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ABSTRACT

This paper presents the final results of the Target Study conducted for the evaluation of the TravInfo Field Operational Test. Four waves of telephone surveys were conducted in 1997 and 1998 among commuters shortly after major incidents on a selected corridor. The case study corridor is a 16 mile segment of US 101 serving major cities between San Francisco and San Jose. The commuter surveys were aimed at an understanding of travel behavior when major incidents occur. The results of the surveys suggest that traveler behavior is not greatly affected by individual incidents causing delays of less than 15 minutes. Although a fair portion of commuters listen to radio traffic reports, they do not often modify their travel behavior in response. In general, commuters do not believe that changing their travel plans will result in shorter travel time. Commuters tend to believe that their normal travel plans are faster than or as fast as alternate plans; however, they value traffic information more for the intangible benefits, such as the ability to reduce anxiety or stress. A 12 minute delay for a 35 minute commute might not be a strong enough incentive to shift mode or switch route because alternatives would not necessarily offer shorter travel time when encountering congestion due to an incident.

KEYWORDS: Incident, travel behavior, benefits, traffic information

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EXECUTIVE SUMMARY

TravInfo is a federally funded Field Operational Test (FOT) aimed at the implementation of a regional advanced traveler information system in the San Francisco Bay Area. The four major test elements are institutional evaluation, technology assessment, traveler response and network performance. The traveler response evaluation has four coordinated studies; 1) Broad Area, 2) Target, 3) TravInfo Traveler Advisory Telephone Information System (TATS), and 4) Information Service Provider (ISP) Customer Studies. The paper presents the final results of the Target Study, a case study of commuter response to traffic information on incidents along US-101 south of San Francisco.

The Target Study is aimed at an understanding of traveler response to incident information. The study objectives are to 1) understand the extent to which incident information influences travel decisions, 2) measure the effects of incident information on overall travel patterns, and 3) assess the benefits of incident reports to travelers. The Target Study corridor on US-101, just south of San Francisco, is well known for its congestion. This corridor was selected because it offers several alternate roadways and mass-transit options for commuters who utilize it.

Within three to four days following a major traffic incident along the highway segment, a sample of commuters who used the highway during the time of the resulting congestion was interviewed. To date, four such incidents have been covered, and the current results of the studies are presented here.

Two of the incidents covered occurred in July of 1997 and the second two occurred in June of 1998. In each month, one northbound and one southbound incident were considered. Sample sizes in each case ranged from 80 to 106 commuters. Demographically, the sample was predominantly white or Asian, highly educated and financially well off. Despite this skewed result, however, it seems the sample well represented those who lived in suburbs south of San Francisco. This region is among the wealthiest in the Bay Area and commuters typically are driving to high-paying managerial or highly specialized jobs in Silicon Valley or San Francisco. Descriptive statistical methods were used to determine distributional profiles and association between variables.

The following are the summary findings of the four surveys of northbound and southbound travelers who

encountered major incidents.

- Ideally, traffic information would divert travelers away from congestion. Generally, commuters have the opportunity to obtain traffic information both before departure and *en route.* However, those who obtain information don't necessarily use it, and those who endure bad traffic one day are not necessarily going to be affected enough by it to obtain more information the next day.

- Of those respondents who actually encountered traffic on Highway 101, 64.8% said that they were no more likely to obtain traffic information prior to departure, and 54% said that they were no more likely to obtain traffic information *after* departing.

- Of those who obtained traffic information before or during their commute, 36.8% thought the information they received helped them save time, and 9 % thought the information made them waste time. However, over half (52.3%) were *unsure* as to whether the traffic information helped them.

- Although some believed the information they received made them waste time, half of them (50.0%) said they were nonetheless more likely in the future to obtain traffic information during their commute. And 66% of those who thought the information had saved them time said that they were more likely to obtain traffic information *en route* in the future. In contrast, however, of those who said they didn't know whether the information had saved them time, 63% (62.9%) said they were no more likely to obtain traffic information *en route* in the future. Obviously, this is not ideal. People tend to be unsure about whether traffic information is beneficial to them. If people believed traffic information has helped them save time, they would probably be more likely to obtain information in the future.

- Commuters have three ways they can alter their travel in response to hearing of traffic congestion: they can change their time of departure, they can change their mode of travel, or they can choose an alternate route to avoid the congestion. Of those who had obtained traffic information, only 17% (17.4%) changed their departure time, 9% (8.7%) changed their method of travel and 24% (23.7%) took an alternate route to Highway 101. Reasons are that respondents did not believe changing departure time (50.0%) or taking an alternate route to Highway 101 (39.7%) would help them them time and many believed the traffic would clear shortly (21.1% overall, on average). The reason why drivers feel this way might be explained by how much time they felt they lost during their commute.

In fact, of those who heard about or witnessed congestion on Highway 101, they said their commutes took 11.9 minutes longer than normal (on average; extreme values omitted). 45% (45.1%) said their commute time was just the same as normal, and only 19% (18.5%) said their commute took at least 20 minutes longer than usual.

Regardless of whether drivers actually lost more than 11.9 minutes on average, driver *perception* is what matters when it comes to whether commuters will modify their travel plans to avoid traffic congestion. Drivers are increasingly becoming accustomed to longer commutes. The average estimated typical commute was 34 (34.1) minutes long; thus an 11.9-minute delay might not be a strong enough incentive to avoid the stop-and-go freeway traffic. Their alternatives are similarly frustrating: stoplights, stopsigns and low speed limits on local roads, long out-of-the-way detours, waiting for the next BART train at the local park-and-ride, waiting for an hour until traffic clears, and so on. And drivers realize there is always the possibility that making such efforts to avoid an incident may be unnecessary, as the traffic might clear, or the alternatives may actually take longer than the normal travel plan.

Commuters therefore tend either to believe that their normal travel plans are faster than alternate plans or they value other benefits of traffic information over saving time.

In order to maximize efficiency in the event of an congestion-causing incident on existing road systems, travelers need to adapt dynamically to existing traffic conditions, yet ironically it seems they will be resistant to adaptation because traffic delays are not yet long enough.

1. INTRODUCTION

As part of the *traveler response* evaluation of the TravInfo Field Operational Test – telephone and internet-based traffic-transit information services available in the San Francisco Bay Area – studies are currently underway to analyze the likelihood that traffic information will affect commuters' travel behavior. Many scholars and transportation professionals believe that incident information will result in significant reductions in delay or substantial savings in travel time. Recently, several studies have attempted to measure the effects of incident information on incident-caused delays; the results were often inconsistent (1, 2). The Target Study is aimed at an understanding of traveler response to incident information. Its purpose is to add knowledge to the existing literature in travel behavior and traffic information to provide information about the Bay Area traveler behavior to the TravInfo project partners. The study objectives are to:

- Understand the extent to which incident information influences travel decisions
- Measure the effects of incident information on overall travel patterns
- Assess the benefits of incident reports to travelers.

The Target Study is part of the traveler response evaluation elements. The traveler response evaluation of the TravInfo Field Operational Test consists of the Broad Area study, Traveler Advisory Telephone System caller study, Target study, and Information Service Provider customer study. The traveler response evaluation is one of the four evaluation elements. The other evaluation elements are Institutional, Technology and System Performance. The results of the initial two waves of the Target surveys are documented in the PATH working paper (3). This working paper reports on the results of all four waves of the Target surveys.

Using a 16-mile segment of US 101 south of San Francisco as a case study corridor, telephone surveys were conducted immediately following four major incidents on this corridor among those who traveled on the morning of the incident. The corridor was selected based on the

availability of alternate routes and mass-transit options. The northbound traffic typically consists of commuters heading for the San Francisco Central Business District and the southbound of commuters heading for Silicon Valley, a major employment center of the electronic and computer industry. Incidents were selected based on pre-determined criteria that included an incident blocking at least one lane and longer than 30 minutes.

The first two incidents meeting the selection criteria occurred in July 1997 and the second two occurred in March 1998. In each month, one northbound and one southbound incident were considered. Immediately following the incident, telephone interviews were conducted with those who traveled on the affected corridor. The paper reports on the findings of the telephone surveys of those who traveled on the study corridor in the morning of the incident in July 1997 and March 1998.

2. PREVIOUS STUDIES

Since the early 1990s, several studies have attempted to identify travel attributes that are specifically influenced by traffic information. Surveying two waves of morning commuters (in 1992 and in 1993) in the Los Angeles metropolitan area, Abdel-aty found that commuter travel behavior is influenced by traffic reports on route choice but depends on perceptions of traffic information, freeway use, commute distance, gender, and the level of education (4). The study also indicated that men and women behave differently; more men than women listen to traffic reports en route; women more often take an alternate route or change their departure time. In the Los Angeles metropolitan area, 36.5% of the survey participants listen to traffic reports before leaving home and 51.2% listen en route. Approximately 60% listen to reports pre-trip or en route. These results were similar to the study of Bay Area commuters conducted in 1995 (5). Los Angeles commuters tend to listen to traffic reports when they expect traffic problems in bad weather. Commuters' route choice is influenced more by observation of traffic congestion than by radio traffic reports.

In 1993, Khattak conducted surveys of morning and afternoon commuters on the Golden Gate Bridge in the San Francisco Bay Area (6, 7). The study found that when people became aware of an incident prior to departure, they expected their travel time to be about a half hour longer than usual, but the actual delay was somewhat shorter. Of those who learned about congestion pre-trip, 45% maintained their original travel plan. Of those who altered the travel plan, 37% changed their departure time, 21% took an alternate route, 2% shifted to public transit and 2% canceled the trip. In en route travel choices, the study showed that commuters who encountered congestion based on an incident expected about a 20 minute delay but experienced a longer delay. Most drivers who had the option to take an alternate (20%), in fact, did so but half of them eventually returned to the original route before completing the trip. Only 0.5% took public transit though 3.5% had the option of taking it. The study found that people were reluctant to follow travel advice, mainly because of their behavioral inertia. Accurate delay time information may influence travelers to a greater extent.

In 1996, Mahmassani investigated path-switching decisions by commuters in response to real-time traffic information using a multinomial probit model. The study found that the departure time and route-change decisions are predicated on the expectation of an improvement in travel time that exceeds a certain threshold depending on travel time to the destination and the importance of perceived information quality on user decisions (8).

These studies have dealt generally with commuter travel behavior with respect to traveler information. The present study deals with commuter responses to traffic information for a specific incident and how they changed their travel behavior based on traffic information on the morning of the incident.

3. METHODOLOGY

This section describes the criteria used for corridor selection and the methods used for survey administration and data analyses.

Corridor Selection

The selected corridor for the Target surveys is a 16-mile segment of the US-101 corridor between the interchange of US-101 and SR 92 to the south and the interchange of US-101 and I-280 to the north. This segment was selected because of the frequent occurrence of major incidents, the availability of strong transit alternatives (SamTrans and Caltrains) and alternate routes (I-280 and parallel arterials).

Survey Method

The computer aided telephone interview (CATI) method was employed in order to collect data. Survey participants were recruited from those auto-owners who traveled on the case study corridor between 6 and 10 AM. Using the video assisted license plate method, volunteers who would participate in the survey were recruited. 563 southbound and 526 northbound commuters agreed to participate.

Incident Selection Criteria

Based on the historical data, the incident selection criteria were developed. The incident must: 1) be located within the study corridor, 2) occur between 6 AM and 9 AM, 3) have an effect lasting at least 30 minutes to ensure that a reasonable percentage of the population using the corridor is affected, 4) have a significant effect on traffic conditions, blocking at least one lane, and 5) not be "catastrophic" (e.g., cannot block the entire freeway for many hours).

The Incidents

Both southbound and northbound commuters were surveyed. US-101 southbound is the primary route to Silicon Valley, a major employment center of the electronic and computer industry. US-101 northbound is the primary route to the San Francisco Central Business

incident and traffic conditions into something quantitative; it would not tell much besides that there is a difference between the data sets. In addition the sample sizes were too small to extrapolate, for example, that more and more people are using different information sources, or that more people are now using traffic reports to change their route choices.

Comparing the northbound and southbound samples suggests a similar situation – there may be differences between the northbound and southbound behavior, but again it would be difficult to explain quantitatively what correlation there is between this behavior and demographics. Therefore, the results of the surveys presented in the paper are based on the total sample of 370.

The descriptive statistical method was used to determine distribution profiles of the sample. In some cases Chi-square and t-tests were used to compare means and proportions of responses.

4. SURVEY RESULTS

Demographically, the sample was predominantly white or Asian, highly educated and financially well off. Despite this skewed result, however, it seems the sample well represented those who lived in suburbs south of San Francisco. This region is among the wealthiest in the Bay Area and commuters typically are driving to high-paying managerial or highly specialized jobs in Silicon Valley or San Francisco. The study sample was fairly representative of morning commuters on both northbound and southbound traffic when compared with the age distribution of the Origin and Destination surveys conducted by Caltrans.

When inquiring how incident reports affect traveler behavior, there are two non-exclusive categories by which the survey participants who listen to traffic information may be classified: those who received traffic information and heard about the congestion before leaving home and those who received traffic information and heard of the congestion while traveling. Upon hearing of congestion before leaving home, a traveler can choose among any of three categories of travel decisions to try to avoid traffic congestion: change in departure time, change in mode

of travel, and change in route. Trip cancellation was not considered in the study since the surveys were oriented to those who traveled on at least a part of the study corridor. Those who heard of the congestion only after leaving home might have only the option of changing their route.

Incident Reports and Travel Behavior

How many drivers were aware of the traffic problem on their planned route on the morning of the incident? Over three quarters (75.1%) of the total participants tuned into radio/television broadcasts in order to obtain traffic information on US 101. Of those who listened to traffic reports, about half (62.2%) heard of the traffic problem on US 101 (Table 1).

Table 1. Acquisition of Incident Information on US 101 (N = 173)

When heard of the incident	Heard of the incident on US 101 %
Pre-trip only	28.9
Pre-trip & continued on En route	24.5
En route only	46.8

How did they respond to incident information? Of those who were aware of the traffic problem on US 101, less than one third (27.7%) changed their travel behavior based on the incident information either prior to departure (33.7%) or en route (21%).

When evaluating typical travel behavior, departure time seems to be the most frequently adjusted behavior; this occurred among 17.4% of the participants who heard of the traffic problem (Table 2).

Table 2. Changes in Travel Behavior Based on Incident Information (N = 173 those who heard of the traffic problem in the morning of the incident)

Travel changes	**Pre-trip** (n = 92) %	**En route** (n = 81) %
Departure time only	13.0	
Departure time, mode & route	1.1	
Departure time & mode	2.2	
Departure time & route	1.1	
Route only	16.3	21.0
Total	**33.7**	**21.0**

Overall Impact of the Incident Report on Travel Patterns

In the context of the overall impact on travel patterns, the incident reports were able to influence 13% of the traveling population on the case study corridor. 2.4% of the population modified their trip for reasons other than traffic problems. 15% travel change could result in significant savings in travel time, but its effectiveness could vary significantly depending on the characteristics of network and traffic flow.

How Traffic Information and Congestion Affect Travel Behavior?

Ideally, traffic information would divert travelers away from congestion. Generally, commuters have the opportunity to obtain traffic information both before departure and *en route.* However, the surveys showed that those who obtain information do not necessarily respond to it, and those who endure bad traffic one day are not necessarily going to be affected enough by it to obtain more information the next day.

Of those respondents who actually encountered traffic congestion on US 101, 64.8% said that they were no more likely to obtain traffic information prior to departure, and 54% said that they were no more likely to obtain traffic information *after* departing. Of those who obtained traffic information before or during their commute, 36.8% thought the information they received helped them save time, and 9% thought the information made them lose time. However, over

half (52.3%) were *unsure* as to whether the traffic information helped them.

Although some believed the information they received made them lose time, half of them (50%) said they were nonetheless more likely in the future to obtain traffic information during their commute. And 66% of those who thought the information had saved them time said that they were more likely to obtain traffic information *en route* in the future.

In contrast, however, of those who said they did not know whether the information had saved them time, 62.9% said they were no more likely to obtain traffic information *en route* in the future. In this survey group, it showed that people tend to be unsure about whether traffic information is beneficial to them. If people believed traffic information has helped them save time, they would probably be more likely to obtain information in the future.

Travelers can alter their travel in response to hearing of traffic congestion: they can change their time of departure, they can change their mode of travel, or they can choose an alternate route to avoid the congestion. Of those who obtained traffic information, only 17.4% changed their departure time, 3.3% changed their method of travel and 18.5% took an alternate route to US 101.

Why didn't people change their travel in accordance to reported traffic conditions? Respondents didn't believe changing departure time (50.0%) or taking an alternate route to US 101 (39.7%) would help save them time (Figures 1, 2 and 3). Many believed the traffic would clear shortly (21.1% overall, on average).

Figure 1. Reasons for not changing departure time

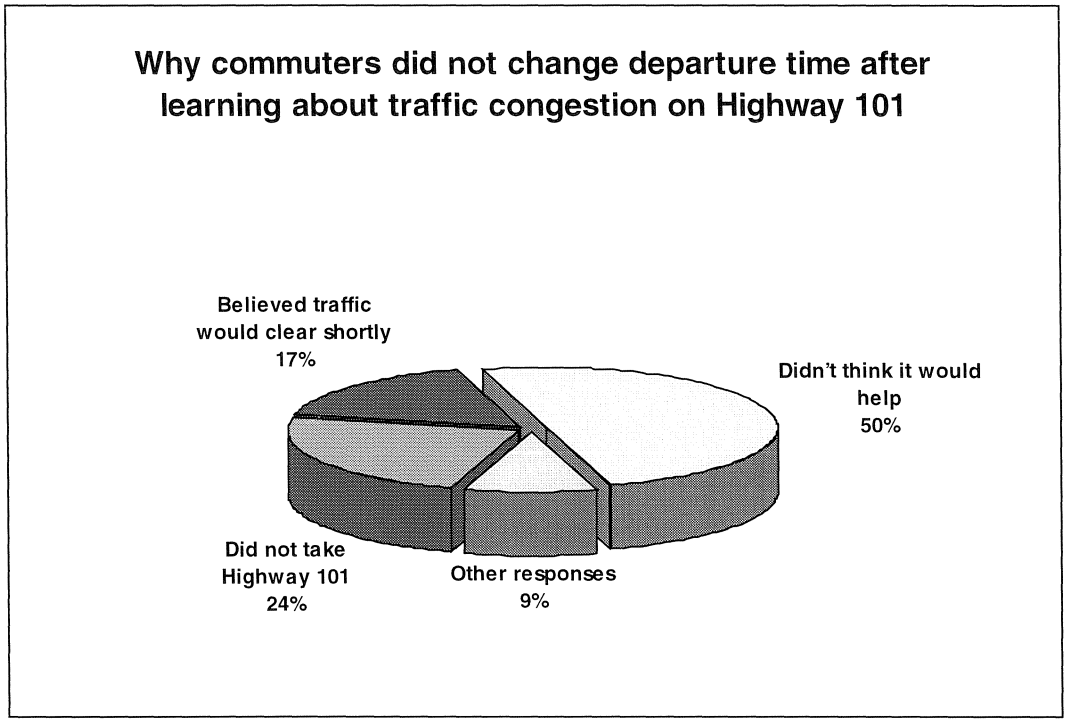


Figure 2. Reasons for not changing mode

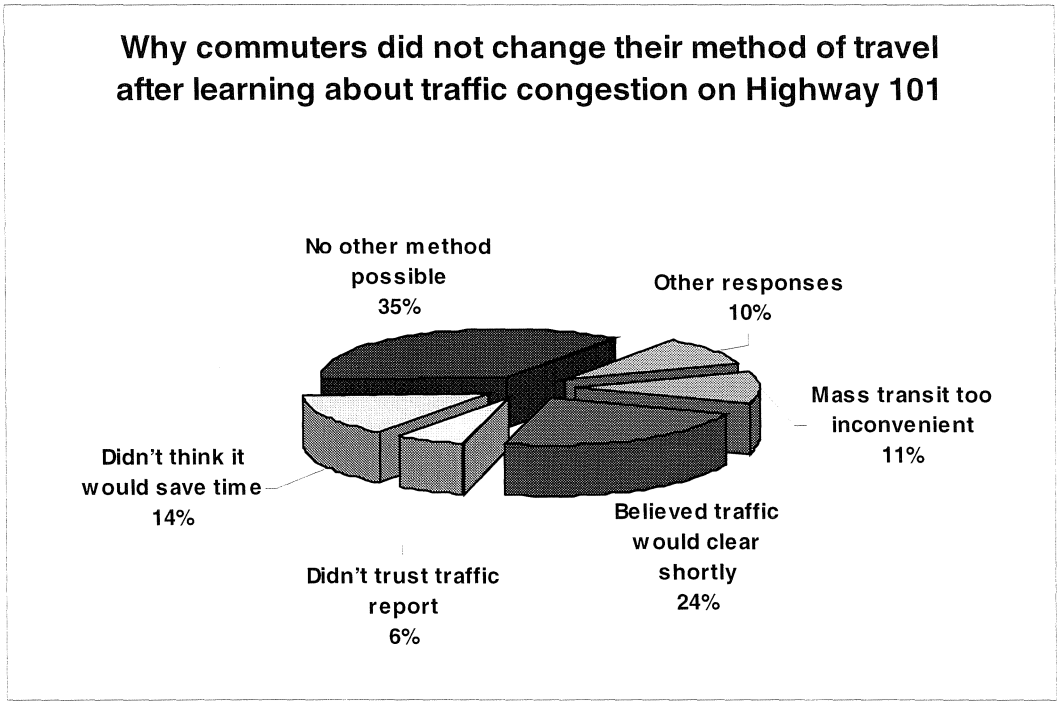
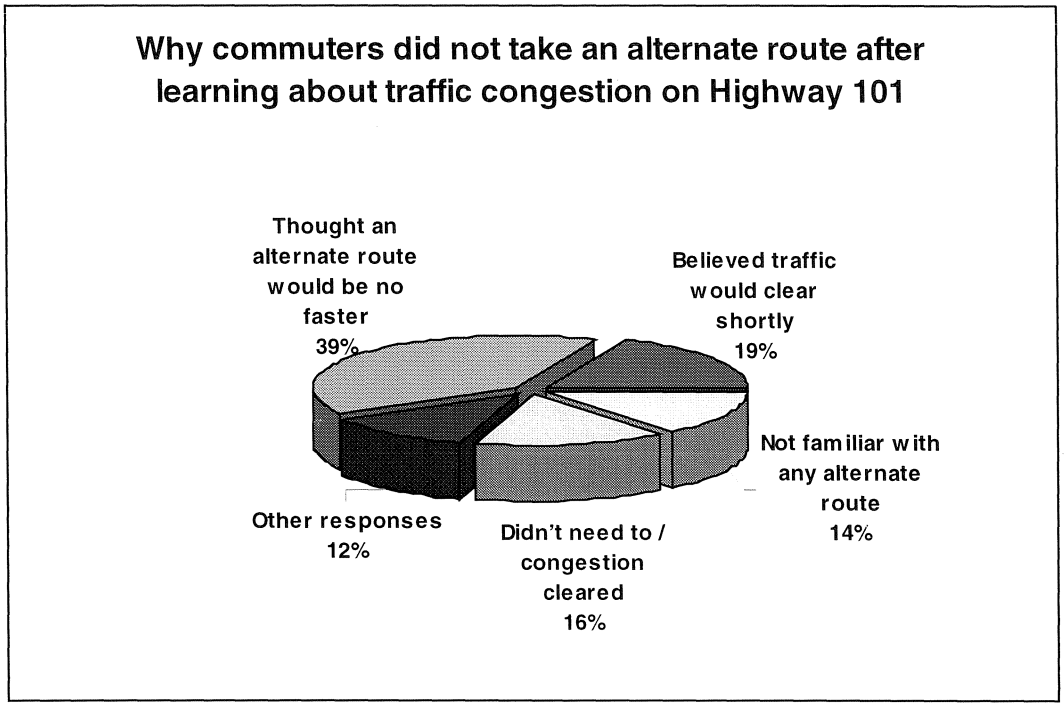
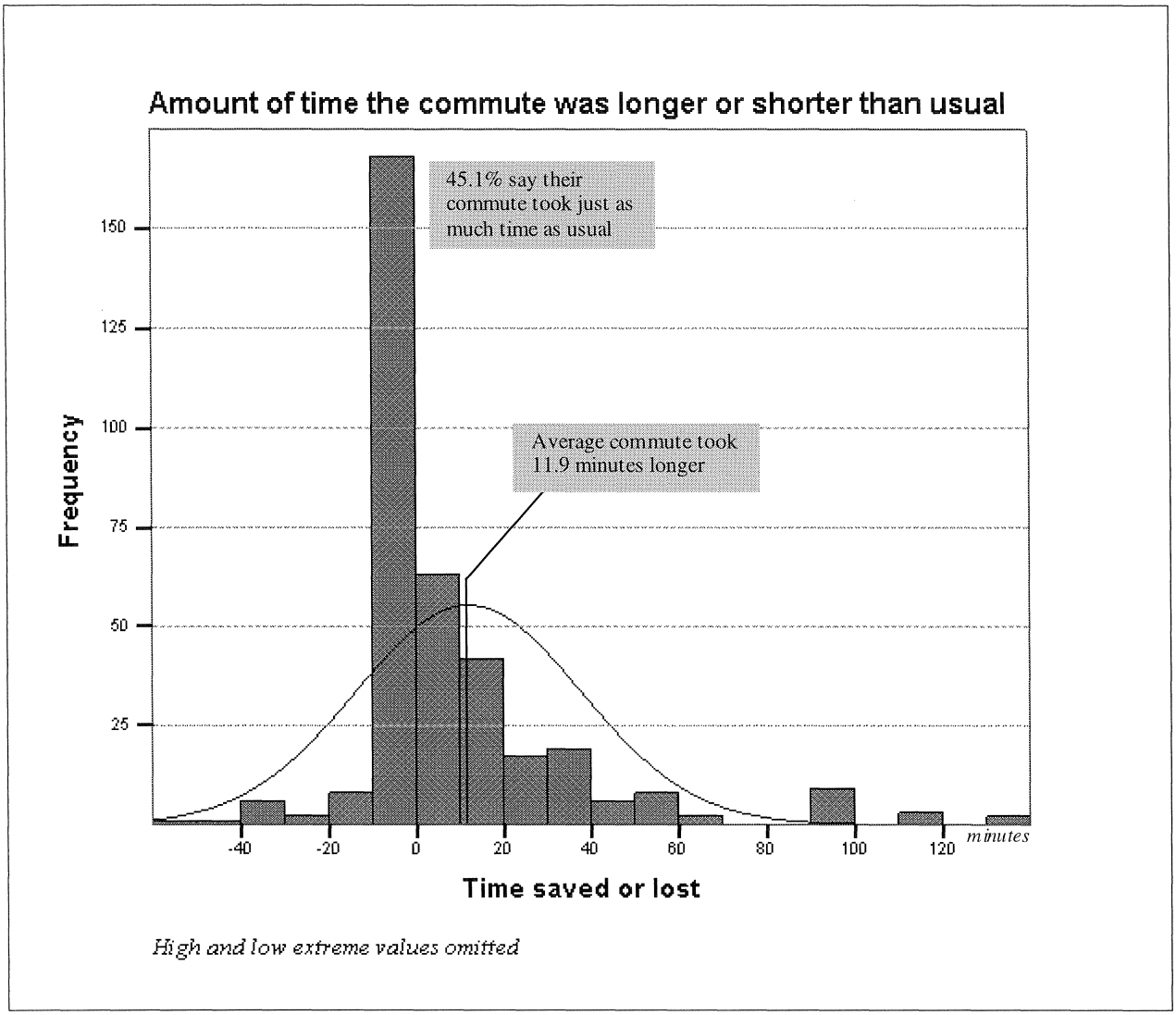


Figure 3. Reasons for not taking an alternate route



The reason why drivers feel this way might be explained by how much time they felt they lost during their commute. In fact, of those who heard about or witnessed congestion on Highway 101, they said their commutes took 11.9 minutes longer than normal (on average; extreme values omitted). 45% (45.1%) said their commute time was just the same as normal, and only 19% (18.5%) said their commute took at least 20 minutes longer than usual (Figure 4).

Figure 4. Perceived commute time under incident



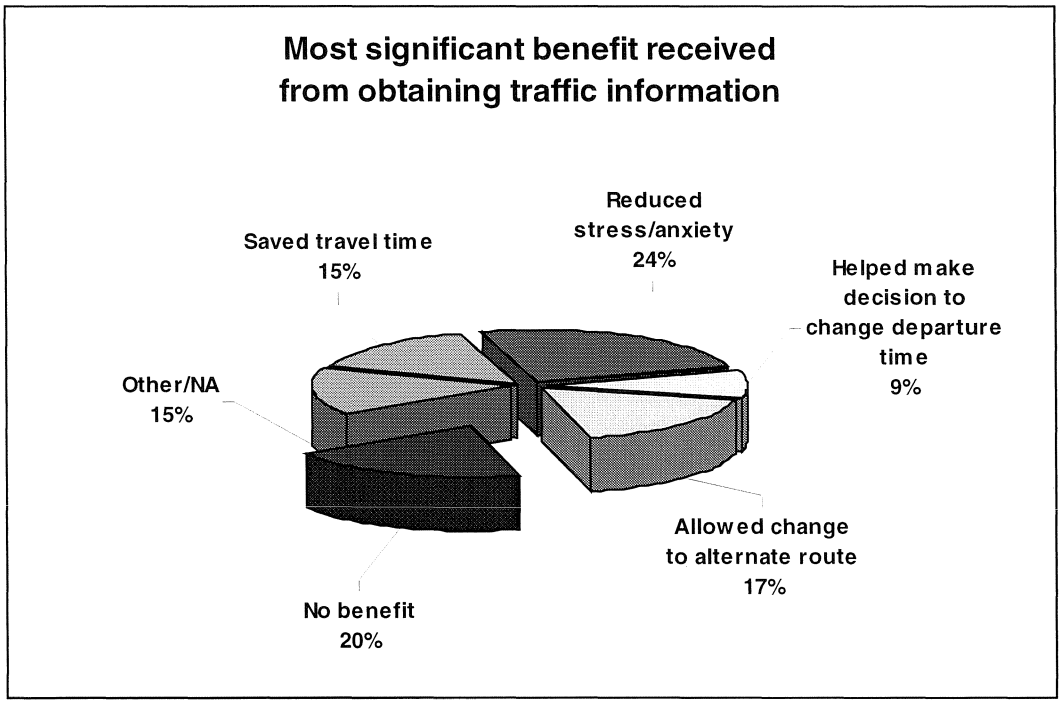
Regardless of whether drivers actually lost more than 11.9 minutes on average, driver *perception* is what matters when it comes to whether commuters will modify their travel plans to avoid traffic congestion.

Drivers are increasingly becoming accustomed to longer commutes. The average estimated typical commute was 34.1 minutes long; thus an 11.9-minute delay might not be a strong enough incentive to avoid the stop-and-go freeway traffic. Their alternatives are similarly frustrating: stoplights, stopsigns and low speed limits on local roads, long out-of-the-way

detours, waiting for the next BART train at the local park-and-ride, waiting for an hour until traffic clears, and so on. And drivers realize there is always the possibility that making such efforts to avoid an incident may be unnecessary, as the traffic might clear, or the alternatives may actually take longer than the normal travel plan.

Commuters therefore tend either to believe that their normal travel plans are faster than or as fast as alternate plans or they value other benefits of traffic information over saving time (Figure 5). People tend to listen to traffic reports more for psychological reasons than for the reason that they can actually change their travel behavior to avoid congestion. Knowing what is going on when stuck in a traffic jam is far better that not knowing the cause of the congestion.

Figure 5. Benefits of traffic information



5. CONCLUSIONS

The results of the surveys suggest that individual incidents do not greatly affect travel behavior because the time delays are not significant enough to convince commuters to modify their travel plans. The commuters may, in fact, be correct in their common belief that changing their travel plans are not likely to get them to or from work any faster than their usual travel plans would. Thus, it seems that in order to alleviate traffic congestion by making more people receptive to traffic reports and by making them take alternative mode of transportation, quite ironically, traffic itself has to get worse or make the alternatives better.

In the extreme cases of Manhattan, Tokyo and other densely-populated cities, extraordinary traffic conditions along with the very high cost of single-occupancy vehicle transportation makes mass transit the primary choice of most people, largely regardless of demographic characteristics. But in other, relatively wide-spread metropolitan areas, mass transit usually cannot be a convenient alternative, alternate arterials to freeways are usually filled with stoplights and low speed limits or are long-distance detours, and waiting 40 minutes to an hour means "wasting" time at home before work or staying at work even longer when one wants to go home.

If there is a major traffic incident on US-101, and a commuter is trying to get to work, and he is only going to be delayed about 10-15 minutes longer than a 30 or 40 minute typical commute, then his best bet is probably to stay on the freeway. So many other commuters will take alternate routes that, unless there is a major parallel freeway nearby, the alternate will be considerably slower than a highway that is moving at five or ten miles an hour.

Another important consideration is that taking mass transit to work instead of a personal vehicle usually means he has to take mass transit back. And if he takes his car to work, he cannot take mass transit back unless he can leave his car at work. Therefore, taking mass transit requires a commitment which many people are unlikely to make. If there is a morning delay of 15

minutes but the return commute is normal, then the total delay for the day is not very much at all.

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