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Understanding Factors Associated with Commute Behavior Changes: An Empirical Investigation from Northern California

December 2012

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Abstract: This study investigates travel behavior changes of regular commuters in the context of the temporary closure of Interstate 5 in downtown Sacramento, California. Specifically, we analyze "temporary" vs. "longer-term" changes in the frequency of drive-alone commuting among 2,012 respondents to an online survey. Interestingly, a similar proportion of the sample increased driving alone (23%) as decreased (22%). Unfortunately from the standpoint of emissions, those who increased driving alone were substantially more likely to make this change a regular ("longer-term") behavior (83%) compared to those who decreased (52%). About 61% of the sample did not change their driving alone in either direction. Numerous variables are considered to be potentially important predictors of changes, including socio-demographic traits, environmental and travel attitudes, and land use characteristics. The influence of the freeway closure is also explored. Discrete choice models of the changes are estimated, and characteristics associated with making positive or negative, temporary or longer-term changes are identified. Important land use characteristics include access to amenities such as grocery stores and schools in the vicinity of home and work locations. Additional characteristics that are important factors in the changes modeled include the background commute patterns, occupation types and attitudes towards transportation and travel.

Table of Contents

Chapters

Appendices

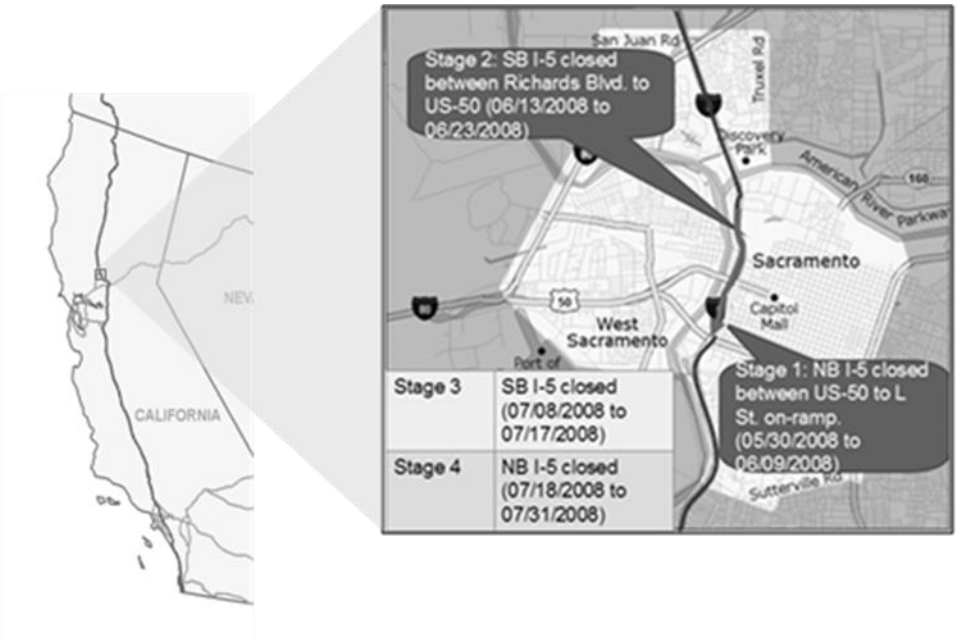
List of Figures

List of Tables

1. Introduction

In June and July 2008, an approximately one-mile stretch of Interstate 5 through downtown Sacramento, California (the state capitol) was intermittently closed for a $27 million reconstruction project ("the Fix I-5" project, or "the Fix"). This link normally carries nearly 200,000 vehicles daily. The Fix did not increase the capacity of the freeway; the purposes of the project were primarily to rehabilitate the pavement and to prevent flooding. The area affected by the Fix and the dates of the closures are shown in Figure 1; note that all lanes in a given direction were closed for more than a week at a time, on multiple occasions.

Figure 1: Areas and Times Affected by the Fix



Source: Created for the project by Kristin Lovejoy and Liang Ye. Interstate 5 map public domain

In preparation for the Fix, numerous strategies were implemented and promoted, including a Governor's Executive Order urging state agencies to use telecommuting, alternative work schedules, and transit to the extent possible (it is estimated that 75,000 State employees work in and around downtown Sacramento). In addition, to encourage the use of alternative modes, and

to limit congestion and other traffic impacts, local transportation planning agencies supplied extensive information to commuters, funded increased transit services, reduced certain transit fares, and offered free parking at some facilities, among other measures.

UC Davis researchers conducted a multi-faceted investigation of the behavioral response to this series of closures during multiple phases of the reconstruction, i.e. before (retrospectively), during (contemporaneously) and after (contemporaneously, six months later) the temporary closures of the interstate link. Several internet-based surveys were administered to a sample of thousands of Sacramento-area commuters potentially affected by the closures, to ascertain how (if at all) they changed their commute patterns in response. The present paper focuses on changes made during the Fix and the six-month period thereafter. Accordingly, the Fix is only one of many possible motivations for the travel behavior changes studied. In particular we analyze changes in the number of days an individual commutes to and from work by driving alone.

2. Related work

Although commute behavior is typically habitual, individuals do change behavior, and factors such as "… the negative effects of an existing activity…, realizing… that it is possible for me.…, hearing of someone else…[or] experiencing a change moment.…" are expected to be important for individuals to make behavioral changes (Ampt 2003 p. 4). In particular, a disruption such as Fix I-5 may activate some of those factors, causing individuals to re-examine their habits and offering a potential motivation for making environmentally positive behavioral changes (Verplanken et al. 2008). Further, changes made due to other influences may also coincide with this disruption or the six-month study period following the freeway closure.

It is reasonable to expect some people to have a greater propensity to make changes, and to persist in those changes, than others. Accordingly, it is valuable to examine what personal and situational characteristics are associated with making a change, and with whether a change is temporary or longer-term. Of particular interest to the present study is the role of land use characteristics in behavior change. Numerous studies (see, e.g., Cao et al. 2009) have explored the impacts of land use on travel behavior in general, but relatively few have done so specifically in the context of behavior *change* and/or habit disruption. The expected relationships are potentially not as straightforward as might be thought. On the one hand people who live in denser, more diverse locations may be more likely to change toward more sustainable commuting behavior because they have more options for doing so, and perhaps a greater inclination from the outset to do so (having selected themselves into an area conducive to such a choice). On the other hand, perhaps such people, living in such areas, have already chosen more sustainable commuting behavior to the extent practical for their circumstances, and therefore are *less* likely to make changes during the study period (because they are already doing it "a lot"). Thus, change models could be rather different from simple cross-sectional choice models.

Disruptions or modifications to transportation infrastructure and services can take several different forms. A number of studies have analyzed behavioral changes as the result of planned reconstructions (e.g. Fujii et al. 2001), unplanned or natural disasters affecting transportation (e.g. Giuliano and Golob 1998), other planned and unplanned interruptions (e.g. Hensher and Brewer 2002), personalized travel counseling (e.g. Taylor and Ampt 2003; Graham-Rowe et al. 2011), and level of service interventions as a transportation demand management strategy (Fujii

and Kitamura 2003). Transportation Demand Management (TDM) is particularly interested in the mechanisms which influence individual behaviors; as Meyer (1999, p. 576) points out, "the major focus of demand management is to influence the individual travel behavior of travelers."

As the interstate highway system and other elements of the transportation infrastructure continue to age, reconstruction projects like Fix I-5 will occur quite frequently. It is important to learn as much as possible about commuter reactions to such projects, to enable future construction to be implemented in the most effective way – including the best ways to use that natural disruption of habitual behavior in coordination with other strategies to motivate shifts toward more sustainable commute choices (Gardner 2009).

As mentioned above, however, it should also be recognized that, whether a major disruption is underway or not, people's lives are dynamic, and travel behavior changes can be made at any time, for any of a number of reasons. Those which have focused on a change in behavior related to land use, have primarily dealt with small groups of individuals who have changed residential location and are thus potentially more likely to make a change in travel behaviors due to changes in the available commute options or other factors. Other factors include changes in household size (e.g. the birth of a child), changes in job or residential location, changes in job duties or in non-work activities, changes in attitude, or even just seasonal changes. Klöckner (2004) explores the relevance of specific life events for travel behavior changes. Beyond such changes that occur naturally, life events may also serve as opportunities for successful habit-changing interventions on the part of transportation planners (for example, see Ampt et al. 2006 and Verplanken and Wood 2006). In any event, it is very much of interest to investigate the propensity to change

travel behavior, and persist in that change, regardless of the reason. The present study does exactly that; we investigate changes made for any reason over the six-month study period, while retaining the Fix as one possible explanatory variable for those changes.

3. Sampling and Data

3.1 Data Collection and the Sample

During the construction project surveys were administered in two waves to thousands of workers and commuters in the Sacramento area. Participants were recruited from California State agencies, and Sacramento area commuter listservs (e.g. the Commuter Club of the Sacramento Transportation Management Association). For further discussion of the sampling and reach of the survey see Ye et al. (2012). Because of the extensive recruitment through State agencies and commuter listservs, as well as the higher education and income of the sample, the sample may overrepresent individuals who are pro-environmental or community/service oriented. Six months after the freeway closures, the Wave 3 survey was administered to the subset of the sample from Waves 1 and 2, who said they would be willing to be contacted again. Thus the Wave 3 sample is potentially further biased towards individuals who are altruistic, interested in the study or in transportation issues in general. All respondents completed the Wave 3 survey and one or both of the Wave 1 and Wave 2[1] surveys.

[1]In previous analyses of Waves 1 and 2 together, to prevent violating the assumption of independence of observations our working sample included all Wave 1 cases, and Wave 2 cases only when they had not taken the Wave 1 survey. In the present analysis, to use the latest-available information on during-Fix behavior, Wave 2 cases are given priority, and Wave 1 cases are only used for those individuals who did not also complete the Wave 2 survey. Due to an oversight, the final working sample for this study contains Wave 2 cases who reported starting the Wave 1 survey (but not completing it) but were not matched to a Wave 1 survey record, and thus we could have both their Wave 1 and Wave 2 responses in the sample without knowing they belong to the same person. In our final working samples, there are at most 38 such cases out of 1387 in the sample for decreasing (or 24 out of the final decrease model sample of 980) and at most 38 cases out of the final increase model sample of 1534. This is not a large enough fraction to be concerned about violating the independent-observations assumption. These cases are not removed from the sample however, it is likely that these cases are discarded in modeling because it is very likely they are missing data, as they reported not completing the Wave 1 survey.

All survey waves asked commuters about their normal commute patterns, which modes of transportation are used and their commute distances and times. Survey content also included socio-demographic information such as employment and education and information about respondents' neighborhood, home and household. During Waves 1 and 2 respondents were asked to report on changes that they made during the freeway closures. The Wave 3 survey asked respondents to report on changes they had made during and since the previous summer. The Wave 3 survey also included questions about preferences in transportation, lifestyle questions and beliefs about transportation and environmental problems.

3.2 Commute Changes of Interest

A number of different dimensions could be considered important when defining the commute changes of interest. For example, a study focusing on physical activity would want to examine instances in which walking and biking increased or decreased. We are interested in actions which are environmentally beneficial, detrimental, or neutral/ inconclusive. In our initial approach any changes that involved increasing the use of alternative modes such as transit, biking or carpooling or decreasing driving alone were considered environmentally beneficial. Any changes that involved decreasing the use of alternative modes, or increasing driving alone were considered environmentally detrimental. However, we eventually realized that it is not really environmentally beneficial to switch from one driving-alternative mode to another, such as from transit to biking. Accordingly, this approach was refined, but some results from our initial approach are presented in Appendix A. To keep the scope of the present study manageable, and to capture the changes which result in more concrete environmental impacts (either positive or

negative) we chose to focus on emissions benefits as the dimension of interest, and therefore changes in drive alone commuting.

We focus our analysis on whether individuals increased, decreased or did not change the *number of commutes they make by driving alone* in a typical 28-day period, and whether any such change was temporary or longer-term. We consider increases and decreases due to *mode changes* (i.e. switching from biking to driving alone would be an increase in driving alone), as well as increases and decreases due to *changing the number of commute days* (i.e. adopting a compressed work week, and commuting only four days each week instead of five, would be a decrease in driving alone when the eliminated commutes would have been drive-alone commutes).

To define longer-term changes, we first examined the frequencies of drive-alone commuting reported at two points in time. Respondents reported the numbers of days they commute by driving alone in the surveys administered during the Fix (Waves 1 and 2), and in the survey administered during the winter of 2009 (Wave 3), approximately six months after the Fix was completed. In the Waves 1 and 2 surveys respondents were asked, "Considering the days in a 4-week (28-day) period on which you make **physical trips to and from a regular workplace,** on how many of those days do you do each of the following?" Answers included, "Drive alone for **most** of the trip". Respondents wrote in values ranging from 0 to 28 in Wave 1, and were given a drop-down menu from which to choose any number of days from 0 to 28 in Wave 2.

In the Wave 3 survey the responses for "Drive alone for **most** of the trip" were defined in terms of the following frequency categories: "Seldom or never; 1-3 times a MONTH; 1-2 times a WEEK; 3-4 times a WEEK; 5 times a WEEK; 6-7 times a WEEK". In addition, in the Wave 3 survey respondents reported whether they had adopted any changes to their commutes since the previous spring *that they are now doing on a regular basis*. Though the response variables are not identical, we are able to compare the typical behavior in the first waves of the survey to the typical behavior in the third wave of the survey in order to identify temporary and longer-term changes in commute patterns (a detailed description of the methods used for comparison is presented in Appendix A). We use the term "longer-term" (rather than "permanent") changes because we do not know with certainty at what point, in the six months between the Fix and the Wave 3 survey, respondents made a change to their commute patterns (it might have been just the week before taking the Wave 3 survey), or at what point the change became a regular behavior. We also do not assume that just because a change was maintained for up to six months it will be maintained indefinitely. "Longer-term" reflects changes which became regular commute patterns for some amount of time that is longer than for changes made only on a temporary basis.

Longer-term changes could be identified in two ways: by comparing the baseline commute patterns for either of the first two survey waves to those of Wave 3, and by tallying changes reported in Wave 3 as representing something done differently (and on a regular basis) "now" compared to "last spring (April, May, June 2008)". Although we considered both the baseline comparisons and the retrospective reporting of changes, we chose to give priority to the baseline comparison across waves, because we expect individuals to answer contemporaneous questions

about their current commute patterns more accurately than they answer a retrospective question asking them to compare their current "typical" commute pattern to their typical commute pattern "last spring". However, for 302 cases which did not answer one or both of the baseline commute questions, we relied on the retrospective reporting of changes in driving alone (of those, 262 reported making neither temporary nor longer-term changes).

Temporary changes made during the Fix were reported contemporaneously in Waves 1-2, and retrospectively in Wave 3. During Waves 1-2 respondents were asked specific questions about whether they were making changes, and if so, what kinds of changes, during each one-week survey period (coinciding with freeway closure periods). During Wave 3, respondents were asked to remember if they made any temporary changes to their commute during the preceding summer and were not limited to reporting changes made specifically because of or during the time of the Fix.[2]

Once the changes had been identified, we developed some rules to define the allowable changes made by any individual: no increases or decreases in drive alone commuting may at once be made on both a temporary and longer-term basis. Longer-term changes are defined as those resulting in a new regular pattern which was maintained at least to the point of the Wave 3 survey, whether or not they began at the time of the Fix (approximately six months earlier), or some later point. Temporary changes are those which were (presumably[3]) made during the Fix or

[2] In fact, in the Wave 3 survey we deliberately did not make the Fix a prominent part of the recruitment and background context for the survey, so as to avoid (as much as possible) biasing respondents toward *exaggerating* its role in any changes.

[3] Respondents were asked how their commute patterns differed from what they were doing "last spring (April, May, June 2008)". It is possible that they reported changes made in May 2008 as "different", when in fact that should have been their new baseline pattern against which to measure *future* changes. It is also possible that they considered (an altered) commute pattern undertaken during the Fix as the baseline, since the Fix began on May 30, 2008.

some later point, but were not maintained through the time of the Wave 3 survey. Once a change becomes longer term, it is no longer considered a temporary change; thus individuals with both a temporary and longer-term decrease in driving alone are only treated as cases with a longer-term decrease. Further, individuals either make increases *or* decreases on a longer-term basis, and not both: the *net* change in driving alone made by individuals cannot occur as both an increase and a decrease at the same time. Respondents could, however, make a temporary change in one direction while making a longer-term change in the other direction, and they could make temporary changes in both directions during the 6-month period of the study. However, respondents who were classified as making temporary changes in both directions could not also be classified as making any longer-term change; since this would violate the first rule.

For modeling longer-term and temporary decreases in drive-alone days, individuals who could not drive alone fewer days were removed from the dataset, since "decrease driving alone" was not in their choice set and therefore leaving them in could badly distort the parameter estimates of the model (Thill 1992). Specifically, all individuals who answered "0" to the (Waves 1-2) question regarding the number of days in a typical 28-day period that they drive alone were excluded from the model sample. Preliminarily, this results in a 25% reduction of the sample – a substantive finding in its own right. That is, a full quarter of our sample was already commuting in essentially the lowest-emission way possible. This is not entirely surprising, given the possible environmentally-minded nature of a sample containing many State agency employees. Although these cases are excluded from our model sample, our presentation of descriptive statistics includes this group – those who could not decrease driving alone – as a fourth segment,

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However, we assume that relatively few people made *multiple* changes to their commute patterns during spring 2008 (*aside* from those induced by the Fix), and that most people taking Wave 3 six months later would associate the Fix with *summer* 2008, not spring.

compared to those who did not make any decrease in driving alone (but could have), those who decreased driving alone for a longer term and those who decreased driving alone temporarily.

Similarly, for modeling the longer-term and temporary *increases* in drive-alone days, individuals who could not drive alone *more* days were removed from the dataset. Specifically, everyone who reported driving alone 28 days per month was discarded from the sample. We considered discarding those who drove alone 20 or more days out of 28, since that would correspond to driving every day for a standard five-day workweek (times four weeks), but since it was still possible for them to drive to work on the occasional weekend, or to routinely work six-day weeks, we conservatively left cases in the sample unless they reported driving alone all 28 days. Another approach would have been to exclude those individuals who commute by driving alone for 100% of their commutes, but (unless commuting seven days a week) these individuals *could* increase the number of commute days, and thereby could increase their level of drive alone commutes and related emissions. Not surprisingly, those who drove alone all 28 days constituted only a small fraction – 0.6% – of the original sample, while about 26% of the original sample drove alone at least 20 days out of 28.

3.3 Land Use Variables

This study focuses on land use factors and how land use characteristics influence the behaviors of interest in this study. Several land use variables were included in the original survey, namely descriptions of respondents' neighborhoods, the distance from their homes to a transit or bus stop, and the type of home in which they are living. In initial model estimations, distances to transit and the category "some retail within a 10-minute walk" (from home) were important

factors in the choices to increase or decrease driving alone. In later model estimations, these respondent-reported variables are replaced with geocoded land use variables, which are measured objectively. Three additional sources of information were utilized to generate a richer set of land use variables: Geographical Information Systems (GIS) data, the online tool Walk Score, and Transportation Analysis Zone (TAZ) information[4]. Each of these is further described below.

In each survey wave, respondents were asked to provide the nearest cross streets to both their home and work locations (we avoided asking for exact addresses to reduce the intrusiveness of the question, and thereby hoped to increase the item response rate). Each home and work location was geocoded, and overlaid with GIS data publicly available from State and local agencies. Taking a ½-mile radius circle, with each home and work location as its center, land use variables of interest were identified. The land use make up for each ½-mile radius circle was determined, and the percentage of coverage for each of approximately 35 land use types was computed (of these, approximately five, including Residential, Industrial and Cropland/Pasture are relevant. Many land use types, such as Tundra or Beaches, apply to other geographic areas of the US). The total lengths of bike paths, roadways and bus routes within each ½-mile radius circle were found, as well as the total count of bus stops.

Another source of land use information was obtained using the online tool Walk Score. Walk Score is an internet-based tool (http://www.walkscore.com/) that provides information about the locations of various amenities in cities and neighborhoods (Walk Score 2011). Utilizing the

[4] Many thanks to David van Herick for generating these measures, as well as the measures of the influence of the Fix described in Chapter 3.

online tool, the Walk Score as well as all the information used to calculate the Walk Score was compiled for each home and work address. The Walk Score is a value ranging from 0 to 100, which is determined using the distances to various amenities from the address given, weighted on expected importance to walkability and with a points system that takes into account the distance to each amenity, with different points for each different type (Walk Score 2011). The compiled data includes the distances to up to eight locations for each of nine different amenity types: restaurants, coffee shops, grocery stores, commercial shops, parks, schools, bars, entertainment locations and banks. Distances which are too long are discarded by Walk Score. In addition to considering the computed Walk Score as a variable of interest in our models, we also worked with different ways to combine this information, such as factor analysis and the utilization of the raw data. Primarily we computed measures reflecting the accessibility of each amenity type.

For each of the nine amenity types, we calculated the sum of the inverses of the distances. That is, we take the sum $\sum_i 1/D_i$, where D_i is the distance (from home or work) of the i-th location in a given amenity category. This accessibility measure for each amenity type is higher with shorter distances; the closer the amenities are to the given address, the more accessible. The measure of accessibility also improves as the number of amenities within the cutoff increases; the more amenities, the more accessible.

Lastly, we obtained land use information by accessing TAZ data from the Urban Land Use and Transportation Center of the University of California, Davis (2011) for the TAZs in which our

respondent pool live. The primary variables of interest at the TAZ level are the population and employment densities.

3.4 The Role of Fix I-5

The role of the Fix in the commute changes of interest in this paper is a logical consideration. Due to data limitations and assumptions made during surveying (addressed in Appendix B.), in this paper we are unable to incorporate respondent reported influences of the Fix directly. However we are able to create measures of the likely influence of the Fix for each commuter. Based on cross streets for respondents' home and work locations, their most likely commute routes were mapped using Google Maps. The routes which are shortest in time were mapped, regardless of distance. The travel times of these routes were compared to the respondent-reported commute travel times. The high correlation (Pearson correlation = 0.895 and $p < .001$) between the travel times for the routes mapped in Google Maps and the respondent-reported commute travel time confirms that the commute routes generated using Google Maps are quite close to those actually used by respondents. In addition to their likely normal route, a route that was forced through the segment of the Fix closures was mapped. For many respondents these routes were the same; indicating that they would most likely use the segments of I-5 which were closed during the Fix, as part of their normal commute route.

Since all mapped routes were chosen based on travel times, we then compare the travel times of the mapped "normal" commute route to the mapped commute route which is forced to include the Fix segment. The difference in travel times represents an estimate of the potential influence of the Fix. When there is no difference in these two travel times, we expect the Fix to have the

most impact, since the equal times indicates that the route through the Fix is the same as the expected normal route. For other differences, the more time added to a commute route by forcing the route to go through the segment of I-5 which was closed, the less impact the closure is expected to have on their commute. For these individuals, they must go out of their way in order to use the Fix segment, so it is not likely that they use this segment on a regular basis. But the smaller the difference, the closer to the Fix segment they are assumed to travel in their normal commute.

A total of 1544 (77%) cases out of 2012 are expected to have a normal commute which does not include the Fix segment. Another 311 cases (15%) are expected to have a normal commute which takes them through the segment affected by the Fix. For the remaining 157 cases (8%), this data was not available, because either the home or work address was not provided, or it was not possible to map their route. Of those for which we have data, 17% are likely to regularly commute through the Fix segment and 83% are not. However, those whose commute times do not differ much from the times of a commute routed through the Fix segment are also likely impacted by the Fix closures. A total of 1299 cases (65%) have commutes which are changed by five minutes or less when forced through the Fix segment, indicating that at least two-thirds of the sample are commuting in the area of the Fix, even if they are not directly using that segment. Thus, many respondents could be impacted by altered traffic patterns during the closures. This variable was explored in model estimations; however, it was not retained in final models, since it was not found to be a significant factor in changes.

4. Descriptive Analysis

Descriptive analysis is conducted to find the frequencies of changes made, and in what combinations. We determine which individuals are more likely to make changes, and what types of changes are made by whom. Specifically, what characteristics (such as gender, income, education, attitudes, beliefs, housing types, neighborhood characteristics, and commute distance) are associated with making positive or negative, temporary or longer-term changes?

Figures 2A-B present temporary and longer-term changes (for increases and decreases in drive-alone commuting, respectively) in a single figure to show the shares making a certain directional change only in the longer term, only temporarily, or mixed with a change in the opposite direction. Interestingly, a similar proportion of the sample *increased* driving alone (23%) as *decreased* (22%). Unfortunately from the standpoint of emissions, those who *increased* driving alone were substantially more likely to do so in the *longer term* (83%) compared to those who *decreased* (52%). About 61% of the sample did not change their driving alone in either direction. A number of individuals both increased and decreased driving alone, making one change temporarily and one in the longer term, or making both changes temporarily. For example, 72 individuals decreased driving alone temporarily but increased in the longer term. Due to the potential overlap between the types of changes an individual can make, there are seven mutually exclusive and collectively exhaustive categories of changes (not counting “no change”) to which any individual may belong. A total of 785 individuals made some kind of change and 110, or 14% of those who made changes, did so in a combination of two changes.

Figure 2A: Decomposition of Changes Resulting in Increases in Drive-Alone Commuting

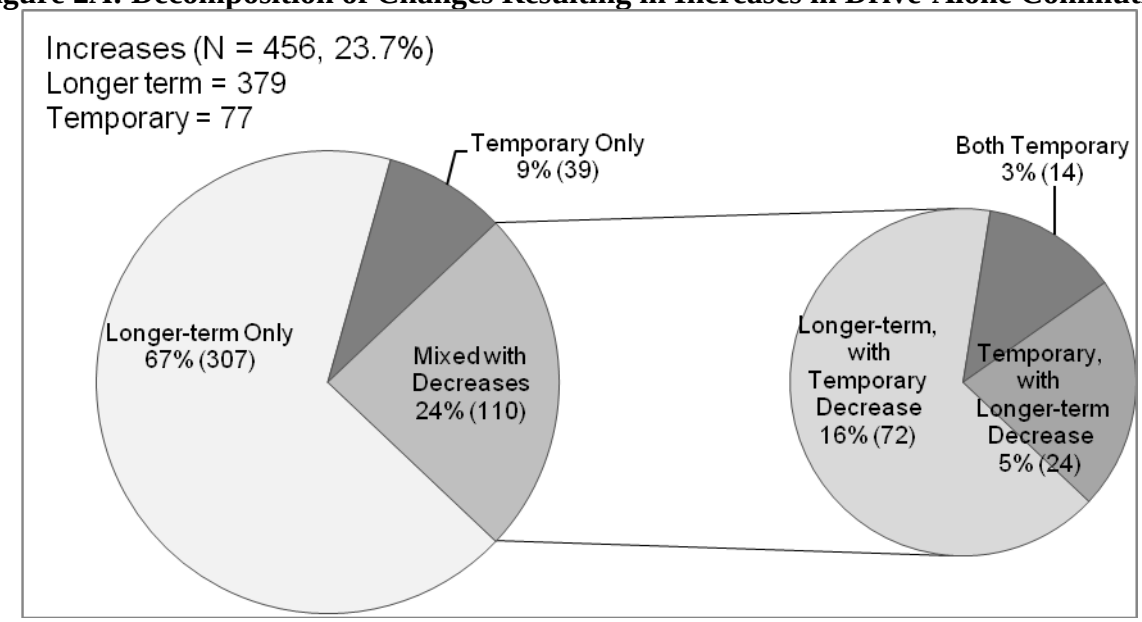
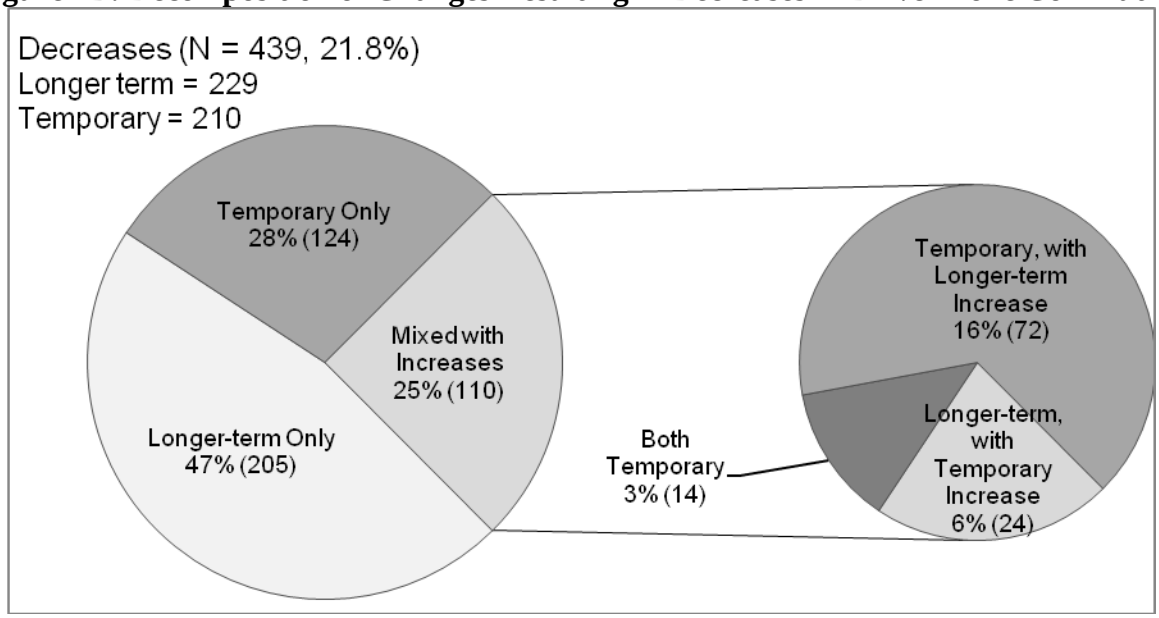


Figure 2B: Decomposition of Changes Resulting in Decreases in Drive-Alone Commuting



Although there are seven categories of changes due to the possibility for individuals to make more than one type of change, our focus is on the two primary categories of changes: increases and decreases in driving alone. Within each category individuals can temporarily change, make a change in the longer term, or make no change, and they cannot make more than one change

within a category, regardless of whether or not they also made a change in the opposite category. Our emphasis is on understanding the factors influencing whether a given type of change (increase or decrease) is made in the longer term or only temporarily. Though this project was prompted by the potential for the Fix to impact commute changes on a short-term or longer-term basis, the respondent-reported influence of the Fix is not considered in model estimations, for reasons presented in Appendix B, together with some analyses of that variable.

For each category of change, we present descriptive statistics for socio-economic, land use, and commute characteristics (Tables 2 and 3; Figures 5A and 5B). For the statistics to be most useful, we reduce the sample to the cases that are present in our final models. We filter out 74 respondents who did not complete the Wave 3 survey, and for the increase categories we discard 12 cases who, in the baseline Wave 1 and 2 surveys, already drove alone 28 days out of 28. There are 500 cases who did not commute by driving alone at all in the baseline, and these are excluded from our model for decreasing driving alone. Here, they are presented as a distinct segment, labeled "decrease not possible". For each characteristic presented, those cases that did not respond are also discarded.

Samplewide, the average age is 47 years; baseline commute time, 33 minutes; and commute distance, nearly 18 miles. Thirty-six percent of the sample is male and nearly all (99.13%) possess a drivers' license. Household size is, on average, 2.5 and households typically have one member, in addition to the respondent, who possesses a drivers' license. Most individuals have annual household incomes of at least $100,000 and live in primarily residential neighborhoods in single-family detached homes.

Turning to the specific segments, for those based on *decreases* in driving alone (shown in Table 1), note that most variables (commute distance, age, household size, education, income, neighborhood type, and dwelling type) do not differ significantly by segment. For the remaining variables, we identify segments that have high or low values on them (looking across the rows of the table), and collate (looking down the columns) those stand-out values to develop a profile of each segment.

Specifically, the *"no decrease"* segment is characterized by having the lowest percentage of males (33%) and a relatively low number of "other" household members with driver's licenses (0.94, on average). Strikingly, the *"longer-term decrease"* segment – the one making the most environmentally-beneficial changes – has virtually no distinguishing characteristics: a relatively high number (1.07) of "other" household members with driver's licenses (a trait shared with the *"decrease not possible"* segment), and the highest proportion (20%) of people living a 10-20 minute walk from transit (a trait shared with the *"temporary decrease"* segment). It is natural for a relative proximity to transit to enable decreases in driving alone, but on the basis of this result we are unable to determine why some people close to transit make longer-term reductions in driving alone, while others, equally close, reduce driving only temporarily.

Table 1: Characteristics of the Sample, by Status with Respect to Decreases in Driving Alone[a, b]

Characteristic	Total Sample (N = 1387)	No Decrease (N = 683)	Longer-term Decrease (N = 162)	Temporary Decrease (N = 135)	Decrease not Possible (N = 407)
Male (1374) (p = .032)	494 (36%)	222 (33%)	57 (36%)	47 (35%)	168 (42%)
Commute Minutes (p < .001)	33.37 (1384)	31.84 (681)	31.75 (162)	31.21 (134)	37.28 (407)
Commute Distance (p = 0.836)	17.87 (1384)	17.99 (681)	17.22 (162)	18.72 (134)	17.65 (407)
Age (p = 0.380)	47.37 (1353)	47.31 (665)	46.03 (159)	48.11 (130)	47.75 (399)
Household Size (p = 0.311)	2.53 (1383)	2.47 (681)	2.64 (161)	2.65 (135)	2.54 (406)
Driver's License (1402) (p < .001)	1380 (99.13%)	678 (99.71%)	161 (100%)	134 (100%)	395 (97.53%)
Number of Other HH Members with Driver's License (p = 0.005)	1.00 (1379)	0.94 (679)	1.07 (161)	0.98 (134)	1.09 (405)
Household Vehicles (p = 0.645)	2.06 (1387)	2.04 (683)	2.23 (162)	2.01 (135)	2.03 (407)
Education (1405) (p = 0.139) [2]					
Some high school(combined with Some college for chi-squared test)	0	0	1 (1%)	0	0
High school graduate	19 (1%)	10 (1%)	4 (2%)	1 (1%)	4 (1%)
Some college	397 (29%)	212 (31%)	44 (27%)	31 (23%)	110 (27%)
College graduate	493 (36%)	233 (34%)	59 (36%)	46 (34%)	155 (38%)
Some graduate school	132 (10%)	71 (10%)	13 (8%)	17 (13%)	31 (8%)
Graduate Degrees	345 (25%)	157 (23%)	41 (25%)	39 (29%)	108 (27%)
Annual HH Income (1406) (p = 0.512)					
Less than $15,000	1 (0.07%)	0	0	0	1 (.25%)
$15,000 to $29,999	18 (1%)	9 (1%)	2 (1%)	1(1%)	6 (2%)
$30,000 to $44,999	86 (6%)	52 (8%)	6 (4%)	6 (5%)	22 (6%)
$45,000 to $59,999	140 (10%)	78 (12%)	11 (7%)	11 (8%)	40 (10%)
$60,000 to $74,999	232 (17%)	110 (17%)	33 (21%)	20 (15%)	69 (17%)
$75,000 to $99,999	293 (22%)	136 (20%)	37 (23%)	28 (22%)	92 (23%)
$100,000 or more	581 (43%)	279 (42%)	69 (44%)	64 (49%)	169 (42%)
Neighborhood Type (1358) (p = 0.576)					
Lot of retail/commercial	135 (10%)	65 (10%)	13 (8%)	10 (8%)	47 (12%)
Some retail/commercial	419 (31%)	197 (30%)	54 (34%)	35 (27%)	133 (33%)
Mostly residential	755 (56%)	381 (57%)	86 (54%)	81 (61%)	207 (52%)
Few other buildings	49 (4%)	23 (3%)	6 (4%)	6 (5%)	14 (3%)

Characteristic	Total Sample (N = 1387)	No Decrease (N = 683)	Longer-term Decrease (N = 162)	Temporary Decrease (N = 135)	Decrease not Possible (N = 407)
Distance to Transit (1330) (p = 0.141)					
Less than 5-minute walk	421 (32%)	191 (29%)	42 (27%)	40 (30%)	148 (38%)
5-10 minute walk	378 (28%)	186 (29%)	44 (28%)	40 (30%)	108 (28%)
10-20 minute walk	212 (16%)	106 (15%)	31 (20%)	23 (18%)	52 (13%)
More than 20-minute walk	319 (24%)	168 (26%)	40 (25%)	29 (22%)	82 (21%)
Type of Home (1403) (p = 0.220)					
Single-family detached	1140 (83%)	568 (84%)	134 (84%)	116 (85%)	322 (80%)
Duplex/town home	89 (6%)	48 (7%)	9 (6%)	8 (5%)	24 (6%)
Apartment/condo	148 (11%)	64 (9%)	17 (11%)	10 (0.93%)	57 (14%)

[a] P-values are shown for chi-squared tests for significant differences in distribution across groups, or for analysis of variance between mean values across segments; [b] For chi-squared tests of income and education, the lowest three categories are combined, since the counts in the lowest two categories are less than five for some segments.

In addition to the latter characteristic, the *"temporary decrease"* segment has a higher share of people living 5-10 minutes from transit than any other group (30%), the shortest average baseline commute time (31 minutes), and relatively few "other" driver's licenses in the household (0.98). Finally, the *"decrease not in choice set"* segment has the highest share of males (42%), the longest average baseline commute time (37 minutes), the lowest share (albeit still 98%) of people with driver's licenses – but relatively high license-holding by other members of the household (1.09), the highest share of people living within a five-minute walk to transit (38%), and the lowest shares of those living 10-20 minutes away (13%) or more than 20 minutes away (21%). These traits are largely to be expected for a group that does not commute by driving alone at all.

Table 2 compares selected characteristics across the segments associated with *increasing* driving alone, where the segment already driving alone seven days a week has been excluded as too small (N = 12) for statistical analysis. Note that for this partition of the sample, only four variables differ significantly (two of them just barely) by segment: commute time ($p = 0.074$), commute distance ($p = 0.004$), income ($p = 0.056$) and distance to transit ($p = 0.063$). The *"no increase"* segment has the longest average baseline commute time (34 minutes) and the smallest share (27%) of people living within 5-10 minutes of transit. The *"temporary increase"* segment has the shortest average commute time (30 minutes), the youngest average age (45 years old), the largest share of people living within 5 minutes of transit (40%), and the smallest share living more than 20 minutes away from transit (16%).

Table 2: Characteristics of the Sample, by Status with Respect to Increases in Driving Alone[a, b]

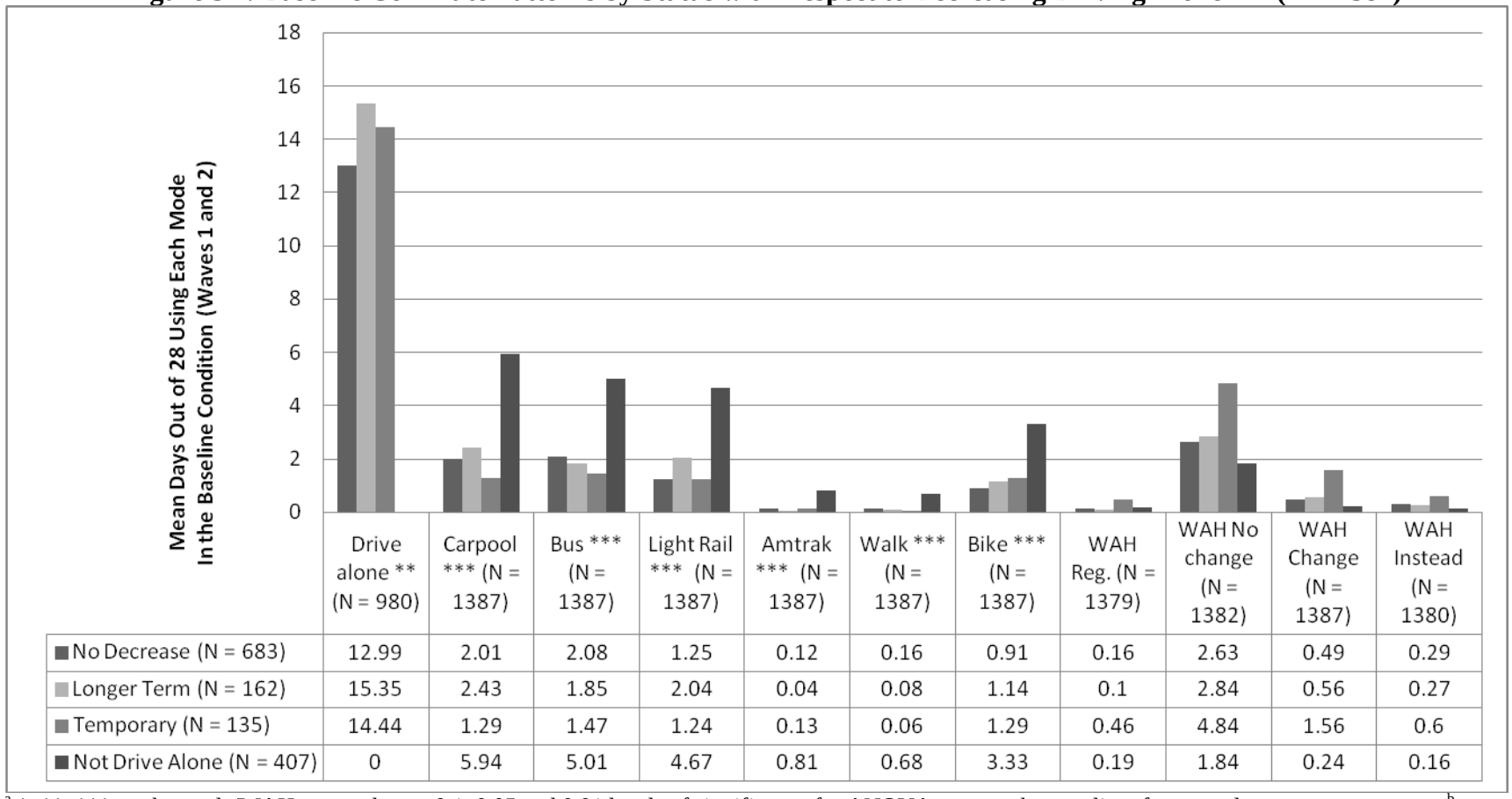
Characteristic	Total Sample (N = 1534)	No Increase (N = 1160)	Longer-term Increase (N = 318)	Temporary Increase (N = 56)
Male (1527) (p = 0.359)	530 (35%)	409 (35%)	106 (33%)	15 (27%)
Commute Minutes (p = 0.074)	33.49 (1532)	34.25 (1158)	31.16 (318)	29.80 (56)
Commute Distance (p = 0.004)	18.19 (1532)	18.60 (1158)	17.18 (318)	16.24 (56)
Age (p = 0.247)	47.67 (1534)	47.76 (1160)	47.81 (318)	45.13 (56)
Household Size (p = 0.535)	2.63 (1534)	2.63 (1160)	2.61 (318)	2.86 (56)
HH other Driver's License (p = 0.886)	1.11 (1526)	1.12 (1154)	1.07 (316)	1.20 (56)
Household Vehicles (p = 0.229)	2.05 (1379)	2.07 (1043)	1.96 (287)	2.10 (49)
Driver's License (1526) (p = 0.426)	1514 (99%)	1144 (99%)	315 (100%)	55 (98%)
Education (1533) (p = 0.830)				
Some high school	1 (0.1%)	1 (0.1%)	0	0
High school graduate	23 (1%)	21 (2%)	1 (0.3%)	1 (2%)
Some college	454 (30%)	336 (29%)	99 (31%)	19 (34%)
College graduate	533 (35%)	407 (35%)	108 (34%)	18 (32%)
Some graduate school	139 (9%)	102 (9%)	31 (10%)	6 (11%)
Graduate degrees	383 (25%)	293 (25%)	78 (25%)	12 (21%)
Income (1492) (p = 0.056)				
Less than $15,000 (excluded from X^2 test)	1 (0.1%)	0	0	1 (2%)
$15,000 to $29,999				
$30,000 to $44,999	19 (1%)	11 (1%)	5 (2%)	3 (5%)
$45,000 to $59,999	92 (6%)	68 (6%)	24 (8%)	0
$60,000 to $74,999	149 (10%)	109 (10%)	33 (11%)	7 (13%)
$75,000 to $99,999	241 (16%)	181 (16%)	49 (16%)	11 (20%)
$100,000 or more	324 (22%)	259 (23%)	56 (18%)	9 (16%)
	666 (45%)	502 (44%)	139 (45%)	25 (45%)
Neighborhood Type (1617) (p = 0.262)				
Lot of retail/commercial				
Some retail/commercial	142 (9%)	116 (10%)	22 (7%)	4 (7%)
Mostly residential	451 (30%)	328 (29%)	102 (33%)	21 (39%)
Few other buildings	834 (56%)	633 (56%)	176 (56%)	25 (46%)
	70 (5%)	54 (5%)	12 (4%)	4 (7%)
Distance to Bus or Light-Rail (1616) (p = 0.063)				
Less than 5 minute walk	450 (31%)	332 (30%)	96 (31%)	22 (40%)
5-10 minute walk	405 (28%)	292 (27%)	98 (32%)	15 (27%)
10-20 minute walk	240 (16%)	196 (18%)	35 (11%)	9 (16%)
More than 20 minute walk	367 (25%)	280 (25%)	78 (25%)	9 (16%)
Type of Home (1523) (p = 0.827)				
Single-family detached	1284 (84%)	970 (84%)	271 (85%)	43 (80%)
Duplex/town home	89 (6%)	69 (6%)	16 (5%)	4 (7%)
Apartment/condo	150 (10%)	114 (10%)	29 (9%)	7 (13%)

[a] P-values are shown for chi-squared tests for significant differences in distribution across groups, or for analysis of variance between mean values across segments; [b] For chi-squared tests of income and education, the lowest three categories are combined, since the counts in the lowest two categories are less than five for some segments.

This profile suggests a group that generally lives close to work and/or takes transit to work as a rule, and therefore when a need to increase driving alone arises, it is relatively easy to keep the change temporary, and to return to the previous commute patterns after the short-term need passes. Finally, similar to the decreasing drive alone partition of Table 2, the *"longer-term increase"* segment here also has very few distinguishing features – notably the lowest proportion of people living a 10-20 minute walk from transit (11%). Otherwise, it shares some traits with each of the other two groups.

We also consider the background commute patterns of individuals who made changes. Figures 3A-B present the average baseline commute patterns of the individuals in the sample, based on their Wave 1 or 2 reports of the number of days out of 28 on which they commuted to work by each mode, or worked at home, just prior to the beginning of the Fix. We include several options for working at home (distinguishing between working at home in lieu of commuting and doing so in addition to commuting). The samples are reduced to the samples used in our final models. However, the segment of individuals who already drive alone no days each month is retained for comparison in the figure for decreases in driving alone.

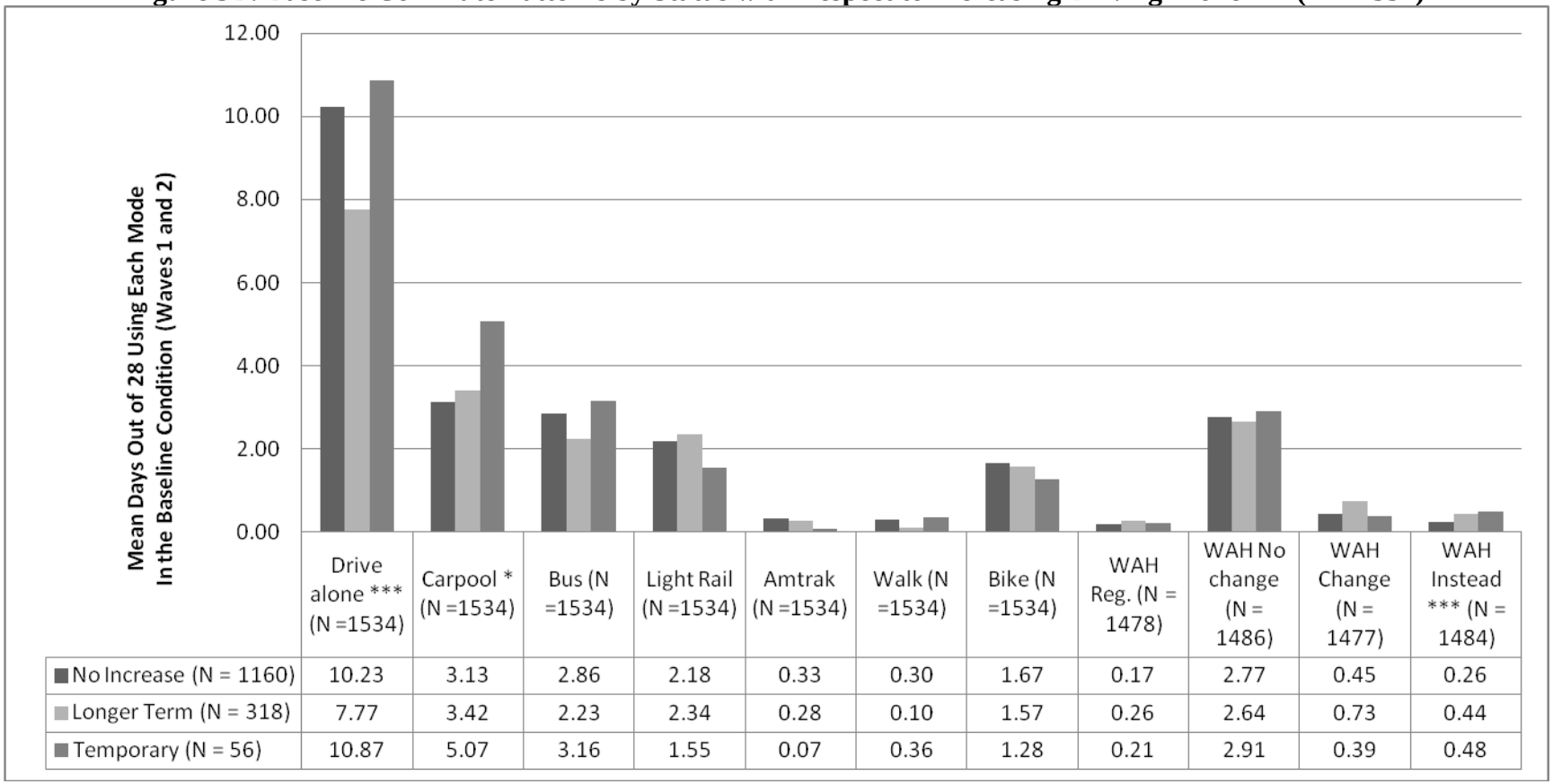
Figure 3A: Baseline Commute Patterns by Status with Respect to Decreasing Driving Alone[a, b, c] (N = 1387)



	Drive alone ** (N = 980)	Carpool *** (N = 1387)	Bus *** (N = 1387)	Light Rail *** (N = 1387)	Amtrak *** (N = 1387)	Walk *** (N = 1387)	Bike *** (N = 1387)	WAH Reg. (N = 1379)	WAH No change (N = 1382)	WAH Change (N = 1387)	WAH Instead (N = 1380)
No Decrease (N = 683)	12.99	2.01	2.08	1.25	0.12	0.16	0.91	0.16	2.63	0.49	0.29
Longer Term (N = 162)	15.35	2.43	1.85	2.04	0.04	0.08	1.14	0.1	2.84	0.56	0.27
Temporary (N = 135)	14.44	1.29	1.47	1.24	0.13	0.06	1.29	0.46	4.84	1.56	0.6
Not Drive Alone (N = 407)	0	5.94	5.01	4.67	0.81	0.68	3.33	0.19	1.84	0.24	0.16

[a] *, **, *** on the mode/WAH names denote 0.1, 0.05 and 0.01 levels of significance for ANOVA tests on the equality of mean values across segments. [b] Values for segment sizes provided for each type of change are based on the sample size of 1387. After removing the 407 cases that do not drive alone, the remaining 980 cases comprise the final sample used in our model. Sample sizes that are less than 1387 are for those alternatives which have further missing data, and were not used in our final models.. [c] WAH Reg: Days working at home "as the regular location of your job", without a conventional commute at all. WAH No change: Days working at home without changing your normal commute, in typical 28-day period. WAH Change: Days working at home and changing the time you commute to or from work, in typical 28-day period. WAH Instead: Days working at home instead of commuting to your regular workplace, in typical 28-day period

Figure 3B: Baseline Commute Patterns by Status with Respect to Increasing Driving Alone[a, b, c] (N = 1534)



	Drive alone *** (N =1534)	Carpool * (N =1534)	Bus (N =1534)	Light Rail (N =1534)	Amtrak (N =1534)	Walk (N =1534)	Bike (N =1534)	WAH Reg. (N = 1478)	WAH No change (N = 1486)	WAH Change (N = 1477)	WAH Instead *** (N = 1484)
No Increase (N = 1160)	10.23	3.13	2.86	2.18	0.33	0.30	1.67	0.17	2.77	0.45	0.26
Longer Term (N = 318)	7.77	3.42	2.23	2.34	0.28	0.10	1.57	0.26	2.64	0.73	0.44
Temporary (N = 56)	10.87	5.07	3.16	1.55	0.07	0.36	1.28	0.21	2.91	0.39	0.48

[a] *, **, *** on the mode/WAH names denote 0.1, 0.05 and 0.01 levels of significance for ANOVA tests on the equality of mean values across segments. [b] Values for segment sizes provided for each type of change are based on the sample size of 1534. This is the final sample used in our model. Sample sizes which are less than 1534 are for those alternatives which have further missing data, and were not used in our final model. [c] WAH reg: Days working at home "as the regular location of your job", without a conventional commute at all, WAH no change: Days working at home without changing your normal commute, in typical 28-day period. WAH change: Days working at home and change the time you commute to or from work, in typical 28-day period. WAH instead: Days working at home instead of commuting to your regular workplace, in typical 28-day period.

For choices with respect to increasing driving alone (Fig. 5B) there are only two commute modes (driving alone, and working at home instead of commuting) for which the mean number of commute days differs between segments. On the other hand, for choices with respect to decreases in driving alone (Fig. 5A), there are significant differences among the baseline commute patterns for all modes. Although part of this may be explained by the fact that one of the segments consists of those who do not commute at all by driving alone, this result occurs even when those individuals are excluded from the analysis.

For both increases and decreases, we see that those with the most opportunity to make the respective changes are most likely to do so. That is, those who increase driving alone on a longer-term basis are, on average, those with the lowest number of days driving alone in the baseline condition. Likewise, those who decrease driving alone on a longer-term basis are those who, on average, have the highest number of days driving alone in the baseline condition. Those who decrease driving alone only on a temporary basis, on the other hand, tend to use collective modes less, and bicycle and work at home more, than those who do not decrease driving alone.

5. Multinomial Logit Models

Next, we present multinomial logit models of increasing (Table 3) and decreasing (Table 4) driving alone, on a temporary or longer-term basis or not at all. Several groups of explanatory variables were considered in model development: socio-demographic data and work-related information as well as a number of transportation-related attitudes measuring time- and price-sensitivity, environmental beliefs, and preference for various modes of travel. Further, land use characteristics for individuals are incorporated into the models, including neighborhood and housing types, distance to transit, and the density of amenities at the home and work locations.

These models provide insight into what factors are important in the persistence of change, as well as how these factors differ between the decision to increase driving alone and the decision to decrease driving alone.

Alternative model specifications were considered, however the pair of multinomial logit models is the most appropriate model structure for this analysis at this time. Other model structures considered were nested logit and bivariate ordered probit. The nested logit model structure places alternatives which are expected to have similar unobserved properties in a nest together. The probabilities for each alternative, and thus the coefficients within each nest, are conditioned on nest inclusion. In this study, it would be reasonable to place the temporary and longer-term alternatives together into a nest, however, temporarily making a change may be more similar to making no change than to making a longer-term change. Alternately, since the no change and longer-term change alternatives both represent stability in the choice, perhaps these should be nested together. Nested logit models were estimated with various nesting structures, however no satisfactory results were obtained no matter which alternatives were nested together. Another possible structure is the bivariate ordered probit, which allows both the increase and decrease models to be estimated together, and accounts for the correlation of unobserved traits affecting both decisions at once. This method will likely be explored further and is discussed in Section 7, Future Research. Next we present the pair of multinomial logit models.

The overall goodness of fit measures of the models are relatively strong, with adjusted ρ^2 measures (equally-likely base) of 0.30 and 0.42 for the decreasing and increasing models, respectively. The market-share (constants-only) model superficially accounts for a sizable

portion of the explanatory power of the model, but that is to be expected when the shares are as unbalanced as they are here. Adding the true explanatory variables diminishes the role of the constant terms, and helps explain *why* the shares are as unbalanced as they are.

Table 3: Multinomial Logit Model of Decreasing Driving Alone
Alternatives = Longer-term (base), No Decrease and Temporary

Multinomial Logit Model (N = 980, 168 Decreased Longer-term; 17%) (***, **, * = Significant at 1%, 5%, 10% level)	**No Decrease (683 Cases; 69%)**	**Temporary Decrease (135 Cases; 14%)**
Land Use Attributes		
Access to Grocery Stores Near Work	-0.020***	-0.036***
Access to Shopping at Work	---	0.006**
Home TAZ Population Density	---	-0.845**
Access to Schools at Home	---	0.033**
Occupation, Household and Commute Variables		
Household Vehicles	-0.236*	-0.352**
Household Members Aged 16 to 18	-0.345*	---
Days Carpooling in Baseline	-0.102***	-0.130***
Days Driving Alone in Baseline	-0.109***	-0.079***
Days Working at Home and Change Commute Time in Baseline	---	0.096***
Occupation Type: Manager	---	0.392**
Individual Attitudes		
Pro-transit Attitude	-0.160**	---
Travel Minimizing Attitude	0.184**	0.212**
Commute Benefit	-0.220***	-0.313***
Anti-Driving	-0.594***	-0.461***
Price Sensitivity	---	0.206***
Constant	4.12***	2.13***
Model Diagnostics		
Log likelihood of full model, $LL(\beta)$	-733.22	
Log likelihood of MS model, *LL(MS)*	-805.80	
Log likelihood of EL model, *LL(0)*	-1076.60	
ρ^2 and adjusted ρ^2 with equally likely base: $\rho^2_{ELbase} = 1 - LL(\beta)/LL(0)$ and $\bar{\rho}^2_{ELbase} = 1 - [LL(\beta) - K]/LL(0)$	0.32 0.30	
ρ^2 and adjusted ρ^2 with market share base: $\rho^2_{MSbase} = 1 - LL(\beta)/LL(MS)$ and $\bar{\rho}^2_{MSbase} = 1 - [LL(\beta) - K + c]/LL(MS)$	0.09 0.06	
ρ^2 of market share model with equally likely base: $\rho^2_{MS} = 1 - LL(MS)/LL(0)$	0.25	---

The signs of most coefficients are in the expected directions, and although we cannot directly compare the magnitudes across all variables (since they are measured on different scales), we can compare the magnitudes of coefficients for a given variable between the two alternatives, as they relate to the base alternative of decreasing driving alone on a longer-term basis.

Beginning with the land use characteristics influencing the choice to decrease driving alone and to what extent, we see some imbalance in that more factors are associated with temporary decreases than with not decreasing at all. The availability of grocery stores near the work location increases the likelihood of making a longer-term change rather than either of the other changes. The higher accessibility of grocery stores can reduce the need to commute by driving alone, since individuals may easily stop at the grocery store at the start or end of their commute, using alternative modes. The remaining land use variables are focused on the propensity to make a change in the longer term or shorter term, with increased access to shopping at work, and to schools at home, both increasing the likelihood of making only a temporary change, whereas higher population density at home increases the likelihood of making a longer-term rather than temporary change. The accessibility of schools may be an indicator of school-aged children in the household, and the need to drive children to school. At the same time, while access to grocery stores at work increases the likelihood of making a longer-term change, perhaps less routine types of shopping, or purchases that are larger or bulkier than groceries, are more difficult to conduct with alternative means of transportation. Lastly, the population density at home is likely linked to the availability of more transportation options, denser road networks and more urban residents. Respondents with higher population densities in their TAZ may also live

closer to their work locations; all of these conditions would support a sustained change to commutes by means other than driving alone.

Managers have an increased propensity (compared to non-managers) to make only temporary decreases rather than longer-term decreases in driving alone. This outcome is likely due to the greater spatio-temporal flexibility of other occupations, compared to managers (who may need their car for offsite meetings or other schedule constraints). Perhaps surprisingly, those with more household vehicles are more likely to make a longer-term decrease. It is possible that in these households there are more restrictions on who uses household vehicles, and that vehicle use is tied to other responsibilities such as household errands, limiting the ability to shift commutes away from driving alone.

Both of the baseline mode-use variables (driving alone and carpooling) increase the propensity to make a longer-term decrease, over both no decrease and a temporary decrease (as indicated by their negative coefficients for the latter two alternatives), relative to the base. On the other hand, higher levels of working at home and changing the commute time is more likely to result in a temporary decrease. It is plausible that the individuals who drive alone more are the most motivated to decrease the amount they drive alone, and thus most likely to do so in the longer term, and somewhat likely to do so temporarily. We also argue that the negative sign on coefficients for carpooling is expected, although with a slightly different interpretation. For example, the average number of carpool days for individuals who carpool is 9-12 days per month (across segments) and the mean days driving alone across segments, for those who carpool, is on average 6-9 days per month. Even though these individuals may have less opportunity to

decrease driving alone, when looking just at the amount they drive alone, there is still *some* room for these individuals to make a change, away from driving alone, and their familiarity with carpooling increases the likelihood that they switch to more carpooling and use carpooling instead of driving alone. For those who work at home and change the time they commute, it is possible that these individuals switch to working at home and not commuting, change to a more condensed schedule, or work at home and still commute, but perhaps use an alternative mode. Since these individuals have some flexibility in terms of *when* they commute, it is reasonable that they may have flexibility in terms of *how* they commute, though it is apparently limited only to temporary decreases.

Additional variables in the model include the number of people in the household age 16 to 18, which increases the propensity to make longer-term decreases in driving alone, rather than no change; vehicles are shared among additional drivers in these households and perhaps this increases the motivation to release a vehicle for another person in the household to use for household responsibilities. Attitudinal coefficients are all reasonable: the more pro-transit, the more likely to decrease driving alone on a longer term basis than make no change, the more utilitarian-minded towards travel, the less likely to make a longer-term decrease (perhaps because switching to another commute mode increases the travel time), while the more benefit experienced during commutes, the more likely to make a longer-term decrease than no decrease or a temporary decrease (alternatives to driving alone may be viewed as more beneficial by providing exercise or time for work). The more anti-driving, the more likely to make a longer-term change, and the more price sensitive, the more likely to only make a temporary change than a longer term change. This last result may have occurred in response to changing gas prices.

Overall we see some similarity in the factors important in determining whether driving alone is temporarily decreased or not decreased at all, when compared to the alternative of making a longer-term decrease in driving alone. However, in general there are many more factors relevant to the choice between longer-term and temporary changes than factors relevant to the choice between a longer-term change and no change. This suggests that several factors are more important to the *duration of change*, rather than to the choice of *whether or not to make a change* at all. Further, specifically considering land use characteristics of respondents' home and work locations, it seems that the greater the extent of certain of land use characteristics, such as access to grocery stores, the greater the duration of decreases in driving alone.

Turning to the multinomial logit model for *increasing* driving alone (Table 5), we again note some overlap between the factors, but we also see that more factors are important for the choice to not increase at all than the choice to increase temporarily, when compared to the baseline of a longer-term increase.

Land use characteristics that matter include the density of schools and entertainment opportunities near home, and the density of grocery stores near the work location, as well as the Walk Score at work. The higher the work Walk Score the lower the likelihood of a longer-term increase in driving alone compared to either of the other alternatives. This is expected since the easier it is to walk to various businesses and other amenities near work, the less necessary a car is for errands or lunch during the work day. As in the decrease model, the accessibility of grocery stores at work also matters – and with a similar interpretation; here, those with higher

densities of grocery stores are more likely to make a temporary change than a longer term change. The access to grocery stores supports the switch back to the use of alternative modes here, when a temporary increase occurs.

The sign on the accessibility of schools indicates the same general trend as in the decrease model; the higher the access to schools at home the more likely a longer-term increase. Again, it is likely that the accessibility of schools indicates the presence of school-aged children and commuters who drive these children to school and thus may increase drive alone commuting because children are driven to school. Finally (for the land use variables) increased access to entertainment opportunities near home raises the likelihood of making no increase in driving alone, instead of increasing on a longer term basis.

The baseline number of days using various modes for commuting is important for both decisions. Here, the interpretation is similar to that for the decrease model. The more baseline days one is commuting by driving alone, the less opportunity to increase driving alone. Likewise, the more days one uses alternative modes which includes carpooling, taking the bus, light rail or Amtrak, biking and walking in our model, the less likely one is to increase driving alone, or at least more likely to increase driving alone only on a temporary basis. It is also logical that those who use alternative modes have less reason to increase driving alone; likely these individuals have some level of commitment to or dependence on the use of alternative modes and when they do switch away from say, taking the bus, to driving alone it is only done on a temporary basis. This could be either because driving alone is not available as a long term option, or because the use of alternative modes is preferred ideologically.

Table 4: Multinomial Logit Model of Increasing Driving Alone
Alternatives = Longer-term (base), No Increase, and Temporary

Multinomial Logit Model (N = 1534, 318 Increased Longer-term; 21%) (***, **, * = Significant at 1%, 5%, 10% level)	**No Increase (1160 Cases; 76%)**	**Temporary Increase (56 Cases; 4%)**
Land Use Variables		
Some Retail in Neighborhood	-0.237*	---
Work Walk Score	0.009***	0.019*
Access to Schools at Home	-0.019**	---
Access to Entertainment at Home	0.057**	---
Access to Grocery Stores at Work	---	0.024***
Occupation, Household and Commute Variables		
Baseline Days Driving Alone	0.102***	0.153***
Baseline Days Carpooling	0.067***	0.139***
Baseline Days Taking Bus	0.066***	0.097***
Baseline Days Taking Light Rail	0.039***	---
Baseline Days Taking Amtrak	0.056**	---
Baseline Days Biking	0.052***	---
Baseline Days Walking for Entire Trip	0.103*	0.181**
Number of Children Less than Six Yrs. Old	0.431***	---
Age	---	-0.030**
Part-Time Schedule	---	1.316**
Normal Schedule	-0.256***	---
Attitude Variables		
Pro-Transit Attitude	0.186***	0.388***
Time Unpressured Lifestyle	---	-0.221*
Constant	-0.014**	-3.097***
Model Diagnostics		
log likelihood of full model, $LL(\beta)$	-937.390	
log likelihood of MS model, *LL(MS)*	-1009.900	
log likelihood of EL model, *LL(0)*	-1685.300	
rho-squared with equally likely base $\rho^2_{ELbase} = 1 - LL(\beta)/LL(0)$ and adjusted $\bar{\rho}^2_{ELbase} = 1 - [LL(\beta) - K]/LL(0)$	0.44 0.43	
rho-squared with market share base $\rho^2_{MSbase} = 1 - LL(\beta)/LL(MS)$ and adjusted $\bar{\rho}^2_{MSbase} = 1 - [LL(\beta) - K + c]/LL(MS)$	0.07 0.06	
rho-squared of market share model with EL base $\rho^2_{MS} = 1 - LL(MS)/LL(0)$	0. 25	---

We also see that age and work schedule are relevant factors, with older people more likely to make a longer-term increase than younger ones, perhaps due to schedule and mobility restrictions and the relative ease and convenience of driving alone. Individuals with part-time schedules are more likely to make temporary changes (vs. longer term) than those with other schedules, whereas individuals with normal schedules are more likely than those with other types of schedules to make longer-term increases (vs. no change at all). Those with part-time schedules may change the number of, or the days of the week of their work days more frequently and thus are more likely than others to increase temporarily. It is reasonable that those with regular schedules tend to continue a pattern of increased driving alone if they adopt one at all. Individuals with higher numbers of young children (less than six years old) are more likely to make no increases. This is reasonably expected since children dictate transportation needs, and do not permit as much flexibility in household schedules in general. Furthermore, changes occasioned by the presence of children are prima facie less likely to be increases in *driving alone*.

Lastly, some attitudes are important in the decision to increase driving alone. Specifically, a pro-transit attitude (not surprisingly) increases the propensity to make no increase or only a temporary increase in driving alone. Having a more time unpressured lifestyle means one is less likely to make a temporary change and accordingly more likely to make a longer-term increase in driving alone or to make no increase. This may also appear to be a counterintuitive result at first, since we would expect individuals who are more time *pressured* to be most likely to make longer-term increases in driving alone. However it is important to keep in mind that increasing driving alone in this study could arise from two distinct sources, with different time use

implications. If occurring due to shifting modes from transit or walking/biking, increasing driving alone would most likely save time, although shifting away from these modes may also limit the ability to work on the train, or get exercise from commuting, which in the end increases time pressures. On the other hand, if the increase arises from increasing the number of commute days (e.g. by reducing telecommuting), it consumes additional time. Thus, it is not surprising that time-pressured people would not increase their driving alone in the longer term. It is also likely that those individuals who are most time pressured are already utilizing the transportation modes/schedules which they find most efficient, and thus are least likely to make any changes.

Overall the model for increases in driving alone is consistent with the model for decreases in driving alone, with similar factors influencing both decisions in similar and in expected ways. Many factors important for increasing on a temporary basis are also relevant for not increasing at all, when compared to the baseline of increasing long term, however there are also several factors – particularly the baseline mode use variables –which are only relevant for the choice between making no increase versus increasing long term. As with the decrease model, land use factors in particular are split, with many of these factors only relevant to no increase. In this case, it seems that the values of some land use characteristics limit the decision to increase driving alone.

6. Conclusions

Model estimations included the testing of several other groups of variables, but none were found to be significant predictors of the commute changes of interest. Namely, socio-demographic characteristics such as income and education were not found to be significant. Additional baseline mode use variables were not important in the decrease model. Available attitudinal

variables also included pro bike/walk and pro low density attitudes, the belief that congestion is a problem and the belief that air quality is a problem. Land use variables included those discussed in Chapter 3; access to all nine amenity types, home and work Walk Score, home and work land use coverage, bike path and bus route lengths, and the respondent-reported distance to transit and neighborhood descriptions. Some of the other variables tested for inclusion included life changes such as change in home or work location, additional employment types (professional, service etc…) and work schedules (variable schedule, compressed work-week). Variables which were not significant were not retained in model estimations, thus the final models provide the best understanding of the commute changes of interest, given the available data.

This study provides insight into the factors which are important to changes in commute behavior. In particular we focus on increases and decreases in the number of commutes made by driving alone, and whether or not we see persistence of these changes in regular commuters' habits even some time after a potentially disruptive reconstruction event (the Fix I-5 reconstruction project in California). Given the uncertainty in our ability to classify a change as Fix-related or not (Appendix B), and the apparently small permanent impact of the Fix (making it difficult to develop models when one alternative has a very small share), we model the adoption of changes for any reason, not just those occurring because of the Fix, and instead considered the expected impact of the Fix as a potential factor in changes.

Using multinomial logit models, we identify key factors predicting increases and decreases in driving alone. We find that attitudes, baseline commute patterns as well as land use characteristics and individual and household attributes are relevant factors in changes in drive

alone commuting over the six-month study period. As research on adoption continues to inform the development and promotion of transportation demand management strategies, emphasis should be placed on how critical factors such as attitudes, land use, life changes, and disruptions like the Fix interact and create unique situations which may lead individuals to lessen their dependence on the personal automobile.

7. Future Research

Several avenues of future research are possible for this project. First, utilizing a bivariate probit model would allow error terms to be correlated across equations; realizing that the choice to increase driving alone and the choice to decrease driving alone are likely affected by similar unobserved factors. This model structure would be relatively straightforward to implement were it not for the non-equivalent choice sets across the sample. There are approximately 500 cases in the sample who do not drive alone at all in the baseline condition and therefore cannot choose to decrease driving alone. Including these cases in a bivariate probit model would distort results, but taking them out would significantly (by 25%) reduce sample size. We will continue to explore the bivariate ordered probit model for this project. Future research could also further incorporate spatial analysis through the identification of spatial patterns of change, whether at the individual level or at neighborhood or city scales.

It is also of interest to transportation researchers to understand how life changes influence travel behavior and mode choice. Since we have panel data in this sample, life changes may be identified such as changes in home or work location, change in employment type or income, and changes in household size or household members with a drivers' license. These types of changes

may influence commute patterns of driving alone, and may also influence changes in commute patterns related to other modes of transportation. Another avenue of future research will identify changes in the use of other modes, specifically, increases in active transport modes; biking and walking may be of interest since these modes are linked with exercise. Transit authorities may be interested in the types of individuals and attitudes or other characteristics which changed levels of transit and bus use. This would aid marketing campaigns, or other types of interventions which are aimed at increasing transit ridership. All of these avenues of future research will give further insight into the factors that influence individuals to make changes in transportation habits, and will build on the work presented here.

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Appendices

A. Defining the Variables of Interest

This appendix discusses the identification of increases and decreases in driving alone and describes an alternative method which was used in earlier analysis.

A1. Previous Methodology

In our initial analysis we looked at all changes involving increased use of environmentally friendly modes of transportation and decreases in driving alone or in overall numbers of commute days as positive environmental changes, and conversely for negative changes. This methodology considered any increase in the use of the following modes to be a positive change: carpool, size of carpool, bus, light rail, Amtrak, walk and bike, as well as working at home that replaced a regular commute. In addition a positive change was attributed to individuals who stated that they commute fewer days overall, and any individual who reported decreasing the number of commutes made by driving alone. The opposite conditions were assigned a negative environmental change such that any decrease in the use of carpool, size of carpool, bus, light rail, Amtrak, walk and bike, as well as working at home that replaced a regular commute were considered negative changes. Further, increasing the number of commute days and/or increasing the number of commutes made by driving alone were counted as negative changes.

It is interesting to note the empirical differences between our original and final definitions of "beneficial" and "detrimental" (the final definitions focusing only on changes in drive-alone commute days). With the original broader definition described above, 23% of cases in our sample had made a longer-term beneficial change, (about half of these also reported a temporary change) and an additional 11% had made a temporary beneficial change (a total of 34% making some positive change). Focusing only on decreasing driving alone, those two shares became 5.7% and 4.3%, respectively. The substantial differences (for longer-term changes) were a forceful post hoc validation of the value of making the distinction. To put it plainly, probably fewer than half of the cases originally identified as making an environmentally beneficial longer-term change actually reduced emissions; the remainder apparently increased transit, carpooling, biking, and/or walking without decreasing driving alone.

Using the broader method to define positive and negative environmental changes meant that anyone who stated that during Wave 3, he now bicycles to work more days than during the previous summer, has made a positive environmental change. Likewise, all those who stated they are now travelling to work by Amtrak fewer days made a negative change. However; if the person travelling more days by bike had previously been travelling by bus, should this be considered a positive environmental change? Or, is it fairly neutral, since she has switched from one environmentally friendly mode to another? Likewise, for the individual who is using less Amtrak for commuting to have truly made a negative change, he must have switched those Amtrak trips to trips driving alone in a car, not to bus or walk commute trips. This subtlety can create a dramatic difference in the numbers of individuals who made positive and negative

longer term changes in six months after the Fix. This is also the case for temporary changes or changes made during the Fix.

Due to these considerations in identifying whether changes made are environmentally beneficial or detrimental, we limit our investigation of changes to *increases and decreases in drive-alone commuting*, on the assumption that it is essentially *only those* changes which affect pollutant and greenhouse gas emissions. Reductions in driving alone can be made when people switch drive alone commutes to other modes OR when people are commuting by driving alone and reduce their total number of commutes, thereby reducing their total level of driving alone. Both of these types of changes should be captured by responses to survey sections C and D of Wave 3 -- questions asking about longer term and temporary changes to commute modes (increased/decreased driving alone) -- however, we decided also to include the responses to the baseline commute patterns in Waves 1-2 and to compare these to the commute days reported in Wave 3.

A2. Longer-term Changes

A2.1 Relevant Survey Questions and Variables

From Waves 1 & 2, the variable A093 asked respondents to record the number of days, out of 28, that they commute by driving alone.

> A093. 50. Considering the days in a 4-week (28-day) period on which you make **physical trips to and from a regular workplace**, on how many of those days do you do each of the following? It is possible for the same trip to fit into more than one category. Please include the trip as many times as it fits.
>
> Drive alone for **most** of the trip (DROPDOWN)
> - None [Default choice]
> - 1 day
> - *2 days*
> - …….
> - 28 days

From Wave 3, we look at three variables. The first is W3.B20, which asks about the frequency of commute trips made by driving alone. This is different from the Wave 1-2 variable A093 because responses are in categories, not a count from 0 to 28.

> Considering the days on which you make physical trips to and from a regular workplace, how often do you do each of the following? It is possible for the same trip to fit into more than one category. Please include the trip as many times as it fits.
>
> 30. W3-B20
> Drive alone for **most** of the trip (RADIO)
> - Seldom or never
> - 1-2 times a WEEK
> - 3-4 times a WEEK
> - 5 times a WEEK

- 6-7 times a WEEK

For the purposes of this analysis the response "Seldom or Never" will include the range of drive alone days 0, 1, or 2 (days per month).

The next Wave 3 variable is W3.C1, which asks whether respondents commute (by all modes) a different number of days a week at the time of Wave 3, than they did during the previous spring.

> W3.C1: In your ***current*** *typical commute*, do you now physically travel to work ***a different number of days*** per week than you *typically did last spring* (March, April, May 2008)?* (RADIO)
>
> - No
> - Yes, I travel to work fewer days per week
> - Yes, I travel to work more days per week

[The "*" appeared on the survey, and means that the question is required to be answered.]

From Wave 3, we also look at the variables W3.C12B and W3.C12C. These variables are from a set of questions which asked whether respondents commute more or less by various modes at the time of Wave 3, than they did during the previous spring. These two particular variables ask whether respondents commute by driving alone more (C12B) or less (C12C).

> W3.C12 In this question we are interested in any *switches* you have made from one means of transportation to another one - ***even if only some of the time.***
> **In which ways (if at all) have you changed *the means of transportation* you use in your commute** compared to last spring (March, April, May 2008)? (Check all that apply.)*
> If a change is only the result of making a different change that we've already asked about before - for instance, if you drive less just because of working fewer days per week - please do ***not*** include it. (CHECKBOX)
>
> - B: I drive alone more often
> - C: I drive alone less often

[The "*" appeared on the survey, and means that the question is required to be answered.]

The responses to questions W3.C21B and C are combined into one variable: W3.C12, with the possible values of "drive alone more", "drive alone less", "neither change", and "yes to both" (yes to both is an inconsistent response in and of itself) for the remainder of this discussion.

A2.2 Rules for Identifying Changes

Definitions:

DA_0 = number of DA days (exact) reported as baseline in Wave 1 or 2
DA_3 = number of DA days (range) reported as baseline in Wave 3

For each respondent (except for cases missing one or more of these variables) we have an exact value for DA_0 and a value for DA_3 which represents the range of values for the Wave 3 drive alone days. We also have responses to the survey questions W3.C1 and W3.C12. We would like to establish whether the responses to these questions are internally consistent for each respondent. There are several variables involved so the rules for determining consistency are complex. In particular, the dependent variables of interest in this study are based on simple

quantitative changes in the number of drive alone days, but the change for any single respondent is the net of changes occurring for one or both of two reasons: (1) the number of commuting days changes (e.g. through changes in the amount of telecommuting, or through the adoption or discontinuation of compressed work schedules), OR (2) mode shifts are made. Question W3.C12 was designed to obtain only the second type of change: respondents were instructed not to include mode changes occurring only as the side effect of a previously reported change such as reducing the number of commuting days (which would be obtained in response to question W3.C1). Of course, it is likely that not all respondents read or heeded those instructions. It is also possible that the number of drive alone days increased due to the first reason and decreased due to the second, or conversely. In order to identify the changes of interest, we first consider, based on the responses to the 28-day questions, for all three waves, which responses to W3.C1 and W3.C12 are plausible.

To identify the plausible changes for each respondent, we completed the following steps, which will be discussed in detail below:

1. Compare DA_0 and DA_3 and determine plausible responses for W3.C12 based on that comparison.
2. Check responses to W3.C12, and identify which are consistent with the plausible responses.
3. Check the responses to W3.C1 to determine if any implausible cases are actually consistent, when W3.C1 is taken into consideration.
4. Examine remaining inconsistent responses one at a time.
5. Handle responses which are missing either DA_0 or DA_3 by relying on W3.C12 responses.
6. Handle responses which show changes based on DA_0 and DA_3, but do not report changes in W3.C12 nor W3.C1, by relying on the apparent changes in drive alone based on DA_0 and DA_3.
7. Define the variables for longer term changes: Longer term increase and Longer term decrease.

Completing the Check:

1. Compare DA_0 and DA_3 and determine plausible responses for W3.C12 based on the comparison of DA_0 and DA_3.

In this step, we take the responses to the 28-day questions from each wave and compare them to determine what changes the respondent might have made. We cannot know for sure what changes the respondent made, because the Wave 1 and 2 responses are exact numbers of days out of 28, whereas the Wave 3 responses are ranges of days, so an increase or decrease is not easily apparent. (The change to ranges in Wave 3 was a deliberate choice to make these questions easier to answer properly, since we had observed numerous inconsistent responses to the counterpart questions in Waves 1 and 2. We believe this was a good decision, although it inevitably poses difficulties in combining and comparing data across waves. On the other hand, comparisons of “exact” answers in Wave 3 to “exact” answers in Waves 1 and 2 would have posed problems of its own, since the “exact” answers would be riddled with inconsistencies that

would potentially differ across wave. The change to ranges reduced precision, but, we believe, increased accuracy).

Thus, there is no way to directly compare the 28-day questions across waves; but we can, however, create rules regarding which changes could have been made based on the values of DA_0 and DA_3 and which could not. Table A1 presents the rules used to identify which sets of responses are considered plausible. The term "marginal same" is used when DA_0 falls on the boundary between categorical responses to DA_3, or in the gap between two categories. For example, 9 - 11 days out of 28 falls between the two categories "1-2 times a week" (4-8 times a month) and "3-4 times a week" (12-16 times a month), and so a DA_0 of 9 or 10 days would be considered marginally the same as DA_3 = "1-2 times a week", and a DA_0 of 10 or 11 days would be considered marginally the same as DA_3 = "3-4 times a week".

A new variable was created in the dataset which compares the Wave 1-2 responses for the 28-day questions for driving alone, and the Wave 3 responses. The plausible responses for changes in drive alone commuting are identified, and then compared, in the next step, to the actual Wave 3 responses to question W3.C12.

2. Check responses to W3.C12, and identify which are consistent according to the identified plausible changes.

For this step, a crosstab is generated, which compares the responses to W3.C12 with the plausible responses which were determined in step 1. This crosstab is shown in Table A2.

Table A1: Plausible Responses to W3.C12, Based on 28-Day Questions in All Waves

Wave 3 Response: DA_3	Wave 1-2 Response(s): DA_0	Plausible Responses to W3.C12
Seldom or Never 1-2 times per month	0	same or increase
	1	any change
	2	same or decrease
	3	marginal same, or decrease
	4, 5, … , 28	decrease
1-3 times a month	0	increase
	1	same or increase
	2	any change
	3	same or decrease
	4, 5	marginal same, or decrease
	6, 7, …, 28	decrease
1-2 times a WEEK 4-8 times a month	0, 1	increase
	2, 3	marginal same or increase
	4	same or increase
	5, 6, 7	any change
	8	same or decrease
	9, 10	marginal same, or decrease
	11, 12, … , 28	decrease
3-4 times a WEEK 12-16 times a month	0, 1, … , 9	increase
	10, 11	marginal same or increase
	12	same or increase
	13, 14, 15	any change
	16	same or decrease
	17, 18	marginal same, or decrease
	19, 20, … , 28	decrease
5 times a WEEK 20 times a month	0, 1, …, 17	increase
	18, 19	marginal same or increase
	20	any change
	21, 22	marginal same, or decrease
	23, 24, … , 28	decrease
6-7 times a WEEK 24-28 times a month	0, 1, …. , 21	increase
	22, 23	marginal same or increase
	24	same or increase
	25, 26, 27	any change
	28	same or decrease

This crosstab shows that nearly two-thirds (1309, or 65%) of cases gave responses to W3.C12 that are plausible according to their responses to the 28-day questions across waves (the blue cells). Approximately 15% of the cases are missing one of the 28-day questions (yellow cells), so consistency cannot be determined. Very few (42, or 2%) cases report a change in W3.C12 that is the opposite of what is shown by the comparison of DA_0 and DA_3 (orange cells), and approximately 18% of cases report no changes in W3.C12 although their responses to DA_0 and DA_3 show that they likely increased or decreased the number of days they drive alone (green cells). The responses for these cases are further examined in the next step to see if considering W3.C1 would show that their response of "no changes" in W3.C12 is consistent because they changed the number of days commuting, instead of the modes with which they commute.

Table A2: Crosstab of Plausible Responses with Actual Responses for W3.C12

Combined Results for Questions W3.C12 B and C * Possible DA changes based on 28 day questions Crosstabulation

Count

		Possible DA changes based on 28 day questions								
		Increase in DA	Decrease in DA	Any Change Okay	Same or Increase Okay	Same or Decrease Okay	Marginal-Same or Increase	Marginal-Same or Decrease	Missing	Total
Combined Result for W3.-C12 B and C	Neither Change	224	134	420	390	63	164	75	262	1732
	Drive Alone More	77	6	20	10	5	17	6	24	165
	Drive Alone Less	6	42	14	9	7	10	10	16	114
	Yes to Both	1	0	0	0	0	0	0	0	1
Total		308	182	454	409	75	191	91	302	2012

3. Check the responses to W3.C1 to determine if any implausible responses are actually consistent, when W3.C1 is taken into consideration.

In this step, the crosstab presented in step 2 is expanded to include the variable W3.C1. When interpreting the results of this table, it is important to note that the responses given to question W3.C1 are for commuting to work by ANY mode. The text of this question asks if "In your ***current*** *typical commute*, do you now physically travel to work ***a different number of days*** per week than you *typically did last spring* (March, April, May 2008)?" If the answer is "yes", we do not ask from which mode the reduced days were drawn, or to which mode the increased days were assigned, so we do not know for certain that the change in commute days would affect the number of drive-alone days specifically. Therefore, we only check this variable if a change reported here *could* indicate the reason for an inconsistency between the 28-day questions and question W3.C12.

Table A3: Crosstab of Plausible Responses with Actual Responses for W3.C12 and W3.C1

Combined Results for Questions W3.C12 B and C * In your current typical commute, do you now physically travel to work a different number of days per week than you typically did last spring (March, April, May 2008)? * Possible DA changes based on 28 day questions Crosstabulation

Possible DA changes based on 28 day questions			In your current typical commute, do you now physically travel to work a different number of days per week than you typically did last spring (March, April, May 2008)?			
			No	Yes, fewer days per week	Yes, more days per week	Total
Increase in DA	Combined Results for Questions W3.C12 B and C	Neither Change	190	13	**21**	224
		Drive Alone More	67	3	7	77
		Drive Alone Less	4	0	2	6

Combined Results for Questions W3.C12 B and C * In your current typical commute, do you now physically travel to work a different number of days per week than you typically did last spring (March, April, May 2008)? * Possible DA changes based on 28 day questions Crosstabulation						
		Yes to Both	1	0	0	1
	Total		262	16	30	308
Decrease in DA	Combined Results for Questions W3.C12 B and C	Neither Change	118	**12**	4	134
		Drive Alone More	6	0	0	6
		Drive Alone Less	34	5	3	42
	Total		158	17	7	182
Any Change Okay	Combined Results for Questions W3.C12 B and C	Neither Change	378	21	18	417
		Drive Alone More	19	1	0	20
		Drive Alone Less	13	1	0	14
	Total		410	23	18	451
Same or Increase Okay	Combined Results for Questions W3.C12 B and C	Neither Change	358	27	5	390
		Drive Alone More	10	0	0	10
		Drive Alone Less	6	0	3	9
	Total		374	27	8	409
Same or Decrease Okay	Combined Results for Questions W3.C12 B and C	Neither Change	55	5	2	62
		Drive Alone More	5	0	0	5
		Drive Alone Less	5	0	2	7
	Total		65	5	4	74
Marginal-Same or Increase	Combined Results for Questions W3.C12 B and C	Neither Change	149	5	10	164
		Drive Alone More	13	0	4	17
		Drive Alone Less	7	1	2	10
	Total		169	6	16	191
Marginal-Same or Decrease	Combined Results for Questions W3.C12 B and C	Neither Change	68	6	1	75
		Drive Alone More	3	1	2	6
		Drive Alone Less	10	0	0	10

Combined Results for Questions W3.C12 B and C * In your current typical commute, do you now physically travel to work a different number of days per week than you typically did last spring (March, April, May 2008)? * Possible DA changes based on 28 day questions Crosstabulation						
	Total		81	7	3	91
Missing	Combined Results for Questions W3.C12 B and C	Neither Change	228	23	11	262
		Drive Alone More	22	2	0	24
		Drive Alone Less	15	1	0	16
	Total		265	26	11	302

Although there are several cases (12 + 21 = 33, in bold) which are consistent when W3.C1 is taken into account, this is not a high proportion of those 358 cases (green cells) which said "neither change" to W3.C12 and yet showed a change based on the comparison of the 28-day questions across waves. These 33 cases will be given values of "1" for the Longer term increase or Longer term decrease variable (as appropriate) according to the 28-day response. In fact, however, ALL of the inconsistent cases which are in the category "increase" or "decrease" for the Allowable Changes variable will be coded according to the 28-day comparison. This is discussed in more detail below. There are 4 cases which are missing question W3.C1, dropping the total sample size to 2008 instead of 2012.

4. Examine remaining inconsistent responses one at a time.

There are a total of 42 inconsistent cases which answered question W3.12C contrary to their Allowable Changes variable category (orange cells in Table 2), including the single case that answered yes to both drive alone more and less in W3.C12. This case is inconsistent for the response to W3.C12 indicating a decrease in driving alone; therefore it is contained within these 42 cases. To be conservative, this case will be counted as having increased driving alone. In Table A4, the gray cells represent the responses which would have been acceptable for the given response to W3.C12 (used in our rules for determining consistency) and the cell counts show the 42 inconsistent cases.

For these 42 cases, we chose to deal with the inconsistency in two ways, based on the reasoning that we should give priority to the 28-day comparison across waves (because we expect individuals to answer contemporaneous questions about their current commute patterns more accurately than they answer a retrospective question asking them to compare their current "typical" commute pattern to their "typical" commute pattern "last spring"). However, we still take a conservative approach to using the 28-day comparisons to define the Longer term increase and Longer term decrease variables, as follows:

i. Cases which fell into the categories "Increase in DA" will be coded as making a longer term increase.
ii. Cases which fell into the category "Decrease in DA" will be coded as making a longer term decrease.
iii. Cases which fell into one of the categories for which "same" was an allowable option, will be coded as making neither longer term increases nor longer term decreases.

Table A4: Inconsistent Cases for W3.C12 and 28-DayQuestions

Days commuting by drive alone, in a typical 28-day period * Drive alone for most of the trip * Combined Results for Questions W3.C12 B and C * Possible DA changes based on 28 day questions Crosstabulation											
Possible DA changes based on 28 day questions	Combined Results for Questions W3.C12 B and C			Drive alone for most of the trip						
				Seldom or never	1-3 times a month	1-2 times a week	3-4 times a week	5 times a week	6-7 times a week	Total
Increase in DA	**Drive Alone Less**	Days commuting by drive alone, in a typical 28-day period	0			0	1	1	0	2
			1			1	0	0	0	1
			3			0	1	0	0	1
			15			0	0	1	0	1
			20			0	0	0	1	1
		Total				1	2	2	1	6
Decrease in DA	**Drive Alone More**	Days commuting by drive alone, in a typical 28-day period	10		1	0	0	0		1
			19		0	0	1	0		1
			20		0	1	1	0		2
			23		0	0	0	1		1
			25		0	0	1	0		1
		Total			1	1	3	1		6
Same or Increase Okay	**Drive Alone Less**	Days commuting by drive alone, in a typical 28-day period	0	5	0					5
			1	0	4					4
		Total		5	4					9
Same or Decrease Okay	**Drive Alone More**	Days commuting by drive alone, in a typical 28-day period	2	1		0	0			1
			8	0		2	0			2
			16	0		0	2			2
		Total		1		2	2			5
Marginal-Same or Increase	**Drive Alone Less**	Days commuting by drive alone, in a typical 28-day period	0		6	0				6
			3		0	4				4
		Total			6	4				10
Marginal-Same or Decrease	**Drive Alone More**	Days commuting by drive alone, in a typical 28-day period	4		1		0	0		1
			5		1		0	0		1
			17		0		1	0		1
			18		0		1	0		1
			22		0		0	2		2
		Total			2		2	2		6

Thus, 6 of these 42 cases will be coded "increase" for the Longer term increase variable, 6 as "decrease" for the Longer term decrease variable, and the remaining 30 cases as "no change" for both variables. In other words, the default assumption will be "no change", unless there is a specific plausible reason to classify it otherwise.

5. Handle responses which are missing either DA_0 or DA_3 by relying on W3.C12 responses.

When the Longer term increase and Longer term decrease variables were created for these cases, they were coded according to the retrospective responses given for W3.C12. Since most cases

were consistent, this is a reasonable simplification when there is missing data. Though in theory we do trust respondents' contemporaneous responses more, for most respondents, these matched the retrospective responses.

6. Handle responses which show changes based on DA_0 and DA_3, but do not report changes in W3.C12 nor W3.C1.

When the Longer term increase and Longer term decrease variables were created, these cases (the remainder of the green cells not handled in step 3) were coded according to the 28-day comparison, with the same reasoning as discussed in step 4.

7. Define the variables for longer term changes: longer term increase and longer term decrease.

Table A5 shows the crosstab between the allowable changes and the responses to W3.C12, similar to Table A 3, however the cells in this crosstab are colored to indicate how the cases will be coded into the Longer term increase and Longer term decrease change variables: Green for Longer term decrease (made a longer term decrease), red for Longer term increase (made a longer term increase), and blue for neither. These categories are mutually exclusive and the single case that responded both yes and no to question W3.C12 for driving alone is classified as "drive alone more", to be conservative.

Table A5: Crosstab of W3.C12 and Allowable Changes – Coded for Longer Term Change Variables

Combined Results for Questions W3.C12 B and C * Possible DA changes based on 28 day questions Crosstabulation
Count

		Possible DA changes based on 28 day questions								
		Increase in DA	Decrease in DA	Any Change Okay	Same or Increase Okay	Same or Decrease Okay	Marginal-Same or Increase	Marginal-Same or Decrease	Missing	Total
Combined Results for Questions W3.C12 B and C	Neither Change	224	134	420	390	63	164	75	262	1732
	Drive Alone More	77	6	20	10	5	17	6	24	165
	Drive Alone Less	6	42	14	9	7	10	10	16	114
	Yes to Both	1	0	0	0	0	0	0	0	1
Total		308	182	454	409	75	191	91	302	2012

Individuals who should have stated strictly increase or strictly decrease based on the 28-day comparison across waves, are coded into the longer term change variables based on the change indicated by the 28-day comparison. The frequencies of the longer term change variables are shown in Tables A6a-b and they match those expected based on the coding indicated above.

Table A6a: Longer Term Increases in Driving Alone

Longer term Increases Drive Alone Days

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	1633	81.2	81.2	81.2
	yes	379	18.8	18.8	100.0
	Total	2012	100.0	100.0	

Table A6b: Longer Term Decreases in Driving Alone

Longer term Decreases Drive Alone Days					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	1783	88.6	88.6	88.6
	yes	229	11.4	11.4	100.0
	Total	2012	100.0	100.0	

These variables will be used in the analysis of longer term and temporary changes.

A2.3 Probabilistic Method for Longer-term Changes

A last method for identifying cases which made longer term changes was also considered, however this method identified potential cases which were either already documented as making a change, or for which the plausible changes were only "any change okay" or a "same or marginal change" is okay. For these reasons, no new cases were added into the analysis using this method and it is not described in more detail here.

A3. Temporary Changes

A3.1 Relevant Survey Questions and Variables

From Waves 1 & 2:

A093. 50. Considering the days in a 4-week (28-day) period on which you make **physical trips to and from a regular workplace**, on how many of those days do you do each of the following?
It is possible for the same trip to fit into more than one category. Please include the trip as many times as it fits.

Drive alone for **most** of the trip (DROPDOWN)

- None [Default choice]
- 1 day
- *2 days*
- …….
- 28 days

Notes: We are interested in identifying the background drive alone days for this variable definition because we want to confirm that individuals COULD have made the changes they claim to make. E.g. if someone reports driving alone fewer days, but reported $DA_0 = 0$, this change is apparently not possible. (The inconsistency could legitimately arise if in Wave 3 the respondent mentally compared her behavior to a different baseline than she reported in Wave 1 or 2, e.g. because she changed her typical behavior during that spring and so remembered different patterns as being "typical" of that period when asked at different times. However, we need to reconcile logically inconsistent responses as much as possible, in order to have an internally consistent analysis). This variable is also used to determine the percentage of commute days which are drive alone, for each respondent in the baseline condition.

B108.fewer_trips: Did you make fewer commute trips than you normally would?

B109a.avoided_by_TC: Did you avoid trips by telecommuting?
B109b.avoided_by_CWW: Did you avoid trips by adoptingt CWW?
[*sic* – typo is in the question label in the SPSS file]
B109c.avoided_by_vacation: Did you avoid trips by taking vacation
B109d.avoided_by_other: Did you avoid trips by some other means
B109e.avoided_by_other_description: Description of other means of avoiding commute trips

B110a.TC_days: Number commute days avoided by telecommuting
B110b.CWW_days: Number commute days avoided by CWW
B110c.vacation_days: Number commute days avoided by taking vacation

Notes: The B108 variable is used to determine whether respondents made fewer commutes during the survey week – regardless of whether or not those changes were made because of the Fix. The B109 questions ask whether the respondent made fewer commute trips ***because of the Fix***, and must be used in coordination with the background commute patterns. We also consider the B110 variables which indicate the number of days respondents reported switching to telecommuting and compressed work week, because the more commutes there are which were not taken, the more likely it is that it was *drive alone* commute trips which were not taken (when there were any drive alone trips in the baseline pattern at all).

B116.mode_change: Did you travel to or from work usindg a different means of transportation?
B117a.mode_carpool: Used carpool on more occasions
B117b.mode_bus: Used the bus on more occasions
B117c.mode_light_rail: Used light rail on more occasions
B117d.mode_Amtrak: Used Amtrak on more occasions
B117e.mode_walk_bike: Used walking/biking on more occasions
B117f.mode_drive_alone: Used driving alone on more occasions.
B117g.mode_none: Used none of the above on more occasions

Notes: B117f provides information about increases made to the number of trips made by driving alone, during the Fix. Respondents are only asked this question if they answered "yes" to a question asking if they changed modes because of Fix I-5. Waves 1 and 2 have a slight but important difference at this point. In Wave 1 they are asked whether they made this change because of Fix I-5 *for each mode they reported changing*, whereas in Wave 2, they are only asked this question (whether they made the change because of the Fix) once, at the beginning of the section of related questions (and the remaining questions were only asked if respondents answered that they made a mode change because of the Fix). For this reason, the responses to B117f are coded as follows (with similar codes for B117a-e):

"1" = "yes because of the Fix" for Wave 1 (accounting for 2 of the 45 people in Wave 1 who reported increasing their drive-alone commutes), or
"yes" for Wave 2 (where "yes because of the Fix" for Wave 2 is captured by the response to question B116.mode_change, asking whether *any* mode change was made);

"2" = "yes, for some other reason" for Wave 1 (accounting for the other 43 of the 45 people in Wave 1 who reported increasing their drive-alone commutes), or
"no" for Wave 2 (where "no" for Wave 1 is captured by a previous question, asked for each mode separately).

Stated differently, for Wave 2, while we know whether a mode change (in general) was made during the study week for any reason, we only know about a shift *to a particular mode* if the (general) mode change was made because of the Fix (which was the case for 56%, or 115, of the 206 people in Wave 2 reporting a mode change during that week for any reason). In later analyses, we will assume that when a general mode change was made because of the Fix in Wave 2, all specific mode changes reported in the followup questions were made because of the Fix (this seems reasonable: that assumption would only be wrong if the respondent made some mode change(s) because of the Fix, but (1) also made some mode change(s) for some other reason, *and* (2) reported those other changes in the questions *following up on the Fix-related changes*). There were a total of 96 cases who reported making a change in Wave 2 for "some other reason", but we cannot attribute those changes to a particular mode.

For Wave 1, by contrast, we know about each specific mode change made during the study week, *and* whether it was made because of the Fix or not. However, *followup* questions about the mode change were asked only if the change was made because of the Fix, so only in those instances do we know what the "instead of" mode was, i.e. which mode was *replaced* by the increase in the mode in question (the B120 questions described below).

Since in Wave 3 we are interested in (temporary and longer term) changes in the number of drive alone commutes, made for *any* reason (Fix-related or otherwise), it would have been nice to have had a record of all drive alone changes made in Waves 1-2, not just those made because of the Fix. As discussed later, however, we do not expect all changes reported in Wave 3 to be reflected in Wave 1 or 2 anyway, so it is not essential to have that information.

B120a.carpool_instead: What would you ordinarily have done instead of carpooling?
B120b.bus_instead: What would you ordinarily have done instead of taking the bus?
B120c.light_rail_instead: What would you ordinarily have done instead of riding light rail?
B120d.Amtrak_instead: What would you ordinarily have done instead of riding Amtrak?
B120e.walk_bike_instead: What would you ordinarily have done instead of walking/biking?
B120f.drive_alone_instead: What would you ordinarily have done instead of driving alone?

Notes: The block of questions B120a through B120f include responses for each other mode allowed in the survey. These questions are only asked if respondents indicated using a particular mode more days during the survey week. For these questions, a response of "1" corresponds to drive alone, as in, "I would have used drive alone that day, but instead I used the indicated mode." The responses of "1" for questions B120a-e (there are no "1" responses for B120f, which would indicate switching from driving alone to driving alone) were counted and incorporated into a single new dummy variable, set to 1 if they switched from driving alone at all (i.e. if there were any "1"s in this block of variables), and 0 otherwise.

From Wave 3:
W3.D1: During last summer (June, July, August 2008), did you (even sometimes) travel to work a different number of days per week than you typically did last spring (March, April, May 2008)?

In this [following] question we are interested in any *switches* you made from one means of transportation to another one - ***even if only some of the time.***
In which ways (if at all) was *the means of transportation* **you used in your commute** *last summer (June, July, August 2008)* different from last spring (March, April, May 2008)? (Check all that apply.)*
If a change was ***only*** the result of making a different change that we've already asked about before - for instance, if you drove less just because of working fewer days per week - please do ***not*** include it.
(CHECKBOX)

W3.D15A: I did not switch any of my commute trips from one means of transportation to another during the summer
W3.D15B: I drove alone more often
W3.D15C: I drove alone less often
[The "*" appeared on the survey, and means that the question is required to be answered.]

Notes: These two W3.D15 variables are similar to the W3.C12 variables used to identify longer term changes. These two variables will be combined into a single variable referred to as W3.D15, as we did with W3.C12B and W3.C12C; however, in this case a "yes" response to both is acceptable, since on a temporary baasis a respondent could have made both changes (an increase in driving alone, and a decrease in driving alone) at two different points in time, during the previous summer.

A3.2 Rules for Identifying Changes

Note: Throughout the discussion of temporary changes, we describe the conditions necessary for an individual to have made temporary increases or decreases to driving alone, but we keep in mind that temporary and longer term changes of the same type are mutually exclusive. That is, if an individual drives alone less in the *long term*, s/he is not also allowed to *temporarily* have driven alone less; a change is no longer temporary if it is made on a longer term basis. As we define temporary changes, we ignore this rule, but it is added as the last step in this process to classify changes reported in both the temporary and longer termconditions, as only longer term changes. The temporary changes of all respondents who indicated the *same* longer term change (i.e. temporary and longer term increase in driving alone) are recoded as "no". On the other hand, respondents may temporarily make one change, but make the *opposite* change on a longer term basis; a respondent could have been driving alone less at some point temporarily, but overall, has made a longer term change to drive alone more.

The discussion of the definition of longer term changes focused on identifying whether the reported changes are internally consistent for each respondent, and rules for handling cases when these responses are not consistent. For temporary changes, there is more freedom afforded respondents: they are allowed to have changes in both directions, there are multiple points in time at which they could report changes, and changes reported in Wave 3 may legitimately not have been reported in Waves 1 and 2 (since a change could have been made at a different time

during the summer than during the week(s) covered by the Wave 1 and/or 2 surveys). In the converse direction, in principle any change reported in Wave 1 or 2 should be reflected as either a longer term or a temporary change in Wave 3, but discrepancies could represent a memory lapse, or (as mentioned earlier) legitimately result from a different memory with respect to what spring baseline is used for comparison. Where a change is reported in Wave 1 or 2 but not mentioned in Wave 3, we apply the principle that individuals provide more accurate information contemporaneously than retrospectively, and we accept the reported change as valid. Accordingly, we complete an exhaustive identification of all responses which indicate any temporary changes, throughout all three waves, with consistency requirements included only where noted.

A3.3 Temporary Increase in Driving Alone

This section covers the variables and definitions used in identifying cases which drove alone more on a temporary basis.

Increases in driving alone due to purposive mode changes

In contrast to the more general situation in Wave 3, in Waves 1 and 2 respondents were not asked whether they commuted *more* days during the survey week (e.g. because of reducing telecommuting or "uncompressing" a compressed work week), because that was not seen as a change commuters were likely to make during the upheaval caused by the Fix construction. Thus, for Waves 1 and 2 we presume that drive-alone commutes will increase only due to mode changes, not due to increasing the number of commute days.

Contemporaneously-reported increases in driving alone during the Fix are reflected by the variable B117f. This directly asks if respondents drove alone on more days during the Fix than they normally would (see the more detailed description above). The frequency of responses to B117f is shown in Table A7. The large number of "not asked" responses arises because individuals were not asked this question if they did not first respond "yes" (Wave 1) or "yes, because of the Fix" (Wave 2) to question B116, which asks if any mode changes were made during the survey week. Since Wave 1 cases who answered "yes" for any reason (whether because of the Fix or not) were able to respond that they used driving alone on more occasions, and we want to capture all individuals who made changes, we also count Wave 1 cases who responded "yes, for some other reason" in the number of respondents who used driving alone on more occasions. Table A7 shows the responses to B117f by wave, to show how many cases drove alone more during the survey week. All of the bold cases in the table are cases who drove alone more during the survey week. There are 6 cases who reported doing so because of the Fix, and there are an additional 43 Wave 1 cases who reported doing so for some other reason. So we have a total of 49 cases who temporarily drove alone more, based on this variable.

Table A7: Increases in Driving Alone According to Question B117f

		Wave number		
		Wave 1 (June 2-8)	Wave 2 (June 16-22)	Total
Used driving alone on	Yes (Wave 2) or Yes because of Fix I-5 (wave1)	**2**	**4**	**6**

more occasions	No or Yes for some other reason (Wave 1) or presumed no (Wave 2)	**43**	111	154
	Not asked	368	1410	1778
Total		413	1525	1938

Table A8 shows the cross-tab of responses to question B116 and question B117f. This shows the 91 total Wave 2 respondents who answered "Yes, for some other reason" to the question "Did you travel to or from work using a different means of transportation?" These 91 cases who answered "yes, for some other reason" were not asked about whether or not they increased driving alone (or any other mode) specifically.

We have a total of 91 + 115 = 206 Wave 2 cases who reported making a mode change during the survey week, and of these we know what mode they increased for the 115 cases who said it was because of Fix I-5. Of these 115 cases, 4 increased driving alone. We can also learn if individuals temporarily increased driving alone any time during the summer, by looking at responses to the Wave 3 quesiton W3.D15. The frequencies of the combined responses to W3.D15 are shown in Table A9.

Table A8: Crosstab of Wave and Changes in Transportation Modes During the Fix

		Did you travel to or from work using a different means of transportation					
		Yes, because of Fix I-5	Yes, for some other reason	No	No response	Not asked	Total
Wave number	Wave 1 (June 2-8)	45	7	337	0	24	413
	Wave 2 (June 16-22)	**115**	**91**	1247	12	60	1525
Total		160	98	1584	12	84	1938

Table A9: Combined Results for Questions W3.D15B and C

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neither Change	1857	92.3	92.3	92.3
	Drove Alone More	**68**	3.4	3.4	95.7
	Drove Alone Less	87	4.3	4.3	100.0
	Total	2012	100.0	100.0	

There are 68 cases which indicate temporarily driving alone more according to responses to W3.D15. A crosstab of the Wave 1 and 2 variables used to identify cases who temporarily increased driving alone with this variable W3.D15 is shown in Table A10. The bold cells show all cases who increased driving alone, and the italic cells show cases which were not previously counted when using the Wave 1 and 2 variables.

From Wave 1, there were initially 45 cases identified who increased driving alone on a temporary basis, and there are 11 additional cases from the Wave 3 responses, who indicated temporarily driving alone more, for a total of 56 Wave 1 cases who temporarily drove alone more. From Wave 2, we had only 4 cases who indicated that they drove alone more; however, from the Wave 3 responses we have 9 + 39 = 48 additional cases who report that they drove alone more. The much higher number of respondents reporting this change in Wave 2 is a side-effect of the high number of cases who were not asked question B117f in Wave 2. Actually, the

total numbers of cases reporting that they increased driving alone for Wave 1 (56) is similar to the total number for Wave 2 (52); and we have a total of 108 respondents who reported that they drove alone more on a temporary basis, either during the survey week (Waves 1 and 2), or at some point during the previous summer, compared to the previous spring (Wave 3) due to changing modes.

From Table 12 we can see that there are 108 cases (in the bolded cells) who reported that they drove alone more on a temporary basis. However, among the 74 Wave 3 cases which were not matched to Wave 1 and 2 cases, there are an additional 4 cases who reported driving alone based on the variable W3.D15, bringing the total to 112 cases from these variables (Table A10).

Table A10: Crosstab of W3.D15B and C with Wave Number (Waves 1-2)

Wave number			Combined Results for Questions W3.D15 B and C			
			Neither Change	Drove Alone More	Drove Alone Less	Total
Wave 1 (June 2-8)	Used driving alone on more occasions	Yes (Wave 2) or Yes because of Fix I-5 (wave1)	**1**	**1**	**0**	**2**
		No or Yes for some other reason (Wave 1) or presumed no (Wave 2)	**34**	**3**	**6**	**43**
		Not asked	343	***11***	14	368
	Total		378	**15**	20	413
Wave 2 (June 16-22)	Used driving alone on more occasions	Yes (Wave 2) or Yes because of Fix I-5 (wave1)	**3**	**1**	**0**	**4**
		No or Yes for some other reason (Wave 1) or presumed no (Wave 2)	90	***9***	12	111
		Not asked	1319	***39***	52	1410
	Total		1412	**49**	64	1525

Table A11: Temporary Increases in Driving Alone

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	1728	85.9	85.9	85.9
	Yes	**112**	5.6	5.6	91.5
	Missing	172	8.5	8.5	100.0
	Total	2012	100.0	100.0	

Increases in driving alone due to increasing the number of commute days (Wave 3 only)

Next, we look at temporary increases in driving alone which are based on increasing the number of days of commuting using the Wave 3 variable W3.D1. This question asks whether fewer or more commute trips were made at some point in time during the previous summer compared to the previous spring. However, as mentioned earlier, when a change to the number of commute trips was reported, respondents were not asked to specify which commute modes were affected by the change. Thus, to utilize the responses for this question to decide whether or not temporary increases in driving alone were made, we must set criteria, based on individual back-

ground commute patterns, for deciding whether changes in the number of commute days most likely correspond to changes in driving alone (as opposed to some other mode(s)).

The variable Pcnt.Commute.DA was created which determines the percentage of each respondent's background commutes which are made by driving alone (i.e. the quantity defined above as DA_0, now expressed as a percentage of total commute days). This is defined as:

Pcnt.Commute.DA = 100 * A093.commute_drive_alone / A092.commute_days

According to the wording of survey questions, Pcnt.Commute.DA is equivalent to the percentage of commute days on which driving alone is used for most of the trip. Other modes may be used on these days in addition to driving alone. The variable Pcnt.Commute.DA is used in combination with responses of "increased commute days" to W3.D1 to identify respondents whose increase in commute days likely corresponds to an increase in driving alone. Comparisons between Pcnt.Commute.DA and W3.D1 are made using a probabilistic approach and are discussed for both temporary increases and decreases in driving alone at the end of this section.

A3.4 Temporary Decreases in Driving Alone

Decreases in driving alone due to purposive mode changes

Contemporaneously-reported decreases in driving alone during the Fix are primarily reflected by the B120 variables (relating to mode changes not occurring as a byproduct of some other change), which ask which mode respondents would have used instead of the modes they used during the Fix (we later address decreases in driving alone due to reducing the number of days of commuting altogether). For the Temporary decrease variable, we look at cases reporting increases in any of the modes other than drive alone (i.e. affirmative responses to questions B117a-e), for which the respondent increased the use of that mode *instead of driving alone* (reported via the response to B120). For example, if a respondent who indicates that she rode the bus more days during the Fix (B117b = 1, or yes) responds to B120b by saying "drive alone," it means that she would normally have driven alone, but instead took the bus during the survey week. We select the responses to the B120 variables for which drive alone is indicated as the normal mode, in order to identify all respondents who switched *from* driving alone to some other mode during the survey week. If a respondent switched away from driving alone to any other mode, we consider this a temporary decrease in driving alone.

Table A12: Temporary Decreases in Driving Alone Due to Mode Switches during the Fix

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	1847	91.8	91.8	91.8
	yes	**91**	4.5	4.5	96.3
	Missing	74	3.7	3.7	100.0
	Total	2012	100.0	100.0	

Based on Wave 1 and 2 responses, a total of 91 cases are identified who switched *to* some mode other than driving alone, *from* driving alone, during the survey week (Table A12).

Retrospectively-reported temporary decreases in driving alone (due to mode changes that are not a byproduct of some other change) are captured by the Wave 3 variable W3.D15. As with increases in driving alone, respondents answered whether they decreased driving alone at some point during the previous summer, compared to their usual pattern the previous spring. There are 87 cases who decreased driving alone according to W3.D15 (Table A13).

Table A13: Combined Results for W3.D15B and C

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neither Change	1857	92.3	92.3	92.3
	Drove Alone More	68	3.4	3.4	95.7
	Drove Alone Less	**87**	4.3	4.3	100.0
	Total	2012	100.0	100.0	

A crosstab of these two variables shows the number of individuals who temporarily decreased driving alone due to a mode change, across all survey waves (Table A14).

Table A14: Temporary Decreases in Driving Alone Across All Waves

		Combined Results for Questions W3.D15 B and C (Wave 3)			
		Neither Change	Drove Alone More	Drove Alone Less	Total
Used Another Mode Instead of Drive Alone (Waves 1 and 2)	no	1718	60	69	1847
	yes	72	4	**15**	91
	Missing	67	4	3	74
Total		1857	68	87	2012

There are 15 cases who drove alone less based on both questions, so a total of 87 + 91 – 15 = 173 cases decreased driving alone on a temporary basis by changing their mode.

Decreases in driving alone due to decreasing the number of commute days

Next, we consider decreases in driving alone which resulted from individuals commuting fewer days. As with Temporary increase, we have the problem that respondents were not asked which mode would normally have been used on the eliminated commute days, so we need a way to decide whether a given individual probably eliminated a drive-alone commute.

We used a random number generator, as we did with the temporary increase in drive alone days, to provide another means of comparing the Pcnt.Commute.DA to W3.D1. The results are discussed for both temporary increases and decreases in driving alone at the end of this section.

The last variables available to use to determine decreases in drive alone, are responses to the Wave 1 and 2 questions about reducing the number of commute days during the survey week. These are responses to the set of Wave 1 and 2 variables B108, B109 and B110; with B109 and B110 containing multiple sub-variables which indicate specific ways respondents reduced the number of commute days during the survey week (as indicated above, it was presumed that

commute days would not *increase* during the Fix, hence the Temporary increase definition process did not have a counterpart to these variables). Decreases in commute days could have been reported because of the Fix, or for some other reason. We are interested in both types of changes.

Respondents reported decreasing the number of commute days in one or more of four ways: telecommuting, adopting a compressed work week, taking vacation or reducing the commute days in "other" ways, with space provided for explanations of the other responses. We consider changes in the number of commute days related to telecommuting or adopting a compressed work week to be legitimate temporary decreases to the number of commute days. We disregard changes to the number of commute days related to vacation, because these are not work days, and probably only represent a shift from taking a vacation at some other time, rather than changes to a typical schedule and/or commute pattern.

For the variable B108 we consider cases that are coded as "1" or "2", to be cases which legitimately reduced commute trips during the survey week. There are 324 cases who meet these criteria (Table A15).

Table A15: Frequency of Respondents Who Made Fewer Commutes during the Fix

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Made Same Commutes	1614	80.2	80.2	80.2
	Made Fewer Commutes	**324**	16.1	16.1	96.3
	Missing	74	3.7	3.7	100.0
	Total	2012	100.0	100.0	

The 324 cases who made fewer commutes during the Fix potentially eliminated drive alone trips on a temporary basis, during the Fix. These 324 cases *potentially* drove alone less, because thus far we have only established that they made fewer commute trips. Next, we must make a best guess as to whether these were trips that would have been made by driving alone. We have a situation similar to the one for variable W3.D1. We can compare the Pcnt.Commute.DA to responses to these questions, to identify those cases which are most likely to have skipped a drive-alone commute trip when adopting a compressed work week or deciding to work at home instead of commuting for some days during the survey week.

A3.5 Probabalistic Method for Temporary Increases and Decreases

The philosophy behind this approach is simply to assign any change in the number of an individual's commute days to driving alone, with a probability equal to the proportion of drive-alone days in that person's baseline commute pattern. To implement this method, for each applicable individual we generated a random number using the generator in SPSS, which returned a value uniformly distributed within [0, 1]. We then multiplied by 100 so that the number would be on the same scale as the Pcnt.Commute.DA variable (i.e. the calculated percentage of baseline commute days which include driving alone for most of the commute trip). If the Pcnt.Commute.DA were greater than or equal to the random number we assigned the change in commute days to driving alone; otherwise not. Thus, each case with a changed number

of commute days has a "Pcnt.Commute.DA" percent chance of changing a drive-alone day(s) (since that is the probability that a number uniformly-distributed between 0 and 100 will fall between 0 and Pcnt.Commute.DA), and a "100- Pcnt.Commute.DA" percent chance of not doing so. For example, if a person drives alone on 60% of her five commute days a week for the baseline, and indicates reducing her commute days, we assume there to be 60% chance that the eliminated day(s) would have been by driving alone, and a 40% chance that it/they would not have involved driving alone.

Using these values is straightforward for those cases which indicated a general decrease or increase in commute days (variable W3.D1), however; we also have information about whether individuals replaced commutes during the Fix with working at home or adopting a compressed work week. For these cases, it is more complicated to determine whether they replaced drive alone commutes with these alternatives, since the probability that a drive alone commute was skipped is dependent on the number of days which were skipped, the normal number of commute days per week and the normal number of commute days per week which are drive alone. These are assigned the following variable names, and calculated as follows:

The number of skipped days = SD = days replaced commute with working at home + days replaced commute with adopting a compressed work week.

The normal number of commute days per week = RCD (rounded commute days), which is found by: A092.commute_days/4 (for 4 weeks), and rounded according to the rule discussed below.

Drive alone days per week = Rounded.DA.Days = A093.commute_drive_alone/4, rounded according to the rule discussed below.

To determine RCD and Rounded.DA.Days, the responses to questions A092 and A093 were divided by 4, to put the 28-day questions on a per-week basis (congruent with the periods respectively covered by the Wave 1 and Wave 2 surveys). Because some individuals commute and/or commute by driving alone some number of days a month which is not a multiple of 4, there are many cases which have remainders when A092 and A093 are simply divided by 4. We do not simply round the cases with remainders though, because the remainders represent the fact that not all individuals commute (or drive alone) the same number of days every week each month. Simply rounding does not capture the fact that the week of the Fix could have been a week with more days of commuting, or a week with fewer days of commuting. In order to capture this, we use a random number to determine whether a value with a remainder is rounded up or down.

Each remainder is between 0 and 1 and is compared to a random number (uniformly distributed), also between 0 and 1. If the random number is greater than the remainder, we round down, and if the random number is less than the remainder we round up. (For example, if the remainder is 0.7, we should round *up* with probability 0.7, and round *down* with probability 0.3. Since the probability of obtaining a U[0,1] number greater than 0.7 is 0.3, we round down if the random number is greater than the remainder.) This gives an integer value for the number of commute days per week, and uses a probabilistic method to capture whether the week of the Fix was a "long work week" or not for those respondents who do not commute a multiple of 4 days per month. We calculated RCD (rounded commute days), and the number of drive alone days per

week, i.e. Rounded.DA Days. Using these, we also calculate the commute days which are not drive alone as NDA = RCD – Rounded.DA.Days.

Then, the probability that at least one DA day was eliminated is (1 – the probability that no DA days were eliminated). This probability is governed by the hypergeometric distribution: the total number of ways to choose SD skipped days out of RCD commute days is $\binom{RCD}{SD}$, the number of ways to choose SD skipped days out of NDA non-drive-alone days is $\binom{NDA}{SD}$, and therefore the probability that the skipped days are all non-drive-alone is $\frac{\binom{NDA}{SD}}{\binom{RCD}{SD}}$, giving

$$Probability\ (more\ than\ 1\ Drive\ Alone\ Day\ Eliminated) = 1 - \frac{\binom{NDA}{SD}}{\binom{RCD}{SD}}.$$

Since an individual who has SD = 0, OR Rounded.DA.Days = 0, has 0 probability of skipping a drive alone commute, we assign the probability of 0 to these cases. Likewise, if SD > NDA and Rounded.DA.Days is not 0, then we are certain that at least one drive alone commute was eliminated, and these cases are assigned a probability of 1. Of the 95 cases for which we are able to calculate a value for SD, we have 2012 – 1923 = 89 cases which do not have missing values on all of the other necessary variables, and for these cases we calculated the probability that a skipped day was a drive alone day, using the equation and rules described above. Of these 89 cases, there are 25 which have a probability of skipping a drive alone day which is not equal to 0 or 1 (Table A16).

For the 25 cases which have a probability other than 0 or 1, we compare this probability to a random number uniformly distributed between 0 and 1. We also consider the cases who indicated they commuted fewer days by telecommuting or adopting a compressed work week, or for some other valid reason (accounted for by responses of "1" or "2" to question B108) but did not indicate how many days. For these cases, we compare their percentage of commutes which are drive alone to a random number uniformly distributed between 0 and 1. These cases skipped at least 1 commute day during the week of the Fix. Using the probability formula above, individuals who skipped one day have a probability of that day being a drive alone day equal to the percentage of days they drive alone. With these comparisons, we find that there are 68 cases who decreased driving alone based on the derived probabilities and using comparisons to random numbers.

Table A16: Probabilities x100 a Skipped Commute Would Have Been a Drive Alone Commute

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.000	18	.9	.9	.9
	20.000	**7**	.3	.3	1.2
	33.333	**1**	.0	.0	1.3
	40.000	**2**	.1	.1	1.4

	42.857	**1**	.0	.0	1.4
	50.000	**2**	.1	.1	1.5
	60.000	**1**	.0	.0	1.6
	66.667	**1**	.0	.0	1.6
	75.000	**3**	.1	.1	1.8
	80.000	**3**	.1	.1	1.9
	83.333	**2**	.1	.1	2.0
	90.000	**2**	.1	.1	2.1
	100.000	46	2.3	2.3	4.4
	888.000	1923	95.6	95.6	100.0
	Total	2012	100.0	100.0	

Table A17: Temporary Decreases in Drive Alone Using Probabilistic Method

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	258	12.8	12.8	12.8
	Yes	68	3.4	3.4	16.2
	Missing	1686	83.8	83.8	100.0
	Total	2012	100.0	100.0	

A3.6 Total Temporary Increases and Decreases based on Probabilistic Method

For decreases in driving alone reported in the Wave 1-2 variables B108, B110a and B110b, which indicate decreases in commute days due to a compressed work week, telecommuting or "other" means, and for increases and decreases in driving alone reported in the Wave 3 variable W3.D1, we used these random numbers to compute new frequencies of respondents who temporarily decreased or increased driving alone based on changes in the number of commute days. From these methods, we obtain the frequencies of temporary changes shown in Tables A18-A19.

Of course, if we were to redo the random assignment with a new set of random numbers (drawn from the same distribution), the results could differ somewhat. However, a sizable proportion of cases would receive the same assignment on any two applications of the method. Since this approach appropriately reflects the uncertainty in what the assignment should be, and eliminates the need for an arbitrary choice of cutoff, we prefer it to the deterministic rule-based assignment method.

Table A18: Probabilistic Method – Temporarily Increased Driving Alone

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	1890	93.9	93.9	93.9
	Yes	122	6.1	6.1	100.0
	Total	2012	100.0	100.0	

Table A19: Probabilistic Method – Temporarily Decreased Driving Alone

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	1731	86.0	86.0	86.0
	Yes	281	14.0	14.0	100.0
	Total	2012	100.0	100.0	

A4. Summary of Changes in Drive Alone Commuting

In principle, it is possible for an individual to temporarily have made a change during the Fix and then gone back to normal patterns, while a few months later, the same person could have made the same changes he made during the Fix, but now continue to do so on a longer term basis. In other words, someone could make a temporary change and a longer term change in the same direction within the 6 month time period.

Because we initially thought of the longer term changes as permanent changes, we did not allow individuals to make both a temporary and a longer term change in the same direction, since a change which is initially temporary is no longer temporary when it is made on a permanent or longer term basis. However, because of the uncertainty in the length of time the non-temporary changes are made, we decided to call these changes "longer term" changes, instead of permanent changes. Also due to the uncertainty about the duration of the longer term changes, an individual *could* conceivably make a temporary and longer term change in the same direction, but we keep the mutual exclusivity of temporary and longer term changes in the same direction. It is acceptable to keep our analysis as it is because we are interested in the **largest changes made** or the longest term change made by each respondent. If a respondent made only a temporary change, then a temporary change is the longest term, or largest change they made, whereas if a respondent made both a temporary change and a longer term change, we keep only the longer term change in our data, since this is the largest change they have made.

So, there is a last condition on those reporting temporary changes; they cannot have reported the same change as a longer term change. If they have reported driving alone more or less as a longer term change, they will not be allowed to have the same change as a temporary change. Once the temporary changes are recoded with this in mind, we obtain the final frequencies of temporary changes shown in Tables A20-21.

Table A20: Probabilistic Method Temporary Increases in Driving Alone

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	1935	96.2	96.2	96.2
	Yes	77	3.8	3.8	100.0
	Total	2012	100.0	100.0	

Table A21: Probabilistic Method Temporary Decreases in Driving Alone

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	1802	89.6	89.6	89.6

	Yes	210	10.4	10.4	100.0
	Total	2012	100.0	100.0	

Refer to Tables A22-A24 for frequencies of individuals making each of the four types of changes of interest. There are a total of 379 + 77 = 456 individuals who increased driving alone for some amount of time, and a total of 229 + 210 = 439 individuals who decreased driving alone. By definition, we have no overlap between individuals who decreased temporarily or longer term, similarly for increases, but we can have overlap between individuals who temporarily increased and decreased, OR between individuals who temporarily increased and longer term decreased or vice versa (however, we cannot have individuals making *both* temporary changes as well as one of the longer term changes, since that would violate the first rule). We do indeed, have 14 cases who were found to have temporarily made both changes (Table A22).

Table A22: Crosstab of Temporary Increases and Decreases in Driving Alone

		Temporarily Increased Drive Alone		
		No	Yes	Total
Temporarily Decreased Drive Alone	No	1739	63	1802
	Yes	196	14	210
Total		1935	77	2012

Table A23 shows the number of individuals who temporarily decreased driving alone, but who increased driving alone on a longer term basis.

Table A23: Crosstab of Temporary Decreases and Longer-Term Increases

		Longer term increase Drive Alone Days		
		no	yes	Total
Temporarily Decreased Drive Alone	No	1495	307	1802
	Yes	138	72	210
Total		1633	379	2012

The converse is shown in Table A24; those cases who temporarily increased the number of days they drove alone, but who ultimately decreased driving alone on a longer term basis.

Table A24: Crosstab of Temporary Increases and Longer-Term Decreases

		Longer term decrease Drive Alone Days		
		no	yes	Total
Using Random Cutoff Temporarily Increased Drive Alone	No	1730	205	1935
	Yes	53	24	77
Total		1783	229	2012

Table A25 shows the crosstab of all temporary and longer term changes.

Table A25: Overlap in Increases and Decreases in Driving Alone

Temporarily Decreased Drive Alone	Temporarily Increased Drive Alone				Longer term increase Drive Alone Days		Total
					no	yes	
No	No	Longer term decrease Drive Alone Days	no	Count	1227	307	1534
				% within Longer term decrease Drive Alone Days	80.0%	20.0%	100.0%
				% within Longer term increase Drive Alone Days	85.7%	100.0%	88.2%
			yes	Count	205	0	205

				% within Longer term decrease Drive Alone Days	100.0%	.0%	100.0%
				% within Longer term increase Drive Alone Days	14.3%	.0%	11.8%
		Total		Count	1432	307	1739
				% within Longer term decrease Drive Alone Days	82.3%	17.7%	100.0%
				% within Longer term increase Drive Alone Days	100.0%	100.0%	100.0%
	Yes	Longer term decrease Drive Alone Days	no	Count	39		39
				% within Longer term decrease Drive Alone Days	100.0%		100.0%
				% within Longer term increase Drive Alone Days	61.9%		61.9%
			yes	Count	24		24
				% within Longer term decrease Drive Alone Days	100.0%		100.0%
				% within Longer term increase Drive Alone Days	38.1%		38.1%
		Total		Count	63		63
				% within Longer term decrease Drive Alone Days	100.0%		100.0%
				% within Longer term increase Drive Alone Days	100.0%		100.0%
Yes	No	Longer term decrease Drive Alone Days	no	Count	124	72	196
				% within Longer term decrease Drive Alone Days	63.3%	36.7%	100.0%
				% within Longer term increase Drive Alone Days	100.0%	100.0%	100.0%
		Total		Count	124	72	196
				% within Longer term decrease Drive Alone Days	63.3%	36.7%	100.0%
				% within Longer term increase Drive Alone Days	100.0%	100.0%	100.0%
	Yes	Longer term decrease Drive Alone Days	no	Count	14		14
				% within Longer term decrease Drive Alone Days	100.0%		100.0%
				% within Longer term increase Drive Alone Days	100.0%		100.0%
		Total		Count	14		14
				% within Longer term decrease Drive Alone Days	100.0%		100.0%
				% within Longer term increase Drive Alone Days	100.0%		100.0%

In summary:

1227 cases did not make any of the changes.
Of the 379 longer term increases in driving alone, for 307 this is the only change.
Of the 229 longer term decreases in driving alone, for 205 this is the only change.
Of the 77 temporary increases, for 39 this is the only change they made.
Of the 210 temporary decreases, for 124 this was the only change they made.
There are 24 cases who made a longer term decrease, and temporary increase.
There are 72 cases who made a longer term increase and a temporary decrease.
There are 14 cases which temporarily decreased and increased driving alone.

B. The Influence of the Fix

B1. The Role of the Fix in Temporary Changes

The Waves 1 and 2 surveys asked respondents about general changes made to their commutes and at the same time asked if these changes were made *because* of the Fix. Only for changes made because of the Fix, the survey next asked more detailed questions about the changes, including the number of days for which the change was made, and what respondents would have ordinarily done instead (i.e. what mode they would have used). Since the detailed information about each change was important for determining whether an increase or decrease was made specifically *to drive alone commuting*, for most temporary changes identified in this study the Fix was necessarily an influence on the change (because those details were not collected for changes not influenced by the Fix). In contrast, the Wave 3 survey first asked respondents what types of changes they made and later asked whether the Fix was an influence for each type of

change in turn, among a list of other possible factors influencing the change in question. This structure of the Waves 1 and 2 surveys applies to all reported changes except increases in the number of commute days: it was assumed, as a reasonable survey design simplification, that individuals would not, because of the Fix, increase the number of days they commute, and thus Waves 1 and 2 did not ask whether respondents increased their number of commute days (but Wave 3 did). In the Wave 3 survey there was also a blanket question about the role of the Fix for *any* changes reported.

In total, 18% of the sample (365 out of 2012) made one or more temporary changes, and of those, the Fix had an influence in 74% of these changes (270 out of 365). However, as explained above, the sample overrepresents the influence of the Fix on temporary changes, given that only Fix-related changes could be properly classified in Waves 1 and 2. In fact, of the 270 cases for which the Fix was identified as a factor in the decision to change commute patterns, 130, or roughly half, are cases for which the influence of the Fix was determined based on the necessary report that the Fix was an influence, in the Wave 1 and 2 surveys.

Figures B1 and B2 show the shares of individuals making temporary decreases and increases in driving alone that were influenced by the Fix. Note that there is some overlap of the cases in each figure, since 38 cases, or 10%, reported both increases and decreases – whether in the same wave (this is possible since Wave 3 changes could have been made at any time over the six months, and since during Waves 1-2 individuals could theoretically skip a commute day that would normally be driving alone, but at the same time, switch a second commute day from another mode *to* driving alone) or across the three waves – and are present in both Figures B1 and B2. Each figure shows the total number of cases increasing or decreasing which were influenced by the Fix, and a breakdown of within which wave those changes and the influence of the Fix were reported. Eighty-one percent of all temporary decreases and 66% of all temporary increases were influenced by the Fix.

Figure B1: Shares of Temporary Decreases in Driving Alone Influenced by the Fix (N = 281)[a]

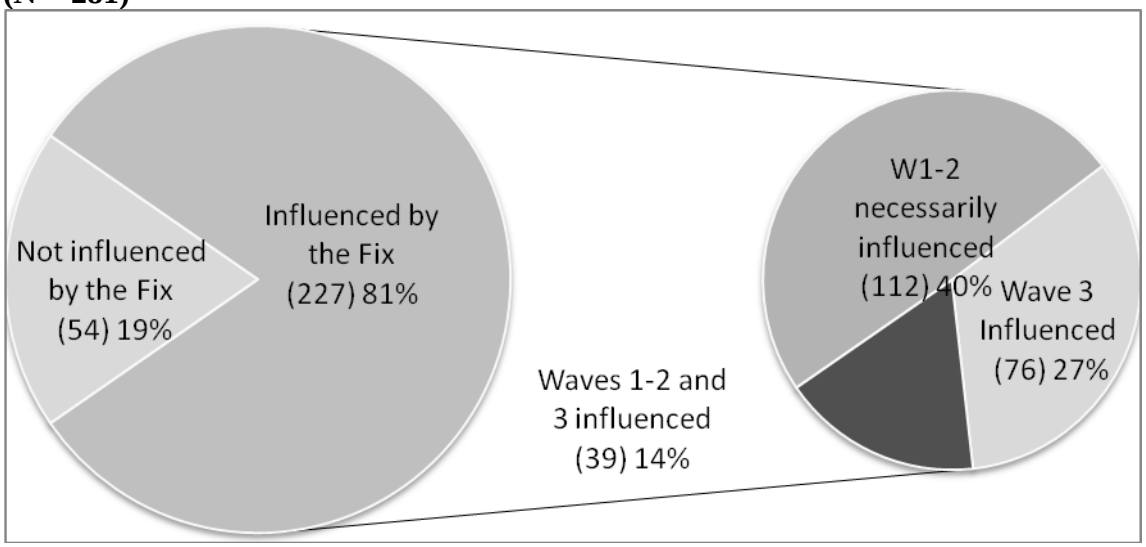
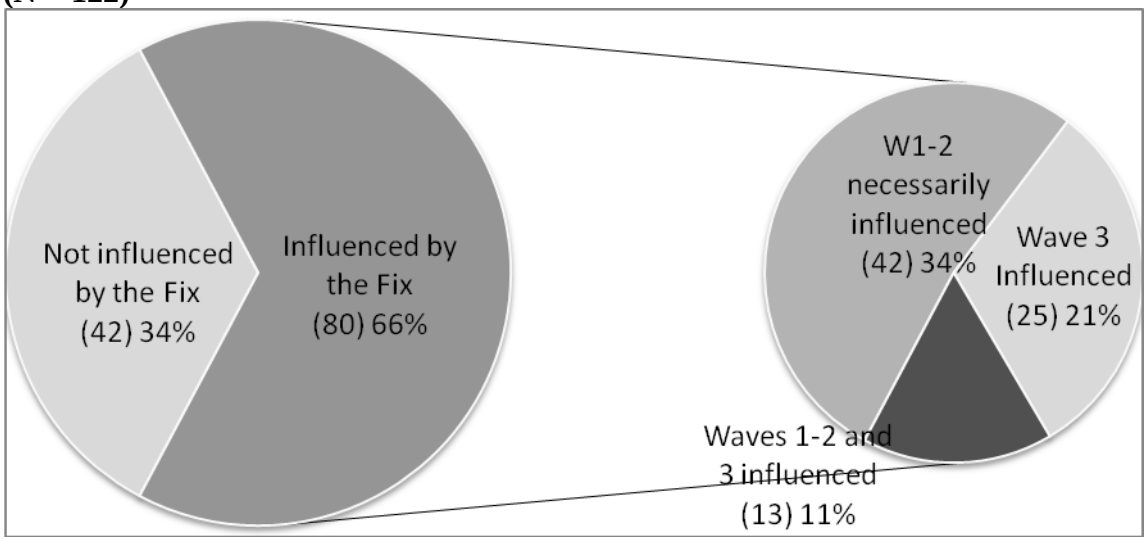


Figure B2: Shares of Temporary Increases in Driving Alone Influenced by the Fix (N = 122)[b]



It is important to keep in mind that in both figures all of the changes which were not influenced by the Fix are changes which were reported in only Wave 3 of the survey.

B2. The Role of the Fix in Longer-term Changes

The longer-term changes in drive alone commuting identified in this study are less dependent on responses related to the Fix given in Waves 1 and 2 of the survey. Recall that longer-term changes could be identified in two ways: by comparing the baseline commute patterns between the first two waves and Wave 3, and by changes reported in Wave 3 as representing something done differently "now (January or February 2009)" compared to "last spring (April, May, June 2008)".

If individuals reported such changes in Wave 3, they were asked if those changes were made because of Fix I-5. Roughly half of the changes identified by the first method (comparing reported baseline drive alone commute days) were not reported in Wave 3[5], and therefore these individuals did not directly report the influence of the Fix. For these individuals, we can only consider the influence of the Fix on any temporary changes they made. Note that here, temporary and longer-term changes of the same type are allowed for the same individual since we want to know whether an initial temporary change which was influenced by the Fix is maintained in the long term. Once the influence of the Fix is determined, temporary and longer-term changes of the same type are compared, and any temporary change which became longer term is only considered a longer-term change.

[5] This could arise from a number of different reasons, reporting errors and memory lapses being two likely ones. But the discrepancy could also arise legitimately if, for example, respondents made multiple changes to their commute patterns during April – June 2008, and used one benchmark for reporting their "typical" baseline commute pattern in Waves 1-2 and a different benchmark for reporting a change from the "typical" in Wave 3.

Figures B3 and B4 present the shares of longer-term decreases and increases that were influenced by the Fix; 30% of the sample (608 out of 2012) made a longer-term change to the number of days they commute by driving alone. Although the Fix is indicated as an influence for roughly one quarter of the longer-term changes, some of these are necessarily influenced by the Fix in that the influence of the Fix was reported during Wave 1 or Wave 2. Further, for one half of the longer-term changes, we have no certainty about whether or not the Fix was an influence (because Waves 1 and 2 did not help determine whether the Fix was an influence, the Fix was not reported as an influence for any of the relevant specific changes in Wave 3, and the blanket question about the influence of the Fix in Wave 3 was not answered[6]), and we have 22 cases who reported making "no changes" at all when asked about the influence of the Fix, even though they had indicated making longer-term changes earlier in the same (Wave 3) survey. Thus, the influence of the Fix is clearly only imperfectly captured, although the direction of any bias is not certain.

Accordingly, if we tried to model the adoption of specifically *Fix-related changes* (as we had originally planned to do), we would face two problems: the potential misclassification of an unknown number of changes as "not Fix-related" (or else the exclusion of the 310 cases for which the role of the Fix is unknown), and the small shares of changes that *can* be identified as Fix-related (70 out of 2012 or 3.5% for longer-term increases[7], and 60 out of 2012 or 3.0% for longer-term decreases), both of which make modeling those shares more difficult and less useful. For these reasons, we chose to model the adoption of changes for any reason, not just those occurring because of the Fix.

[6] However, given that all three of these conditions would have had to be true in order for us not to be able to classify the change as Fix-related, we speculate that most of the unclassified changes were *not* made because of the Fix, and thus that the shares presented are relatively accurate proportions for this sample.

[7] The fact that Fix-related longer-term increases in driving alone exceed longer-term decreases is unexpected, but not entirely far-fetched, especially given that both shares are small (and thus that random fluctuations in either group could have resulted in the opposite relationship). Temporary increases in driving alone are certainly plausible (carpools may have been disrupted during the Fix, some transit riders switched to driving alone – perhaps out of fear of being stranded on a bus in heavy congestion with no perceived control over the situation) and were observed in the sample, and accordingly it is not unreasonable that some of those temporary changes would have become longer-term.

Figure B3: Shares of Longer-Term Decreases in Driving Alone Influenced by the Fix (N = 229)

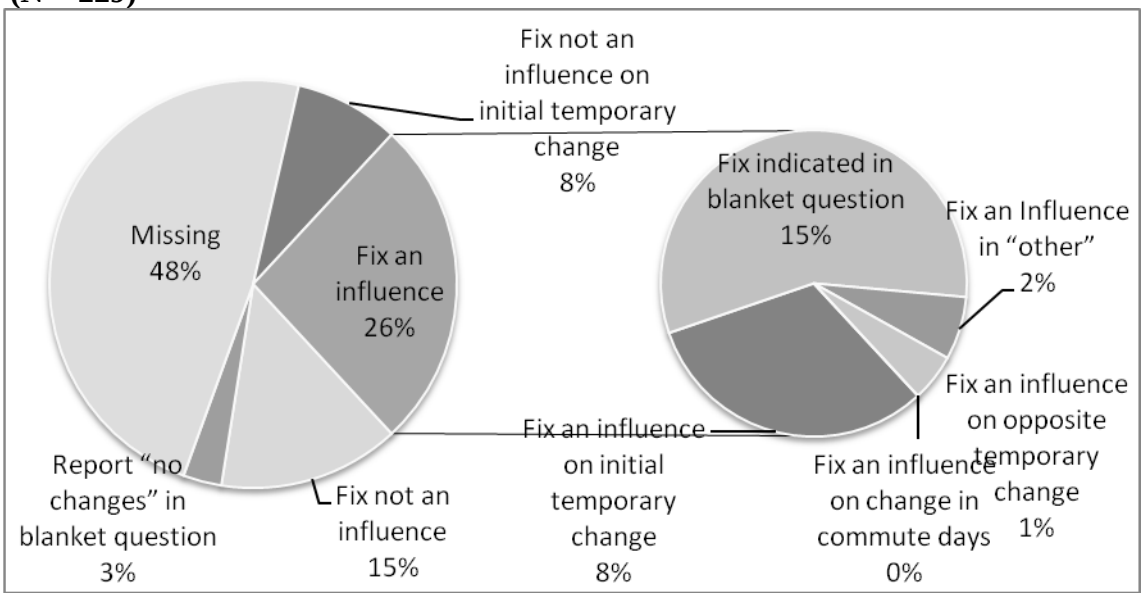


Figure B4: Shares of Longer-Term Increases in Driving Alone Influenced by the Fix (N = 379)