

Commuter Impacts and Behavior Changes during a Temporary Freeway Closure: The Fix I-5 Project in Sacramento, California

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1 Abstract

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3 In the nine weeks between May 30 and July 31, 2008, a one-mile stretch of Interstate 5 (I-5) in
4 downtown Sacramento, California was intermittently closed for a reconstruction (“the Fix I-5
5 project”, or “the Fix”). To study the impacts of the Fix on commuters’ travel behavior, a series of
6 three internet-based surveys was conducted. The present paper offers a preliminary analysis of the
7 first two of those surveys. We address the (passive) impacts of the closure on commuters, and the
8 (active) choices of commuters during the closure. The passive impacts of the Fix do not appear to
9 be excessive: majorities of respondents in all relevant subsamples that were analyzed did not find
10 conditions to be worse than usual, and sizable minorities found them to be better. Among the active
11 changes to commute trips, the easiest options – avoiding rush hour and changing route – were the
12 most common responses (adopted by 48% and 44%, respectively). Among the changes that reduce
13 vehicle-miles traveled, increasing transit use and increasing telecommuting were the most
14 common (each adopted by about 5% of the relevant subsample). Evidence suggests that conditions,
15 and commuters’ behavior, began to revert to normal as the Fix progressed. A binary logit model of
16 the choice to increase transit use suggests that persuading current transit users to increase the
17 frequency they use transit is easier than convincing nonusers to switch to transit. Women and
18 (counter to expectation) those in larger households were more likely to increase their transit use.
19 Employer transit subsidies supported increases in transit, while variable work hours and free
20 on-site parking discouraged it.

21
22 **Keywords:** Behavior change, Mode choice, Transit users, Network disruption, Transportation
23 Demand Management (TDM)

24 25 26 1 INTRODUCTION

27 In the nine weeks between May 30 and July 31, 2008, a one-mile stretch of Interstate 5 (I-5) in
28 downtown Sacramento, California was intermittently closed for a \$27 million reconstruction (“the
29 Fix I-5 project”, or “the Fix”). With average daily traffic of 190,000 vehicles, this portion of I-5 is
30 part of a major north-south conduit for interregional traffic (extending from Canada to Mexico), as
31 well as a key commute route serving downtown Sacramento (the state capital) and other job
32 locations in the region. To mitigate the impact of the Fix, a number of strategies were implemented
33 by Caltrans and other public agencies, including providing extensive information on the Fix and
34 commute alternatives through the media, seminars, and the internet; funding increased transit
35 service and (in some cases) reducing transit fares and offering free parking at some facilities;
36 reducing off-street parking rates in downtown Sacramento after 5 p.m., to motivate commuters to
37 travel after the evening peak; and providing roving tow truck service to promptly remove disabled
38 vehicles on other portions of the regional highway network. Two weeks before the Fix (May 16),
39 Gov. Schwarzenegger issued Executive Order S-04-08 (1), directing State executive agencies to
40 promote commute alternatives (such as telecommuting, alternative work schedules, and transit) for
41 their employees to the fullest extent possible, and encouraging other public agencies and private
42 companies to do so as well.

43 The Executive Order also authorized a study of the impacts of the Fix, with a view to
44 evaluating the effectiveness of the commute modification strategies being promoted, and the
45 extent to which more sustainable commute patterns would be the longer-term result.

46 As the interstate highway system and other elements of the transportation infrastructure

1 continue to age, reconstruction projects like Fix I-5 will occur quite frequently. Therefore, it is
2 important to learn as much as possible about commuter reactions to such projects, to enable future
3 projects to be implemented in the most effective way. At the same time, such projects offer
4 valuable opportunities to disrupt habitual behavior in a natural way, and to use that disruption to
5 motivate shifts toward more sustainable commute choices (2).

6 Accordingly, the University of California, Davis was funded by the California
7 Environmental Protection Agency (through the California Air Resources Board) to conduct an
8 evaluation of the impacts of the Fix on commuter behavior. As part of that evaluation, a series of
9 three internet-based surveys was conducted. The present paper offers a preliminary analysis of the
10 first two of those surveys. Specifically, we address the passive impacts of the closure on
11 commuters, and the active choices of commuters during the closure. By “passive impacts” we
12 mean the situation experienced by commuters in terms of factors largely outside their control (e.g.
13 the number of times they were delayed), whereas by “active choices” we mean strategies that
14 commuters may have exercised to cope with the closure (e.g. taking vacation, telecommuting, or
15 changing mode). In addition to presenting descriptive statistics, we develop a binary logit model of
16 the most frequently adopted active choice that reduces vehicle-miles traveled (VMT), namely the
17 choice to increase the use of transit during the Fix.

18 The remainder of the paper is organized as follows. The next section briefly reviews
19 previous related research. The subsequent section describes the data collection, survey contents
20 and variables used in this study. Then, we discuss descriptive statistics for the passive impacts
21 experienced and active choices made by commuters. The binary logit model is presented in the
22 following section. The last section summarizes the study and suggests future research directions.

24 **2 LITERATURE REVIEW**

25 A number of studies have analyzed the impacts of traffic network disruptions. Such disruptions can
26 be either planned (such as partial or complete highway closures for reconstruction) or unplanned
27 (natural or human-caused disasters such as earthquakes or major accidents). In the first category,
28 several studies have examined the travel behavior impacts of major reconstruction projects, and
29 evaluated some strategies implemented during these projects (3-7). Fujii, et al. (3) studied the
30 changes in perceptions and use of public transportation among 335 drivers in Osaka, Japan, by
31 surveying them before and during an 8-day temporary closure of a freeway. The authors suggest
32 that a temporary structural change may be an important catalyst that triggers cooperation in a
33 social dilemma. The study showed that the expected commute time by public transportation was
34 overestimated by automobile commuters in the sample, and indicated that by inducing the use of
35 public transportation, a temporary modification in the road network may contribute to adjusting
36 the perceived travel time by transit to more realistic values.

37 In the I-195 Providence River [Rhode Island] Bridge Repair Project (4), traffic
38 management strategies were compiled, selected, and implemented to move people through and
39 around the project area. These strategies included interventions on (i) education (public
40 information and community liaison activities), (ii) traffic engineering (coordination of traffic
41 control signals and emergency routes), (iii) enforcement (monitoring and enforcing speed limits),
42 and (iv) ridesharing and transit (carpool matching, free bus service and park-and-ride lots). The
43 paper notes that each project is unique. Therefore, strategies should be selected in order to conform
44 to the project area and each project's characteristics.

45 Other studies have focused on the outcomes of unplanned disruptions to the transportation
46 system (8-10). An analysis (8) of travelers' responses to the 1994 Northridge earthquake in

1 Southern California indicates that most travelers adjusted to the emergency conditions on the road
2 network by changing routes and travel time schedules, and avoiding discretionary trips in the
3 damaged areas. The impact of the 14-month closure of Centre Street Bridge for reconstruction in
4 Calgary, Canada (9) also shows a small decline in vehicle trips. Auto users mainly stuck to their
5 mode, and only a limited increase in transit use was registered. On the other hand, a study by
6 Tsuchida and Wilshusen (10) shows evidence that the conversion of Route 17 to a carpool facility
7 after the 1989 Loma Prieta (Bay Area, California) earthquake led many people to adopt
8 ridesharing, with 57% of the adopters continuing to carpool even after the route was reopened to
9 general traffic.

10 Several studies also focused on mode shifts and on the persistency of the adoption of the
11 new mode in the future. Planned projects, in particular, may provide opportunities to promote
12 active changes in commuters' behavior, especially switching from the often predominant "drive
13 alone" mode to a more sustainable mode like carpooling or transit. However, drivers tend to
14 develop a habit (or routine) with regard to their regular commuting behavior. This increases the
15 resistance, or inertia, to eventual changes in the travel mode. Therefore, larger efforts are required
16 to convince travelers to switch from the use of a private car to other more sustainable travel modes
17 (11). Some strategies may be used to trigger a change in travel behavior, while different strategies
18 may be needed to help commuting drivers develop a new habit of, for instance, using public
19 transportation (12).

20 21 **3 SAMPLING PLAN AND SURVEY CONTENTS**

22 23 **3.1 Data Collection**

24 Since UC Davis was not approached about conducting the study until a few weeks before the
25 closure, there was not enough time to draw a rigorous, geographically-based random sample and
26 recruit participants by mail. Instead, respondents were recruited via e-mail invitations, delivered
27 by willing organizations in the study area to their constituencies. Cooperating organizations
28 primarily included:

- 29 a. Numerous State agencies, who broadcast the invitation to their staff in the Sacramento
30 area;
- 31 b. The Fix I-5 listserv (which included around 6,000 people who signed up to receive daily
32 updates on the Fix);
- 33 c. Transportation Management Agencies (TMAs), who transmitted the invitation to their
34 members – generally employer-based transportation coordinators – who in turn could have
35 transmitted it to the employees of their organization;
- 36 d. The Commuter Club of the Sacramento TMA, comprising about 25,000 individuals who
37 signed up to receive commute-oriented information and services; and
- 38 e. The University of California, Davis, which issued a press release publicizing the study and
39 the link at which the survey could be taken.

40 Given the *ad hoc* nature of the recruitment process, we can neither compute a response rate, nor
41 expect a completely representative sample. It is likely that State workers are overrepresented
42 (although they do comprise a plurality of the workforce in downtown Sacramento), as well as
43 internet-literate workers, workers with especially burdensome commutes, those most heavily
44 affected by the Fix, and those who made environmentally-beneficial changes to their behavior. At
45 the same time, self-employed and small-business workers are probably underrepresented, some of
46 whom (together with the less computer-literate) may also have been heavily affected by the Fix, so

1 biases in the sample are counteracting each other to an unknown extent.

2 Accordingly, the descriptive statistics presented in Section 4 should be viewed with caution.
3 Nevertheless, we suggest that some data are better than no data, and we also believe that
4 *comparisons* in the data should be largely robust (e.g., a ranking of active changes in order of
5 frequency). Thus, we encourage the reader to focus on trends, conditional relationships, and the
6 model (which is a specific type of conditional relationship): in these cases, it is less critical to have
7 a sample that is representative of the total population (13, 14).

8 Two internet-based surveys were administered during the period of the Fix (a third,
9 follow-up survey was distributed seven months later, and is not analyzed here). The first,
10 hereafter referred to as the Wave 1 survey, sought information on behavior during the first closure
11 of the freeway, of all lanes in the northbound direction (Monday, June 2 – Sunday, June 8, 2008, for
12 our purposes). The second survey (Wave 2) addressed the first closure of the freeway in the
13 southbound direction (June 16-22). At several points in the analysis below, we compare the
14 responses between Wave 1 and Wave 2. The reversed direction of the closure is a confounding
15 factor in the interpretation of the results, but since commute behavior could be expected to be
16 relatively symmetric, our expectation is that any differences found across waves are more
17 reflective of the dynamic adjustments commuters made as the Fix progressed, than of differences
18 due to the directionality of the closures.

19 The invitations for the two surveys were sent to the same organizations, in the hope that the
20 same respondents would complete both surveys. However, due to delivery problems at the
21 organizational level, many respondents received an invitation for only one of the waves. Many
22 others also chose to complete Wave 1 but declined to complete Wave 2 (or conversely). The final
23 usable sample comprises 4520 valid responses to the Wave 1 survey, and 4976 for Wave 2,
24 including 1528 people who have taken both surveys. An additional group of 1034 Wave 2
25 respondents stated that they had completed the first survey too, but did not provide enough
26 information for us to be able to match those cases to their Wave 1 responses. This means that only
27 2414 Wave 2 cases comprise respondents who had not taken the first survey.

28 In future work, it will be of interest to analyze the 1528 matched responses, to take a more
29 rigorous look at the dynamic aspect of adjustments to the Fix. For the present study, however, we
30 wanted to avoid the complication of having a sizable fraction (about a third) of the sample not
31 being independent across waves (making descriptive statistics and model coefficients less
32 trustworthy). Accordingly, for this analysis we have retained the 4520 Wave 1 cases and the 2414
33 *new* Wave 2 cases, for a pooled sample of 6934 cases.

34 TABLE 1 presents the sample statistics for some selected characteristics, including all
35 variables significant in the final model presented in Section 6. The “average” characteristics are:
36 age 47, female, college graduate, in a household with 2.7 members, 2.1 cars, and having an annual
37 income of \$75,000 - \$99,999. Altogether, the sample seems fairly typical of the white-collar,
38 career government workforce to be expected in a state capital. Even the high proportion of female
39 respondents (nearly two-thirds) is not as unbalanced as it may seem, in view of the fact that in
40 general about 60% of state and local government workers are women (15). Average age,
41 educational level, income, household size, and number of licensed drivers are similar between the
42 two waves, but Wave 2 respondents report a slightly longer commute, on average (33 minutes),
43 than Wave 1 respondents (31 minutes). The average number of vehicles per household is also
44 slightly higher in Wave 2 (2.3) than in Wave 1 (2.0).

45

TABLE 1 Selected Characteristics of the Sample, by Wave

Characteristic (sample sizes)	Pooled data N (%)	Wave 1 N (%)	Wave 2 N (%)
<i>Number of cases</i>	6934	4520	2414
<i>Number of females (6407, 4160, 2247)</i>	4160 (64.9)	2679 (64.4)	1481 (65.9)
<i>Average age (years) (6053, 4016, 2037)</i>	40.6	41.0	39.9
<i>Average educational level^a (6284, 4097, 2187)</i>	4.06	4.05	4.08
<i>Annual household income (5977, 3886, 2091)</i>			
Less than \$15,000	29 (0.5)	16 (0.4)	13 (0.6)
\$15,000-\$29,999	106 (1.8)	74 (1.9)	32 (1.5)
\$30,000-\$44,999	493 (8.2)	350 (9.0)	143 (6.8)
\$45,000-\$59,999	715 (12.0)	468 (12.0)	247 (11.8)
\$60,000-\$74,999	1070 (17.9)	699 (18.0)	371 (17.7)
\$75,000-\$99,999	1243 (20.8)	787 (20.3)	456 (21.8)
\$100,000 or more	2321 (38.8)	1492 (38.4)	829 (39.6)
<i>Average household size (6328, 4166, 2162)</i>	2.72	2.66	2.85
<i>Number of licensed drivers (6387, 4163, 2224)</i>	6333 (99.2)	4134 (99.3)	2199 (98.9)
<i>Average number of household operational vehicles (5722, 3572, 2150)</i>	2.08	1.97	2.27
<i>Residential neighborhood (6359, 4137, 2222)</i>			
A lot of retail/ commercial within a 10-minute walk	598 (9.4)	403 (9.7)	195 (8.8)
Some retail/ commercial within a 10-minute walk	1809 (28.4)	1212 (29.3)	597 (26.9)
Almost all residential	3559 (56.0)	2285 (55.2)	1274 (57.3)
Few other buildings around	243 (3.8)	148 (3.6)	95 (4.3)
Other	150 (2.4)	89 (2.2)	61 (2.7)
<i>Distance from home to the nearest bus stop or light-rail station (6356, 4136, 2220)</i>			
Less than a 5-minute walk	1680 (26.4)	1127 (27.2)	553 (24.9)
5 - 10-minute walk	1729 (27.2)	1139 (27.5)	590 (26.6)
10 - 20-minute walk	1042 (16.4)	668 (16.2)	374 (16.8)
More than a 20-minute walk	1501 (23.6)	932 (22.5)	569 (25.6)
Don't know	404 (6.4)	270 (6.5)	136 (6.0)
<i>Average commute minutes (6878, 4484, 2394)</i>	31.9	31.3	33.0
<i>Average commute miles (6872, 4483, 2389)</i>	17.8	17.6	18.0
<i>Primary job work schedules (6920, 4513, 2407)</i>			
Part time ^b	388 (5.6)	237 (5.3)	151 (6.3)
Conventional ^c	3221 (46.5)	2173 (48.1)	1048 (43.5)
Variable ^c	1461 (21.1)	930 (20.6)	531 (22.1)
Compressed 9-80 work week ^d	1504 (21.7)	966 (21.4)	538 (22.4)
Compressed 4-40 work week ^d	261 (3.8)	168 (3.7)	93 (3.9)
Other	85 (1.2)	39 (0.9)	46 (1.9)
<i>Number using transit as primary commute mode (6595, 4302, 2293)</i>	1183 (17.9)	698 (16.2)	485 (20.1)
<i>Number currently using transit but not primary commute mode (6595, 4302, 2293)</i>	1098 (16.6)	664 (15.4)	434 (18.9)
<i>Employer-provided free on-site parking (6575, 4289, 2286)</i>	1618 (24.6)	1203 (28.0)	415 (18.2)
<i>Employer-provided paid on-site parking (6575, 4289, 2286)</i>	1627 (24.7)	1164 (27.1)	463 (20.3)
<i>Employer-provided reduced-rate transit passes (6575, 4289, 2286)</i>	4122 (62.7)	2639 (61.5)	1483 (64.9)
<i>Employer-provided variable start/ end times (6575, 4289, 2286)</i>	4109 (62.5)	2725 (63.5)	1384 (60.5)

^a 1=Some grade or high school; 2=High school graduate; 3=Some college or technical school; 4=Four-year college, university, or technical school graduate; 5=Some graduate school; 6=Completed graduate degree(s).

^b Less than 35 hours per week.

^c 7 ½ - 8 hours per day. Conventional: with a start time between 8:00 and 9:00 a.m.; variable: with a variable start time.

^d 9-80: one day off every two weeks; 4-40: one day off every week

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1 As shown in FIGURE 1, we applied three filters to the data at various points in the analysis. (1) We
 2 excluded the respondents who were out of the region for the entire week of the closure from the
 3 remainder of the analysis. However, it is a pertinent finding that some 5% of the sample (4.2% in
 4 Wave 1, 6.5% in Wave 2) left the region altogether during the closure. (On the other hand, only
 5 0.87% of the total – 0.85% in Wave 1, and 0.91% in Wave 2 – did so because of the Fix; the rest did
 6 so for other reasons, e.g. planned summer vacations). (2) We additionally excluded (the small
 7 fraction of) respondents who did not commute to work during the closure week from the analysis
 8 of commuters' active choices for work-related trips (Section 5.1). (3) Finally, we further excluded
 9 respondents who already used transit for all their commuting trips from the model of the choice to
 10 increase transit use (Section 6).

Total sample: pooled data, Wave 1, Wave 2 (6934, 4520, 2414)			
Remaining sample (6590, 4332, 2258)			
Out of region (344, 188, 156)	Didn't commute to work (28, 4, 24)	Remaining sample (6562, 4328, 2234)	
		Use transit for all commute trips (1123, 587, 536)	Remaining sample for logit model (5439, 3741, 1698)

11
 12 **FIGURE 1 Data filters and remaining sample sizes for pooled data, Wave 1, and Wave 2**

13 14 3.2 Survey Contents

15 The contents of the Wave 1 and Wave 2 surveys are nearly identical (aside from referring to
 16 different dates and directions of closure). There were four parts in each survey:

17 *Part A* collects information on “normal” (pre-Fix) work and commute patterns, including
 18 occupation, work schedule, commute distance and time, frequency of commuting, means of
 19 transportation used for commuting trips, etc.

20 *Part B* seeks information about travel changes made during the target week. Additionally,
 21 it explores whether those changes were made due to the Fix, or for some other reasons. Although
 22 this part of the survey includes several potential dependent variables of interest, the model of this
 23 study only focuses on the choice to increase transit use.

24 *Part C* explores the programs that were available to respondents, possible facilitators and
 25 barriers to changing commuting habits, and sources of information on Fix I-5.

26 *Part D* collects information on sociodemographic characteristics, including age, gender,
 27 household size, auto ownership, income, and education.

28 29 4 PASSIVE IMPACTS ON COMMUTERS

30 In this section, we focus on the passive impacts of the Fix I-5 project. We asked four questions
 31 regarding those impacts: a general question about travel conditions during the closure week,
 32 followed by three more detailed questions on the number of times they were delayed, number of
 33 times they arrived at a destination *more* quickly than usual, and number of times they had to take
 34 an unplanned detour during the closure week. Respondents who reported being out of the region
 35 during the entire week were excluded, leaving 6,590 respondents to answer these questions.

36 Turning first to the pooled data (TABLE 2), we see that the Fix certainly had an impact, but
 37 not a universal nor a uniform one. Around 47% of the sample reported that traffic conditions
 38 were worse for them during the closure week, and similar shares reported encountering delays and
 39 forced detours (generally on multiple occasions). But that leaves more than half the sample

1 reporting that conditions were as good as (35%) or better than (18%) usual, and nearly a quarter
2 reporting sometimes arriving at their destination *more* quickly than usual (again, generally on
3 multiple occasions). Thus, it appears that the various coping strategies adopted by commuters
4 actually improved conditions for some (whether those who themselves made changes, or those
5 who benefitted from the changes made by others – presumably some of both), and to some extent
6 helped compensate for the deterioration in conditions for others. Overall, the passive impacts of
7 the Fix do not appear to be excessive.

8 Wave 1 and Wave 2 show some systematic differences in response, with Wave 1 reflecting
9 stronger impacts. Compared to Wave 1, a smaller share of respondents in Wave 2 found travel
10 conditions to be better than usual, while a larger share found them to be “about the same” as usual.
11 Smaller proportions in Wave 2 than in Wave 1 also reported experiencing each of the three specific
12 impacts. Thus, it appears that the effects of the Fix, both positive and negative, diminished over the
13 course of the project.
14

1 **TABLE 2 Passive Impacts, by Wave**

Passive Impacts (sample sizes)	Pooled data N (%)	Wave 1 N (%)	Wave 2 N (%)	Average Number of Times (for those reporting this impact)	Pooled data	Wave1	Wave 2
<i>Travel conditions (6547, 4300, 2247)^a</i>							
(1) Much worse	488 (7.5)	326 (7.6)	162 (7.2)				
(2)	926 (14.1)	594 (13.8)	332 (14.8)				
(3)	1645 (25.1)	1120 (26.0)	525 (23.4)				
(4) About the same	2289 (35.0)	1377 (32.0)	912 (40.6)				
(5)	460 (7.0)	335 (7.8)	125 (5.6)				
(6)	319 (4.9)	227 (5.3)	92 (4.1)				
(7) Much better	420 (6.4)	321 (7.5)	99 (4.4)				
<i>Number reporting delays^b (6553, 4300, 2253)</i>	3016 (46.0)	2071 (48.2)	941 (41.8)	Occasions delayed	4	3.17	
<i>Number reporting arriving more quickly^b (6495, 4241, 2254)</i>	1520 (23.4)	1125 (26.5)	395 (17.5)	Occasions arriving more quickly	4.09	4.01	4.31
<i>Number reporting forced detours^b (6552, 4297, 2255)</i>	2894 (44.2)	2102 (48.9)	792 (35.1)	Forced detour occasions	3.93	3.96	3.83

^a During the week of [June 2-8 or June 16-22] (Mon – Sun), how were travel conditions in the affected area for you?

^b During the week of [June 2-8 or June 16-22] (Mon – Sun), on how many occasions ...

... were you substantially delayed when travelling through the affected area, **because of Fix I-5?**

... did you arrive at your destination more quickly than usual when traveling through the affected area?

... were you forced to take a detour in the middle of your trip, **because of Fix I-5?**

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5 COMMUTERS' ACTIVE CHOICES

As noted earlier, the term “active choices” refers to the behavior changes made to deal with the changes in travel conditions. In view of the significantly different natures of work- and non-work related trips (16, 17), we treat each category separately. Most of the questions on work-related trips deal specifically with commuting, but one asks about the use of teleconferencing to avoid traveling to work-related meetings.

5.1 Changes in Work-Related Trips

As discussed above, this portion of the analysis excludes all respondents who did not travel to work in the region at all during the week in question. The literature identifies a number of possible active choices that can be made in these circumstances (18-21). In the subsections below, we respectively discuss making fewer commute trips (via telecommuting, alternative work schedules, and/or vacation), changing commute mode, and other changes (departure time, route, and teleconferencing). For the first two categories, after asking about making each change, we also asked how many days the respondents performed each action, how well the choice worked for them, whether they had made that choice before, and how likely they were to continue the action after the Fix.

5.1.1 Making Fewer Commute Trips

Respondents were asked whether, during the closure week, they made “fewer commute trips than you normally would”, with response options “Yes, because of Fix I-5”, “Yes, for some other reason”, and “No”. We discuss only the changes made because of the Fix. About 14% of respondents made fewer commute trips (because of the Fix) during the closure week (see TABLE 3). Among those reporting fewer trips, about half achieved it by telecommuting, and about a fourth achieved it via each of compressed work week and taking some vacation days (multiple answers were possible). Interestingly, however, the share of respondents making fewer commute trips in Wave 2 (8%) is only about half that of those making fewer trips in Wave 1 (15%), suggesting that the motivation to change one’s commute patterns is diminishing as the Fix progresses. Among those making fewer commute trips, similar proportions telecommute across both waves (47%), whereas Wave 2 shows a substantially smaller proportion of cases reporting compressed work week changes (22%) than in Wave 1 (28%), and a larger proportion of respondents reporting taking some vacation days (30%, compared to 24% in Wave 1).

It is desirable, of course, to estimate the overall shares of people using each means of making fewer commute trips during the Fix. However, our ability to do so is complicated by the fact that more than a third (315) of the 923 cases reporting making fewer commute trips did not state the means by which they did so. If we conservatively assume that those 315 cases represent mistaken responses to the initial question, and that *none* of them actually reduced their commuting, then we find, for example, that overall, $297/6552 = 4.5\%$ increased their use of telecommuting, while 2.5% achieved the reduction by each of compressed work schedules and vacation days. On the other hand, if we assume that the 315 non-responses *all* reduced their commutes, distributed among the available means in the same proportions as those who responded, we can estimate the share of those increasing telecommuting to be 47.4% of the 14.1% reporting making fewer commute trips, i.e. 6.7%. Similarly, reducing commute trips via compressed work schedules and taking vacation days would have been adopted by 3.7% each. The true shares are likely to be enclosed by these two extremes, and if we use the midpoints of the ranges as our best guess, we find that increased telecommuting, compressed work schedules, and vacation days are adopted by about 5.6%, 3.1%, and 3.1%, respectively.

1 **TABLE 3 Commuters' Active Choices, by Wave**

Number Making these Choices (sample sizes)	Pooled data N (%)	Wave 1 N (%)	Wave 2 N (%)	Average Number of Times (by those who made this choice)	Pooled data	Wave 1	Wave 2
Work related trips				Work related trips			
Made fewer commute trips (6552, 4328, 2224)	923 (14.1)	665 (15.4)	258 (8.0)				
Made fewer work-related trips (6552, 4328, 2224) ^a	3 (0.1)	0 (0.0)	3 (0.1)				
Made fewer trips, trip purpose not specified (6552, 4328, 2224) ^b	36 (0.5)	12 (0.3)	24 (0.7)				
Means of avoiding the commute trips (627, 406, 221) ^c				Means of avoiding the commute trips (433, 333, 100)	2.63	2.84	1.91
<i>Telecommuted</i>	297 (47.4)	193 (47.5)	104 (47.1)	Days avoided commuting by telecommuting (290, 193, 97)	2.17	2.28	1.94
<i>Adopted compressed work week</i>	163 (26.0)	114 (28.1)	49 (22.2)	Days avoided commuting by compressed work week (157, 114, 43)	2.92 ^d	3.30 ^d	1.93
<i>Took some vacation</i>	165 (26.3)	99 (24.4)	66 (29.9)	Days avoided commuting by taking vacation (99, 99, 0)	1.80	1.80	N/A ^e
<i>Other</i>	2 (0.3)	0 (0.0)	2 (0.9)				
Missing responses for means of avoiding the commute trips ^f (923, 665, 258)	315 (34.1)	258 (38.8)	57 (22.1)				
Teleconferenced (6468, 4264, 2204)	203 (3.1)	140 (3.3)	63 (2.9)	Trips avoided by teleconferencing	2.34	2.31	2.41
Avoided rush hour (5506, 3326, 2180)	2642 (48.0)	1677 (50.4)	965 (44.3)	Days avoided rush hour	3.90	3.89	3.92
Changed route (5254, 3352, 1902)	2371 (45.1)	1640 (48.9)	731 (38.4)	Days changed route	3.44	3.46	3.38
Non-work related trips				Non-work related trips			
Changed location (6098, 3892, 2206)	1302 (21.4)	890 (22.9)	412 (18.7)	Times changed location	2.62	2.53	2.82
Changed route (6325, 4119, 2207)	2768 (43.8)	1951 (47.4)	817 (37.0)	Times changed route	2.85	2.92	2.68
Changed the day activity was conducted (6316, 4121, 2195)	1160 (18.4)	820 (19.9)	340 (15.5)	Times changed the day	2.47	2.43	2.56
Changed the time activity was conducted (6300, 4105, 2195)	1370 (21.7)	990 (24.1)	380 (17.3)	Times changed the time	3.15	3.16	3.14
Used internet instead (2191, N/A, 2191)	142 (6.5)	N/A	142 (6.5)	Times used internet instead	3.21	N/A	3.21
Canceled the activity (6290, 4099, 2191)	1342 (21.3)	960 (23.4)	382 (17.4)	Times canceled the activity	2.53	2.45	2.74

^a The survey directly asked about changes to commute trips and to non-work trips, but not about changes to (non-commute) work trips (such as business meetings). The responses reported here were obtained from write-in descriptions to the "other (please specify)" option on the commute reduction question described in footnote c. As such, they certainly understate the actual level of changes made to non-commute work trips in the sample, and are included here only for completeness.

^b These responses were also write-ins to the "other (please specify)" option on the commute reduction question.

^c During the week of [June 2-8 or June 16-22] (Mon-Sun)... . . . , how did you avoid the commute trips that you would have otherwise made? (Options: Telecommuted to work; Adopted a compressed work week; Took vacation time; Other). Categories are not mutually exclusive.

^d This unexpectedly high average suggests that a number of respondents failed to read the word "avoid" in the question ("how many days did you avoid physically travelling to and from work by ..."), and responded with the number of days they commuted to work. The same could be true of the telecommuting and vacation strategies, as well.

^e N/A: Not asked.

^f Cases which reported they made fewer commute trips but did not indicate how they avoided the commute trips.

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1 Telecommuting is a TDM strategy which has been promoted by transportation and environmental
2 agencies in the United States and elsewhere (22, 23). However, it is known to have disadvantages
3 as well as advantages (24), so it is of interest to assess how the experience was perceived by those
4 who adopted (or increased) it during the Fix. Only a few respondents who used it felt that it worked
5 poorly or very poorly for them: 2.1% of the 192 respondents who had ever telecommuted before
6 and 6.3% of the 98 who had not (results not tabulated, to conserve space). However, people who
7 had telecommuted before were also more inclined to continue it: among the 51 who were currently
8 already telecommuting (and simply increased it during the Fix), 58.8% indicated being very likely
9 to continue – compared to 50.5% among the 117 who had used it before but were not currently
10 telecommuting, and only 20.6% among those who had not telecommuted before.

11 The results are similar for compressed work schedules. About half of the 75 respondents
12 who had tried compressed work schedules before were very likely to continue to adopt them and
13 only 1.4% of those who had tried them before reported that they felt it worked poorly or very
14 poorly for them. By contrast, only about a third of the 78 respondents who had not tried
15 compressed work schedules before were very likely to continue them, even though only 3.9% felt
16 it did not work well for them.

17 5.1.2 *Changing Modes*

18 Respondents were asked whether, during the closure week, they traveled “to or from work using a
19 different means of transportation than you normally would”, with the same response options as in
20 Section 5.1.1. Again, we analyze only the changes made because of the Fix. Respondents reporting
21 such changes were then asked which mode(s) they used on more occasions than normal (multiple
22 answers were possible). Similarly to the strategies involving reducing commute trips
23 (telecommuting, compressed work week, and vacation), we also want to know the overall shares
24 of people changing their use of each mode. Applying the same approach discussed in Section
25 5.1.1 to the 117 people who report changing their mode usage but did not indicate which mode(s)
26 they changed, we find the following (lower – upper) bounds: 4.6 – 6.1% increased their use of
27 transit, 0.5 – 0.6% increased driving alone, 1.3 – 1.5% increased carpool or vanpool use, and 2.3
28 – 2.7% increased walking or biking. Taking the midpoints of those ranges as our best guess, we
29 find that increased transit, driving alone, carpooling or vanpooling, and walking or biking are
30 adopted by about 5.4%, 0.6%, 1.4%, and 2.5%, respectively. Thus, increasing transit use was the
31 most common mode change, adopted by 68.2% of those who altered their commute mode patterns.

32 After the question regarding which mode(s) they used on more occasions than normal,
33 respondents were asked what they would have ordinarily done on those days (again, multiple
34 answers were possible). TABLE 4 crosstabulates the results, for the pooled sample. The vast
35 majority (92.9%) of those making commute mode changes increased their use of more sustainable
36 modes, most often at the expense of driving alone. For example, 69.9% of those who increased
37 their transit use would otherwise have driven alone to work.
38

TABLE 4 Commute Mode Changes due to Fix I-5 (Pooled Data)

Ordinarily used instead	Increased use during (& because of) Fix I-5 ^a									
	<i>Drive alone</i>		<i>Car or vanpool</i>		<i>Walk or bike</i>		<i>Transit</i> ^b		<i>Row total respondents</i>	<i>Row total responses</i>
	<i>N (Row %)</i>	<i>Column %</i>	<i>N (Row %)</i>	<i>Column %</i>	<i>N (Row %)</i>	<i>Column %</i>	<i>N (Row %)</i>	<i>Column %</i>		
<i>Drive alone</i>	0 (0.0)	0.0	59 (17.4)	71.1	108 (31.9)	72.0	235 (69.3)	69.9	339	402
<i>Carpool or vanpool</i>	10 (12.7)	28.6	2 (2.5)	2.4	13 (16.5)	8.7	67 (84.8)	19.9	79	92
<i>Walk or bike</i>	0 (0.0)	0.0	1 (33.3)	1.2	0 (0.0)	0.0	3 (100.0)	0.9	3	3
<i>Transit</i> ^b	23 (26.4)	65.7	19 (21.8)	22.9	27 (31.0)	18.0	25 (28.7)	7.4	87	94
<i>Other</i> ^c	2 (16.7)	5.7	2 (16.7)	2.4	2 (16.7)	1.3	6 (50.0)	1.8	12	12
<i>Column total cases</i>	35	100.0	83	100.0	150	100.0	336	100.0	493	603

^a An initial question about whether the respondent “traveled to or from work using a different means of transportation than you normally would” (because of the Fix) was followed by questions asking which modes were increased, and which were decreased. The specific wording of the latter two questions was: “During the week of [June 2-8 or June 16-22] (Mon-Sun)... which did you use on more occasions than you normally would have?” and “What would you ordinarily have done on those days, instead of commuting by [the indicated mode(s)]?” The table includes only cases which answered both follow-up questions, which constitutes 80.8% of the 610 cases answering the initial question in the affirmative. Multiple answers to both follow-up questions were possible; *all percents in the table are calculated on the basis of respondents (e.g. 493 total respondents), not responses (603 total reported mode changes)*, and therefore may not sum to 100. However, no one except transit users (see note b) reported replacing more than one ordinarily-used mode, so in columns for the first three modes, respondents and responses are equal.

^b “Transit” includes bus, light rail, and Amtrak, which are not mutually exclusive. Thirty-six cases which reported increasing the use of two transit modes were counted twice in the “Transit” column (so that the 336 responses in this column correspond to 300 respondents), and 4 cases which reported using two different transit modes as their ordinary commute mode also were counted twice in the “Transit” row. In both instances they are multiply-counted as responses, but only once as respondents.

^c “Other” includes telecommuting.

1 Given that the freeway closure motivated some commuters to change their travel habits and try a
2 new mode (18), we are interested to know more details about those commuters and their
3 experience. Due to space limitations, we focus on the most common mode change – increasing
4 transit – and briefly summarize some key descriptive results for the pooled data. Among the 224
5 respondents who increased transit use during the closure week and answered the follow-up
6 questions about the experience, only 8.9% felt that it worked poorly or very poorly for them. Thus,
7 it seems that using transit was largely a positive experience for those who took it during the Fix.
8 With respect to likelihood of continuation, a sizable fraction of respondents who increased their
9 transit use reported being “very likely” to continue commuting by transit, but that fraction differed
10 considerably depending on prior history. Among the 148 who were currently already using transit
11 to commute (and simply increased their use during the Fix), 51.4% indicated being very likely to
12 continue, but among the 52 who had used it before but were not currently commuting by transit,
13 that figure was 34.6%, and among the 13 who had never used transit before, no one was very likely
14 to continue. Thus, it seems that the overall proportion of commuters who both increased their use
15 of sustainable modes during the Fix and are likely to maintain that change beyond the Fix is
16 relatively small – around 2%, in the case of transit. Nevertheless, the composite outcome of a
17 number of such small effects could be sizable.

18 19 *5.1.3 Other Changes*

20 The active choices discussed so far are considered to be potentially somewhat costly (in a
21 generalized sense of the word), in that they may require lifestyle adjustments (e.g. conforming
22 one’s work hours to a transit schedule, enforcing self-discipline to work at home) and/or affect
23 other people (e.g. household members, co-workers) (25). By contrast, the remaining changes
24 shown in TABLE 3 are considered relatively low-cost, entailing minimal change to established
25 patterns. Accordingly, a number of studies have found such changes to be the most common
26 responses to increasing congestion or disrupted commute patterns (26), and the present analysis is
27 no exception. Nearly half the respondents reported making a special effort to avoid rush hour
28 during the closure week (on an average of four days out of the week), and 44% of those
29 driving/carpooling to work that week reported making planned changes to their commute route (on
30 an average of 3.4 days). Again, the motivation to make these changes appears to diminish as the
31 Fix continues, with marked decreases between Waves 1 and 2 in the shares doing them.

32 Teleconferencing is often touted as a way to reduce work-related travel, especially when
33 conditions are disrupted (27). Apparently its adoption is still not widespread, however – at least in
34 our sample, only about 3% of respondents took advantage of this strategy, avoiding an average of
35 2.3 trips each.

36 Altogether, 60.0% of respondents in the pooled sample made at least one of the active
37 changes analyzed in Section 5.1. Interestingly, this proportion remained relatively stable across
38 waves: 61% in Wave 1, and 58% in Wave 2.

39 40 **5.2 Changes in Non-work Related Trips**

41 TABLE 3 also includes descriptive statistics on commuters’ active choices with respect to
42 non-work trips. Five questions in Wave 1 respectively asked respondents how many times they
43 changed the location, changed the route, changed the day or the time of day they performed a
44 non-work activity, and did not do a non-work activity at all because of the Fix. Wave 2 added a
45 sixth question that asked how many times respondents used the internet to do a non-work activity
46 instead of traveling to it because of Fix I-5.

1 Among these six active choices for non-work related trips, the most popular option was
 2 changing the route to avoid the Fix I-5 area, exercised by about 44% of eligible respondents.
 3 Changing the location or the time of an activity, or canceling it altogether, were each adopted by
 4 more than a fifth of the eligible respondents, while nearly that many (18%) changed the day on
 5 which an activity was conducted. The least common option was internet substitution for traveling
 6 to an activity, exercised by just 6.5% of (Wave 2) respondents. In all of these cases, those who
 7 exercised a given option did so an average of 2.5 – 3.2 times during the closure week.

8 Similar to the results for the passive impacts, proportionally fewer commuters made active
 9 changes in Wave 2 than in Wave 1. Interestingly, however, those who adopted a non-work strategy
 10 in Wave 2 did so on a similar or greater number of occasions, on average, compared to their Wave
 11 1 counterparts.

12 13 **6 “INCREASE TRANSIT USE” MODEL**

14 Although it is helpful to see descriptive statistics on how commonly various changes were made, it
 15 is also desirable to better understand the types of people who make a given change. This is perhaps
 16 best done in the context of a model (as opposed to crosstabulations), in which multiple covariates
 17 can be controlled for simultaneously. Space does not permit providing models for all the changes
 18 we see in our sample, but we choose to present a model for the most common mode change that
 19 reduces vehicle travel, namely the choice to increase the use of transit for commuting.

20 The dependent variable is created from the survey question which asks (of those who pre-
 21 viously indicated traveling to or from work using a different means of transportation during the
 22 closure week than they normally would, because of the Fix), “During the week of ... which did
 23 you use on more occasions than you normally would have?” with seven possible response options:
 24 “Carpool or vanpool”, “Bus”, “Light rail”, “Amtrak train”, “Walking or biking”, “Driving alone”,
 25 and “None of the above”. In our model, we combine “Bus”, “Light rail” and “Amtrak train” into a
 26 single “transit” variable, equal to 1 if respondents selected any of those modes, and 0 otherwise. In
 27 addition to our previous filter excluding respondents who were out of the region for the entire
 28 week or did not travel to work any days that week, we also excluded from our model respondents
 29 who already take transit for all of their commute trips, since in none of these cases would in-
 30 creasing transit use be a feasible option. After this additional filter, 5439 cases were left, including
 31 287 (5.3%) who increased their transit use due to the Fix (this differs from the 300 cases mentioned
 32 in footnote b of Table 4, due to the additional filter: 13 cases reported increasing their transit use
 33 due to the Fix, but also reported that they already use transit for all of their commute trips). As des-
 34 cribed in the “Survey Contents” section, a number of potential explanatory variables are available,
 35 including sociodemographic traits and the availability of various employer-based commute mod-
 36 ification instruments such as preferred parking for car/vanpools and reduced-rate transit passes.

37 Due to missing data, our preferred model (**TABLE 5**) has 205 (4.6%) respondents who
 38 increased their transit use during the closure week and 4251 who did not. The ρ^2 goodness-of-fit
 39 measure (28), with the equally-likely model as base, is 0.770, which, taken at face value, is
 40 considered quite good in the context of disaggregate discrete choice models. With shares this
 41 unbalanced, however, the market-share model alone (the model containing just the constant term)
 42 has a ρ^2 value of 0.731, initially suggesting that the true explanatory variables only add 0.039 to
 43 the goodness of fit. On the other hand, when we re-estimate the same model except without the
 44 constant term (not shown), we find a ρ^2 value of 0.713, which indicates that most (93%) of the
 45 explanatory power of the model lies in the “true” variables. That is, the true variables are
 46 substantively helping to explain *why* the shares are so unbalanced.

47

1 **TABLE 5 Binary Logit Model of Increased Transit Use, Pooled Data (1=Increased transit**
 2 **use, 0=Did not increase transit use)**

Variable Name	Model	
	Coefficient	P-value
<i>Constant</i>	-4.628	0.000
<i>Sociodemographics</i>		
Female (dummy variable – DV)	0.452	0.007
Household size	0.199	0.000
Live in neighborhood with a lot of retail/ commercial within a 10 minute walk (DV)	-0.673	0.046
<i>Mode usage</i>		
Transit is primary commute mode (DV)	1.255	0.000
Currently uses transit but is not primary mode (DV)	2.066	0.000
<i>Employer-provided Commute Strategies</i>		
Free on-site parking (DV)	-0.466	0.028
Paid on-site parking (DV)	-0.546	0.003
Reduced-rate transit passes (DV)_	0.725	0.000
Variable start/end times (DV)	-0.303	0.052
Valid number of cases, N	4456 (yes: 205; no: 4251)	
Final log-likelihood, $LL(\beta)$	-711.817	
Log-likelihood for market share model, $LL(MS)$	-831.405	
Log-likelihood for equally-likely (EL) model, $LL(0)$	-3088.664	
No. of explanatory variables, K (including constant)	10	
$\rho_{ELbase}^2 = 1 - LL(\beta) / LL(0)$	0.770	
Adjusted $\rho_{ELbase}^2 = 1 - [LL(\beta) - K] / LL(0)$	0.766	
$\rho_{MSbase}^2 = 1 - LL(\beta) / LL(MS)$	0.144	
$\rho_{MS}^2 = 1 - LL(MS) / LL(0)$	0.731	
χ^2 (between the final model and the EL model)	4753.694	
χ^2 (between the final model and the MS model)	239.176	

3
 4 Nine variables besides the constant are retained in the model: two mode usage variables, four
 5 employer strategies, and three sociodemographic variables. We discuss each of these in turn.

6 We hypothesized that people who already used transit to some extent would be more likely
 7 to increase their use of it than others would be to start using it. Accordingly, we tested several
 8 indicators of transit use. Two dummy variables, marking those who use transit as their primary
 9 commute mode (defined as respondents who use transit on at least as many commute days as
 10 they do any other commute mode in a typical month) and those who currently use transit but do
 11 not have it as their primary commute mode, are strongly significant and positive, as expected. Our
 12 interpretation is that people who currently use transit are familiar with the schedule, stop/station
 13 locations, and riding experience, and would therefore find it easier to step up their use. By contrast,
 14 nonusers may have erroneous impressions of transit, e.g. an overestimation of commute time (3),
 15 or may have simply decided it is not practical for them, while those who already use transit as their
 16 primary commute mode have little room to increase their use. The impact of transit being the
 17 primary mode is weaker (coefficient 1.26) than that of transit being currently used but not the
 18 primary commute mode (coefficient 2.07). The interpretation is that those who are already using
 19 transit as their primary commute mode have less room to increase their transit use than those

1 who currently use transit but not as their primary mode.

2 We believe it is valuable to realize that it may be more effective to try to persuade current
3 transit users to increase their use than to try to convince nonusers to switch – although we
4 recognize that both potential markets are important. On the other hand, it could also be argued that
5 including user history variables such as these two is not as insightful as identifying the “first
6 principles” that influence whether one *does* currently use transit or not, and including those in the
7 model instead. Thus, we also tested excluding these two variables from the model (results not
8 shown). When we did so, all other variables remained significant, and the ρ^2 value was 0.74, a
9 goodness of fit not much lower than that of our selected model. Accordingly, we view these
10 variables as incrementally informative, but they are by no means having an undue influence on the
11 model.

12 Four employer-provided commute strategies are significant in the model, all with expected
13 signs: employer provision of reduced-rate transit passes increases the probability of using transit
14 more during the Fix, while free on-site parking, paid on-site parking, and the availability of
15 flextime decreases it. The free on-site parking variable is consistent with previous studies
16 showing that free worksite parking discourages transit use (29-31), but our model also suggests
17 that even paid parking, if it is conveniently located on-site, has a similar deterrent effect in this
18 context. The interpretation of the flextime result is that if people can change their departure times
19 to avoid congestion caused by the Fix, then their current commute mode (most often the
20 automobile) may remain viable.

21 Finally, three sociodemographic traits are also significant in the model. The gender
22 variable indicates that women are more likely than men to increase transit use, consistent with
23 other evidence (32-34) finding women to be more likely to use transit in general. The positive
24 coefficient of household size was initially unexpected, but is also saying something meaningful.
25 We assume that people in larger households have more complex activity-travel patterns, and
26 therefore our original expectation was that commuters in such households would be more likely to
27 find the car to be most practical, and more likely to stick with the car. However, further reflection
28 and responses to open-ended questions of the survey suggest another possibility. It may be that the
29 more complex patterns of larger households are more vulnerable to disruption, and have less
30 ability to absorb a disruption without much change. Thus, commuters in larger households may
31 have a greater *need* to change than those in single- or two-person households, while at the same
32 time, there might be more limitations on the ability of such commuters to choose certain other
33 actions such as changing route or departure time. The speculation that larger households are more
34 susceptible to disruption in general found some support in our data. Specifically, based on
35 independent-samples t-tests of whether mean household size differed with other commute pattern
36 changes, we found that *most* of the changes we studied are associated with larger household sizes,
37 including telecommuting, taking vacation (both statistically significant), adopting compressed
38 work schedules, increasing car/vanpool use, and increasing driving alone (but not increasing
39 bike/walk). Nevertheless, we also tested excluding household size from the model; there were
40 some small differences between the two models but the one including household size had a better
41 overall fit than the one excluding it. So we decided to retain household size.

42 Similarly, the negative coefficient for living in a denser/mixed-use residential
43 neighborhood may at first seem counterintuitive (we tested each of the levels of the “Residential
44 neighborhood” variable shown in Table 1, both as individual dummy variables, and as a single
45 ordinal variable excluding “other”), since conventional wisdom holds that living in a denser
46 mixed-use neighborhood is associated with *greater* transit use. In our sample, however, existing

1 (pre-Fix) transit commute shares are similar across neighborhood types, and even somewhat
2 higher among those living in lower-density areas (30.5% for those living in purely residential
3 neighborhoods and 32.6% for those living in very low-density areas) than among those living in
4 the densest/most mixed-use areas (29.3%). However, the latter group also has the highest shares of
5 walking/biking to work (22.8%, compared to 9.0% and 4.2% for the lower-density categories,
6 respectively). *Transit* achieves its highest share, then, for the *medium-density/mixed-use* neigh-
7 borhoods (33.3% for those living near “some” retail/commercial activity, compared to 14.7% for
8 walking/ biking in those neighborhoods), losing share in the denser areas to walking/biking, and in
9 the less dense areas to cars. With that as the baseline pattern, then, and keeping in mind that this is
10 a model for *incrementally increasing* the use of transit (although including those who were not
11 otherwise using it right before the Fix), it is perhaps not surprising that those living in lower-
12 density, more purely residential environments are more likely than others to increase their use of
13 transit: those living in more conducive environments are more likely either to have already
14 maximized their transit use to the extent practical, or to have found walking/biking to be more
15 practical than transit.

16 This is a somewhat encouraging result, suggesting that there *is* room to increase transit
17 commuting even when the residential neighborhood is not stereotypically conducive to it. We also
18 had variables representing the walking time to the nearest bus stop/rail station (shown in Table 1),
19 and found a similar relationship when they were allowed to enter the model: the farther the
20 distance to the nearest transit node, the more likely the respondent was to increase her transit use.
21 Using the density/mixed-use variable in Table 5 resulted in a better significance and goodness of
22 fit, so we chose to retain it rather than the distance variables (the ordinal forms of the residential
23 neighborhood and distance-to-transit variables were strongly correlated, at -0.659).

24 It is pertinent to mention the variables that were *not* significant in the model, as well as
25 those that were. Besides the variables just discussed, we tested a number of other variables,
26 including work schedule type (part-time, conventional, flexible, compressed), occupation,
27 commute time and distance, income, number of vehicles per household member and per licensed
28 driver, and a geographically-based indicator of how strongly the respondent’s commute might
29 have been affected by the Fix. However, none of these variables were significant in the final
30 model.

31

32 **7 SUMMARY AND SUGGESTIONS FOR FUTURE RESEARCH**

33 This study analyzed passive impacts on commuters of the Fix I-5 reconstruction project, and their
34 active choices to mitigate those impacts. Two waves of surveys were implemented (for this study,
35 effectively constituting repeated cross-sections), during successive closures of all lanes in one
36 direction (southbound and northbound, respectively) of the interstate highway. The two
37 subsamples have similar characteristics on key variables such as gender, age, educational level,
38 and income.

39 The passive impacts during the Fix do not appear to be excessive. It appears that the
40 various coping strategies adopted by commuters actually improved conditions for some, and to
41 some extent helped compensate for the deterioration in conditions for others. However, the two
42 waves show some systematic differences in response, with Wave 1 reflecting stronger impacts
43 (both positive and negative). It appears that the effects of the Fix, both positive and negative,
44 diminished over the course of the project.

45 Among the active changes to commute trips, the easiest options (such as avoiding rush
46 hour and changing route) were the most common responses (adopted by 48% and 44%,

1 respectively) – a result supported by several other studies. Among the active changes that reduce
2 the number of commute trips made, our best estimate is that about 5.6% of the total eligible
3 respondents increased telecommuting, and about 3.1% each increased their use of compressed
4 work schedules and vacation days because of the Fix. Commute mode changes were made by 7.8%
5 of the eligible sample, including increasing transit (5.4%), increasing walking or biking (2.5%),
6 increasing car/vanpooling (1.4%), and increasing driving alone (0.6%). Thus, the vast majority
7 (94%) of those making mode changes increased their use of more sustainable modes, most often at
8 the expense of driving alone. Altogether, 60.0% of eligible respondents made at least one of these
9 active changes to their commute.

10 Focusing on the most common mode change, using transit was apparently a largely
11 positive experience for those who tried it during the Fix: only 9% of those increasing their use of
12 transit felt that it worked “poorly” or “very poorly” for them. On the other hand, only about 44%
13 of those who increased their transit use report being “very likely” to continue after the Fix,
14 including none of the (13) brand-new transit users. Thus, it seems that the amount of permanent
15 new transit ridership generated by the Fix is relatively small.

16 A binary logit model was built to better understand the choice to increase transit use during
17 the Fix. Nine variables appear in the model: two relating to mode usage, four marking employer
18 commute policies, and three sociodemographic traits. Despite the unbalanced shares (4% / 96%),
19 the true explanatory variables in the model account for a considerable portion (about 71%) of the
20 information in the data. The significance of dummy variables for those who currently use transit in
21 their commute suggests that persuading current transit users to increase their use may be easier
22 than convincing nonusers to switch to transit. The employer’s subsidy of transit naturally supports
23 increasing its use, while provision of on-site parking – interestingly, whether free *or* paid – and
24 variable start/end times discourage increasing transit use. The latter result in particular illustrates
25 the conflict that sometimes arises among policy instruments: making work hours more flexible is
26 considered beneficial for reducing congestion and for balancing work and family needs, but the
27 increased flexibility in avoiding peak-period congestion may enhance the appeal of continuing to
28 commute by driving alone. Finally, women and (counter to expectation) those in larger households
29 and in lower-density single-use residential areas were more likely to increase their transit use. The
30 result for households appears to reflect a greater vulnerability to disruption of the complex activity
31 patterns in larger households, with the result that commuters in such households have a stronger
32 impetus to make *any* change when disruption occurs. The result for neighborhood density/mixture
33 suggests that those living in more “transit-conducive” environments are more likely to have
34 already maximized their transit use to the extent practical, but also suggests that there *is* room to
35 increase transit commuting even when the residential neighborhood is not stereotypically
36 conducive to it.

37 Several directions for future research are indicated. Using the same data set, we can model
38 not only other behavioral changes beyond the one explored here (increased transit use), but also
39 the reported likelihood of continuing to use a strategy adopted (or increased) during the Fix. With
40 the addition of geocoded home and work location information (for those who reported nearby
41 street intersections), we can explore a number of geographic relationships with observed outcomes.
42 Ultimately, we will be merging the attitudinal and behavioral data collected in Wave 3 with Waves
43 1 and 2, to provide a rich basis from which to further investigate the persistence of behavioral
44 changes prompted by the Fix.

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