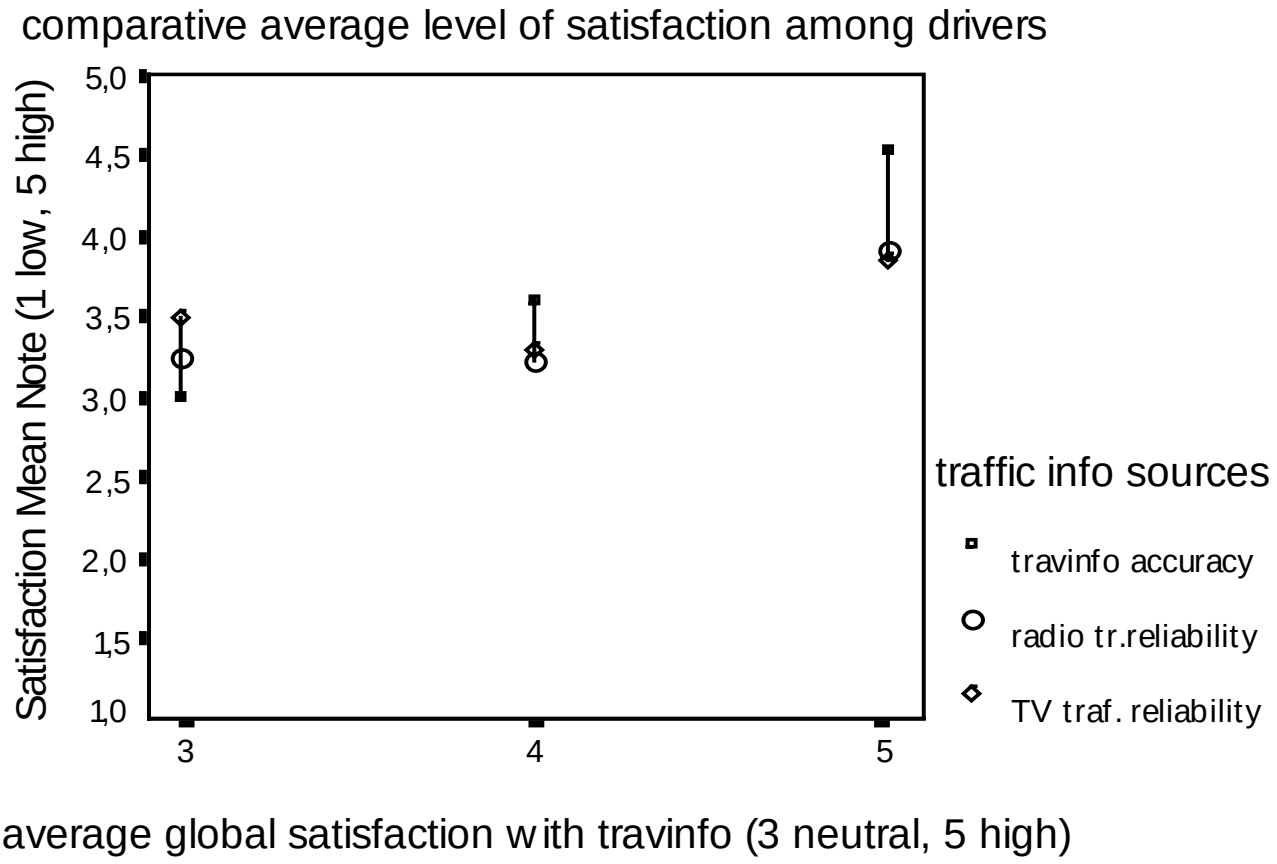
comparisons of TravInfo with radio and traffic



The results also show that there might be a general pattern among the drivers as to how they rate traffic information sources, and that this pattern is not only related to the TravInfo service. When drivers are very satisfied with TravInfo, they tend to prefer TravInfo to television or

radio information, but they also tend to give higher rates to television and radio traffic accuracy (Figure 14). One can thus hypothesize that there is a positive perception of the traffic information quality among specific segments of the population, regardless of the source of information.

Fig.14



The level of satisfaction varies with the frequency of use with TravInfo and we can expect that the average level of satisfaction will increase over time because the great majority of TravInfo callers (90%) say they will use TravInfo again. This pattern is similar for both drivers and transit users.

5. MARKET ISSUES

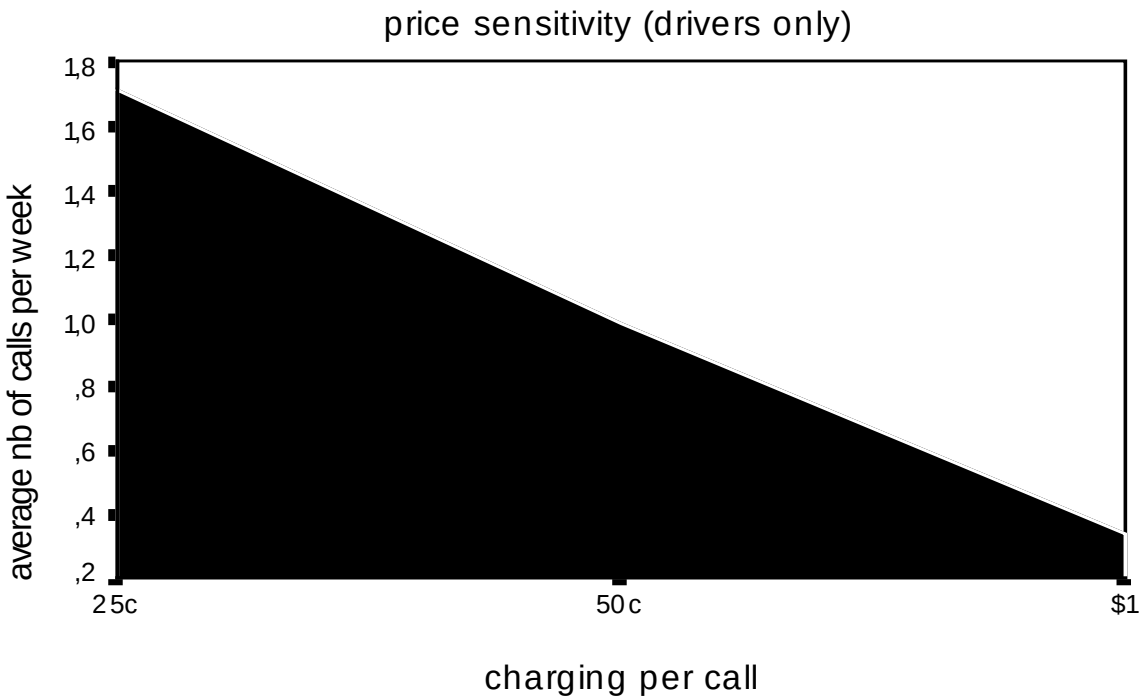
5.1 Monetary value of the service

As observed in other studies (Multisystems, 1996; Beaton, 1994; Beaton and Sadana, 1995; Harris, et al., 1995), the TravInfo callers do not seem to value the TravInfo service very much even if they are very satisfied with it. When frequent callers were asked about how many times they believed they would call TravInfo if the charge was 25 cents per call, the number of callers would drop by 20%, if it was 50 cents, the number would drop by 60%, if it was $1, the number would drop by 80%. These responses include both drivers and transit users. (Frequent callers are defined as those who call TravInfo at least three times a week.) When referring to traffic information for drivers, the number of callers would drop even more significantly if the charge was 25 cents per call; the number of callers would drop by 39% (if the charge was 50 cents, it would drop by 50%; if it was $1, it would drop by 80%).

The SmarTraveler study in Boston showed similar results about price sensitivity among travelers. If the subscription fee was $5 a month, the number of subscribers would drop by 50%. If the fee was $10, less than 2% of SmarTraveler users would continue using it. The study done by the New Jersey Institute of Technology found a similar trend. A subscription fee of $5 a month would decrease the number of subscribers by 42%.

The TravInfo study shows that the average willingness to pay for the service would be about $2 a month for the drivers and that the users would adjust their number of calls depending on the charge per call (Figure 15).

Fig.15



The monthly payment that the transit users would accept is about half that of the drivers. The survey results suggest that consumer willingness to pay for traffic/transit information is significantly lower than the cost of TravInfo operation. Therefore, it may be necessary to support the service with public funds until it becomes self-sustainable.

5.2 Customizing the service

At this point, the main issue remains in understanding the mechanisms of valuing the TravInfo types of services by the users. It remains unclear if the users most highly value the information itself or if the users most highly value the help the information provides in driving situations.

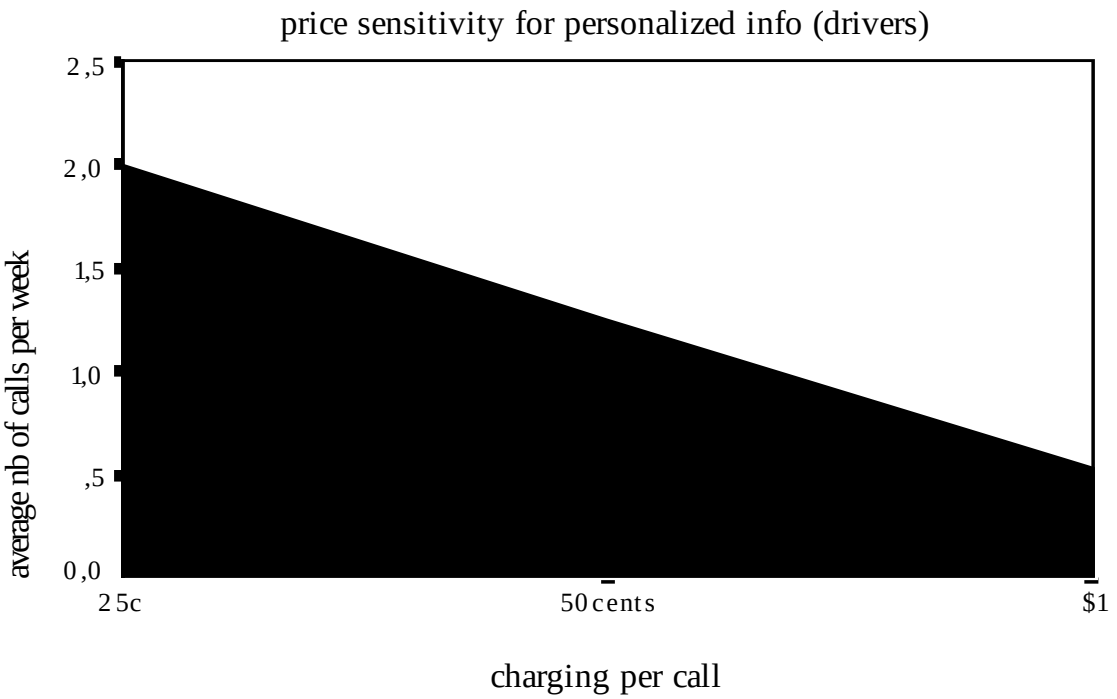
It is quite easy to understand how drivers can value the information itself, but it is more difficult to ascertain if the drivers really saved time as a result of obtaining information from TravInfo, or if it was even possible to save time when they took an alternate route. It is, however, important to determine the characteristics of these two parameters before attempting to further explain the monetary value of TravInfo to the users. The survey showed that TravInfo callers were more satisfied with TravInfo because of its convenience than other attributes such as

accuracy, dynamic information, availability, etc. 'Convenience' was rated 4.2 on a scale of 5 being 'very satisfied.'

The survey also showed that the TravInfo information was rated slightly higher than radio or television traffic information as suggested in Figure 14. Comparing the radio and television information, which is free, respondents were willing to pay for TravInfo information. This implies that consumers' value TravInfo information more than radio or television traffic reports. The willingness to pay for TravInfo value added services may be in the range of $2 per month, which does not give any idea of the value of basic information via radio. The value of traffic information cannot be measured only in monetary terms, i.e., willingness to pay for information. The value of the information service is relative to what is already available in the region such as radio and television traffic reports in the Bay Area. The more the drivers perceive the benefits of traffic information the more the drivers tend to access traffic information through multiple means, as explained in the previous section. However, if no information is available, the value of information (among those who think they benefit from traffic information) may be perceived to be higher. For example, a German telecom group, Mannesmann Autocom GmbH, is launching a paid traffic information service in Germany for the interurban autobahn network. The business strategy of the group is to offer customized information services to cellular subscribers on an exclusive basis. The purpose of the 'exclusivity' is to ensure that the value of traffic information to those who subscribe to it be recognized and its service be shared by a relatively small group of users. This business approach is different from the traffic information industry in the U.S. The U.S. system is media dependent and thus the concept of exclusivity may not be the information providers (Malchow, et al, 1996)

The price sensitivity of personalized TravInfo information for drivers is similar to the price sensitivity of TravInfo information in general (Figure 16), which may mean that the drivers do not foresee that personalized information would be significantly different or more valuable than the non-personalized information they obtain today. There were not enough valid cases available to evaluate the value of personalized information for transit users.

Fig.16



It should be noted that 30% of the drivers called TravInfo from cellular phones and consequently had to pay to use the service due to airtime fees of 49 cents per minute.
(However, in some cases, the monthly subscription fee can cover all calls made for traffic information.)

Such users therefore seem to give a higher monetary value to TravInfo information than the remaining population does, although the price of obtaining TravInfo traffic information over the cell phone is lower than the price of traffic information offered by cellular providers. Figures 17 and 18 show the differences in estimated monetary value of actual TravInfo information and personalized information among the drivers who used cellular phones to connect to TravInfo. It appears that there is a higher elasticity with respect to personalized TravInfo services among cellular subscribers.

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Fig.17

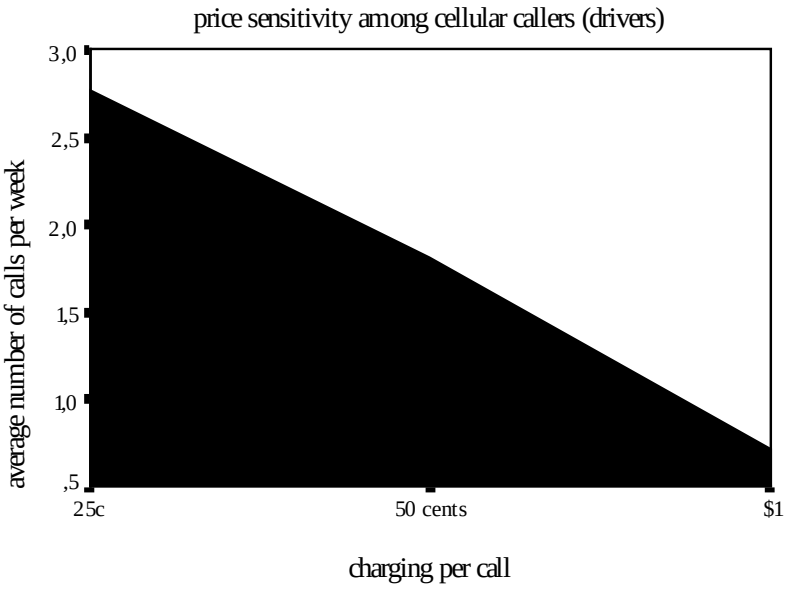
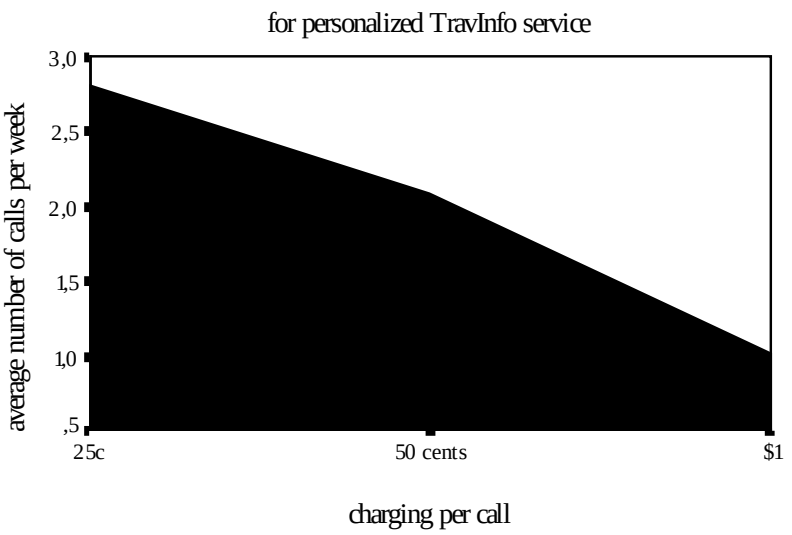

price sensitivity among cellular callers (drivers)
3,0
2,5
2,0
1,5
1,0
,5
average number of calls per week
25c
50 cents
$1
charging per call

Fig.18


price sensitivity among cellular users (drivers)
for personalized TravInfo service
3,0
2,5
2,0
1,5
1,0
,5
average number of calls per week
25c
50 cents
$1
charging per call

6. MULTIPLE CORRESPONDENCE ANALYSIS

The main issues related to the marketability of TravInfo pertain to data sources of traffic information, such as radio reports, the perception of the various services enhanced by TravInfo and changes in the behavior of motorists as a result of TravInfo. The findings of the survey presented in Sections 3, 4, and 5 are based on crosstabulations of two variables using the stepwise method. In this section, we present the results of the multiple correspondence analysis using the nonlinear principal component analysis method known as PRINCALS in an SPSS environment (P R I N C A LS - VERSION SPSS 6 BY DEPARTMENT OF DATA THEORY UNIVERSITY OF LEIDEN, THE NETHERLANDS). An important attribute of this method is that it can examine preference data ranked or rated by respondents in multiple steps. It also permits gaining a better and global understanding of the relationships among several variables under consideration. Its principal component is a statistical technique that linearly transforms an original set of variables into a smaller set of uncorrelated variables, yet it represents most of the information in the original set of variables.

This statistical method is often used for the categorical data. These data are typically summarized in contingency tables. Analysis of tabular data requires a set of statistical models, based on Chi square tests and distances. This method is different from usual correlation and regression based approaches used for quantitative data. The nonlinear principal components analysis extends this method to examine ordinal data as well. The survey data dealing with preferences that are ranked or rated such as in the case of TravInfo, can be effectively examined using this method.

The following variables were examined :

q1 : main reason to call TravInfo - value label	1- those who heard about congestion 2 -those who want to check for traffic
q28: change intended route as a result	1-yes 2-no
q51: frequency of calls to TravInfo	1- five or more times a week 2-three to four times a week 3-one to two times a week 4- one to three times a mount 5-less than once a month 6- first call
q65: level of satisfaction with the TravInfo quality	1-very dissatisfied to 5- very satisfied
q69: usefulness of radio traffic reports	1-poor to 5- excellent
q82: evaluation of possible personalized TravInfo information	1-not important at all to 5-very important

The eigenvalues (correlation between row and column scores) showed that the first two dimensions (axis representing combination of sets of variables) have a total value of .3042 + .2048 = .509. This square value, .259, indicates that the two dimensions represent 25.9% of the total variance. In other words, almost 26% of the variance of the 25 categories of the six variables can be represented in two dimensions (along the x-axis and the y-axis).

Dimension	Eigenvalue
1	,3048
2	,2048

Further analyses show the contribution of each variable along two dimensions:

Single Fit

Variable	Row Sums	Dimension	
		1	**2**
Q1	,554	,496	,058
Q51	,596	,476	,120
Q65	,587	,587	,001
Q69	,635	,116	,520
Q82	,515	,145	,370
Q28	,170	,009	,161
Mean:	,510	,305	,205

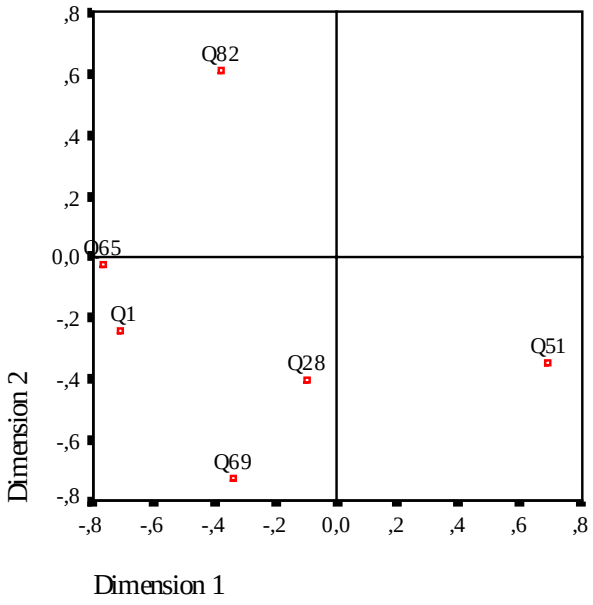
The first dimension is primarily a combination of q1 (reason to call TravInfo), q65 (level of satisfaction with TravInfo), and q51 (frequency of calls to TravInfo).

The second dimension is mainly a combination of q69 (level of usefulness of radio traffic information for the drivers) and, to a lesser extent of q82 (level of interest for a more personalized information from TravInfo). The variable q28 (route change) contributes to the dimension 2; the contribution is small because few people in fact changed route, as indicated in the previous section.

A graphical plot of component loadings of the six variables along two dimensions are presented in Figure 19. The component loadings, i.e., coordination along the two dimension axis

are equivalent to the Pearson correlation between the quantified data and the object scores (responses of each individual) .

Fig.19 Component Loadings



Component Loadings

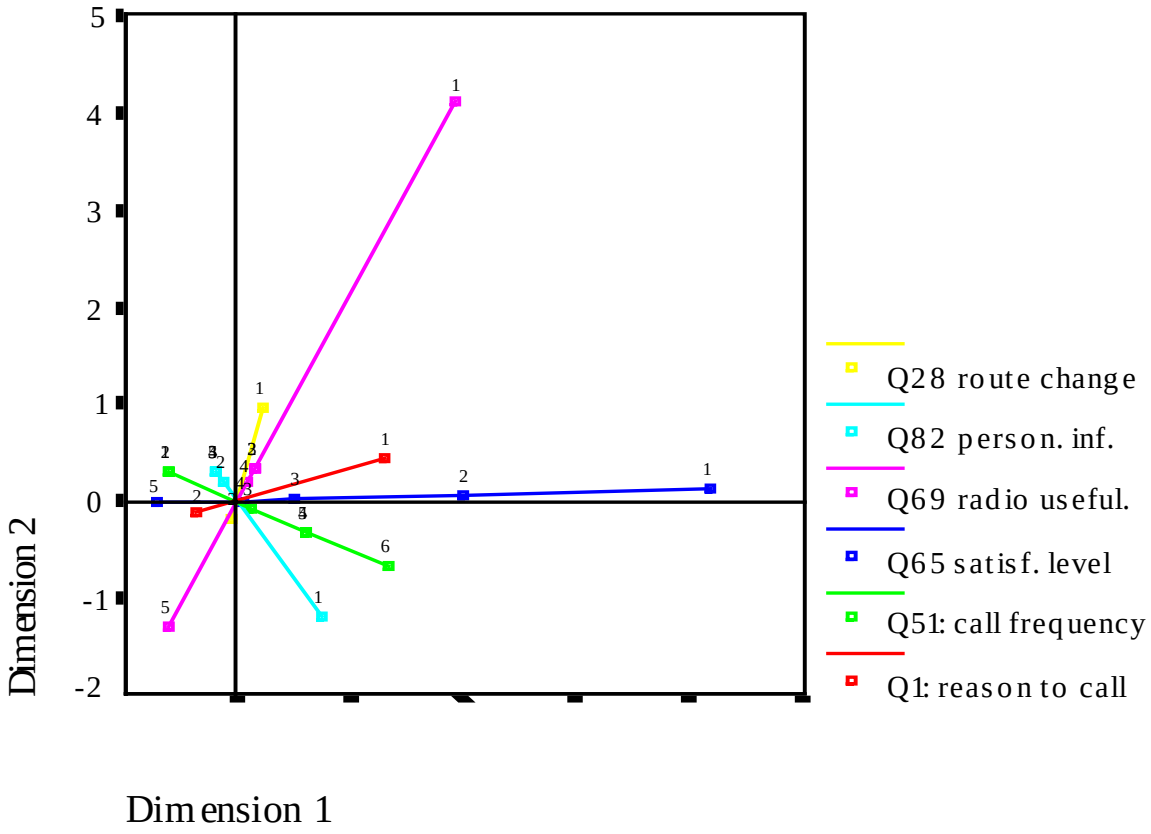
Variable	Dimension	
--------	**1**	**2**
Q1	-,704	-,240
Q51	,690	-,346
Q65	-,766	-,023
Q69	-,340	-,721
Q82	-,381	,608
Q28	-,096	-,401

Apparent relationships between variables are shown in Figure 19. In Dimension 1, along the x-axis, the distance between the variables q1 and q65 are close, but they are farther away from the

variable q51 on the opposite side. In Dimension 2, along the y-axis, variable q69 is located on the opposite side of the variable q82.

Figure 20 shows a plot of different values for each category in the variables considered in a two dimensional environment. Figure 20 provides a detailed explanation of the relationships:

Fig.20 All Category Coordinates



This figure shows that most of the ordinal values of the variables are increasing or decreasing along the x- or y-axis which means that the survey responses are clustered in some manner by which relationships can be explained.

Dimension 1 differentiates the group of drivers who called TravInfo because they heard about congestion, but they were not satisfied with the quality of the information. They

represented the first time or infrequent callers. The clusters of those who called often are satisfied with the quality of information and their purpose of the calls is mostly to check incidents or bottlenecks.

Dimension 2, along the y-axis, showed two extreme situations: a very low level of interest in listening to radio traffic reports (score 1) and strong interests in subscribing to the personalized TravInfo service. The other situation was a high level of interest in obtaining radio traffic information (level 5) and a very low need for the personalized TravInfo service (score 1 on a scale to 5). The multiple correspondence analysis showed that a higher correlation among variables in Dimension 1 exists in route change behavior than the correlation found in Dimension 2.

One could hypothesize that the **first dimension** of the analysis represents a satisfaction function with TravInfo where drivers value the information itself and **the second dimension** represents a utility function of traffic information where drivers value the information as far as it is related to their driving experience. These results should be confirmed through different surveys with more respondents to increase the robustness of the statistical analysis.

The contributions of the different categories to the two dimensions may lead to the assumption that the level of satisfaction with TravInfo does not give any indication of the real impact of this information on travel behavior. At the early stage of development, TravInfo must be compared with other sources of information to know if this service is considered as a substitute or as a complement to existing ones. The answers to this question may help to design advertisement campaigns and to better explain the goals of the service.

7. CONCLUSIONS

The paper was concerned with TravInfo callers in respect to the usage of traffic/transit information, its influence on travel decisions, and the perception of TravInfo for the quality of information. The first wave of the TravInfo user survey was administered in April 1997 over a two-week period, approximately eight months after TravInfo became operational. This paper presents the preliminary results of the first wave of the TravInfo user survey. The key finding of the study was that the perception of traffic information was significantly different from that of transit information. The majority of the participants found that the TravInfo traffic information service is quite reliable and accurate, and gave high marks. On the other hand, the transit information service was thought to be less efficient in its delivery, even though the majority of the respondents rated the service above average.

Furthermore nearly 90% of the traffic information callers made trips subsequently while only 50% of those who asked about transit information made trips. This suggests that the net benefits of traffic information to users are perceived differently from the benefits of transit information. The perceived benefits of traffic information were to avoid congestion but the benefits of transit information was to make a trip without getting lost.

Finally, the majority of participants among drivers indicated that they are willing to pay $2 per week for the TravInfo traffic information service. Although the value of information cannot be measured solely on the willingness to pay for information, our survey results concur with the results of the SmarTraveler caller surveys in the Boston region (Multisystems, 1996).

The results presented in this paper are limited to the results drawn from a small sample of traffic information callers. To improve the results significantly, it is necessary to increase the sample size for this type of survey research. It should be noted that approximately 80% of the calls were directed to transit information during the month of April, 1997. Although the ratio between transit and traffic information inquiries varied by area code, only 6,870 calls were for traffic information while 33,200 were for transit. The evaluation of the Traveler Information Center (TIC) where the TravInfo information service operates, found that the call characteristics of three subregions, north (area code 707), south (area code 408) and peninsula (San Francisco

area, area code 415) were significantly different from the call characteristics of the East Bay (area code 510). The call volume in April showed that while 90.7% of the calls in area code 510 were for transit, over 50% of calls in other area codes were for traffic. The call volume data suggest that there is a need for additional surveys after the call volume of traffic inquirers reaches a sufficiently high level in order to measure the impact of TravInfo on travel behavior. The net impact of the TravInfo services on the roadway network performance can be measured most realistically when the TravInfo project is fully deployed.

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