Modal Shifts in California from 2012-2017: Investigating Changes in Biking, Walking, and Transit from the 2012 CHTS and 2017 NHTS

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16. Abstract
This study evaluates changes in travel mode shares in California over the period from 2012, when the California Household Travel Survey (CHTS) was most recently completed, to 2017, the most recent implementation of National Household Travel Survey (NHTS). Initial review of the data suggests decreases in biking and walking over this time period. This study explores the factors contributing to this change, namely are these apparent changes the artifact of methodological differences between the analysis of the two surveys, or do they reflect real changes in the travel behavior of Californians? We also explore external factors, or changes over time that may contribute to mode share changes, such as demographic shifts or system-wide shocks such as the Great Recession. There are many differences in the preparation of the data used in the analysis across the two surveys; for example, the variables included in weighting are not the same for the CHTS and the NHTS. These differences are not found to have an impact on the outcomes of interest; however, they do suggest the need for more coordination among the NHTS and the CHTS to better enable comparative studies.

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Modal shifts in California from 2012-2017: Investigating changes in biking, walking and transit from the 2012 CHTS and 2017 NHTS

EXECUTIVE SUMMARY

This study explores factors contributing to the decrease in biking and walking in California over the period from 2012 to 2017, as observed in comparisons of the most recent California Household Travel Survey) and the California add-on sample of the National Household Travel Survey (NHTS), respectively. In this study we focus on methodological differences between the surveys as many of these differences could impact results. Interestingly, the methodological differences explored here are not found to have substantial impacts on the outcomes of interest.

Key Findings

1. The mode share changes identified in preliminary review of the data persist even when considering different performance metrics, including usual mode to work and the occurrence of walking or biking in the past week.
2. Mode shifts are larger for some groups within the population. Namely, there is a larger decrease in biking among males, and a larger shift from active modes to private vehicle use among Hispanic groups.
3. The sampling methods, recruitment process and survey instrument for both the 2012 CHTS and the 2017 NHTS are very similar overall, and not expected to yield differences in outcomes.
4. The weighting procedures differ in a number of ways. First, the geographic scale at which weighting was carried out differs. An analysis of the impacts of this difference would require the weights be reproduced for one or both of the surveys.
5. The weighting procedures for the 2012 CHTS did not include gender or variables reflecting the time of survey participation, whereas in the 2017 NHTS, gender, month and day were all included in the weighting procedures. A post-hoc adjustment applied to the 2012 data to account for this difference did not result in substantial differences in the outcomes of interest here.
6. The 2012 CHTS included data collection through GPS devices allowing for a comparison of GPS-observed and respondent-reported travel. CHTS analysts derived a trip correction factor based on the identified differences; however, the trip correction factor does not result in a substantial impact on the overall changes in mode share between 2012 and 2017.

Recommendations

For weighting procedures for future administrations of the CHTS we recommend matching the NHTS procedures to the greatest extent possible to ensure differences in weighting procedures do not impact comparisons of results between the two survey efforts.

The available documentation of the CHTS and the NHTS data processing methods has many gaps and is not sufficiently complete to enable replication of the methods. The incomplete documentation makes it difficult for anyone working with the data to know what was done and whether methodological differences might impact outcomes. This is particularly true for the treatment of loop trips and for the write-up concerning the trip correction factors.

One other area where there were apparent differences between the publicly available data and the data used for results presented in reports is travel duration or travel time. The 2012 CHTS report (Caltrans 2013) presents average distance and time for each travel mode. The time values are quite different than what could be reproduced with the available data, suggesting there was data cleaning and/or processing that was not documented in the report. Travel time weighted mode shares could not be produced with the available data, as the results suggested data cleaning is needed (for example, the maximum estimated duration of a self-reported walk trip in the self-reported 2012 data is 960 minutes, if no data processing is applied).

Finally, it would be helpful for the NHTS to make available information on respondent age. While age is identifiable information, age categories would be useful for analysis, especially since age and cohort effects are likely relevant to the changes we observe here. Next steps for this project should include a deeper look at the role of mode shifts and population dynamics of Hispanic groups.

1. Introduction

This study evaluates changes in travel mode shares in California over the period from 2012, when the California Household Travel Survey (CHTS) was most recently completed, to 2017, the most recent implementation of National Household Travel Survey (NHTS). A comparison of the CHTS results to the California add-on sample of the NHTS suggests that active travel declined over the five year period. The purpose of this study is to assess whether differences in methodology between the two surveys may explain the apparent decline and to identify factors that might have resulted in a true decline in active travel. In addressing these questions, we explore different measures of mode share, including mode share of trips, distances travelled, and the share of individuals using active modes for any travel. This report summarizes that work and provides recommendations for future tracking of changes over time as well as the measures of mode share that might be most useful to Caltrans' evaluation of bicycling and walking. The outcomes of this study may help the California Department of Transportation (Caltrans) in evaluating their progress toward their goals of tripling bicycling and doubling walking and transit.

As a starting point for the analysis, Table 1 includes trip mode shares in 2012 and 2017 for consolidated travel modes. Modes were consolidated due to differences in the mode choices presented in each survey. In general, the 2012 public transportation options could be grouped into the 2017 options. The most notable differences are in the use public transportation and private vehicles. For private vehicles, the 2012 survey did not separate out different types of private vehicles but did distinguish between the respondent as a driver or a passenger. In 2017 more vehicle types were provided but whether the traveler was a driver or passenger was contained in a different variable. Based on these differences, the best way to consolidate these mode choices was to combine them into the one "private vehicles" category. The full set of modes in each survey year and how they have been consolidated are presented in Table 3.

The values in Table 1 reflect the results available from analyses completed prior to this study. The 2012 values were reproduced to match those in the 2010-2012 California Household Travel Survey Final Report (California Department of Transportation, 2013). The values for 2017 closely match the results provided in the form of the Caltrans Code Book (Unpublished data, California Department of Transportation, 2020). Differences are presumed to be due to the slightly smaller sample available in the publicly available data from that used in the codebook. The total number of households that completed the 2012 CHTS is 42,431; with a total of 132,318,491 total household trips using all modes of transportation (California DOT, 2013). In 2017, there are 26,113 household records in the California add-on Sample to the NHTS, with approximately 185,627 trips reported (Unpublished data, California Department of Transportation, 2020).

For 2017, it was possible to compute standard errors and confidence intervals using replicates of the weights generated using a jackknife procedure (Federal Highway Administration 2018). Based on the standard errors, 95% confidence intervals were computed, and the percent change from the mode share estimates were found, and included in Table 1. Those modes with small shares have less precise estimates, likely an artifact of the jackknife procedure used.

However, the modes we are most interested in—driving, walking, public transit, and biking—have larger shares and smaller margins of error. The available data/methods did not allow for the construction of confidence intervals for the 2012 data. However, if we assume that the confidence intervals (showing the likely range of the share for each mode) would be similar to that in 2017, we can examine the changes in mode share with this in mind.

Results of the 2012 CHTS indicate that for trips overall, shares of biking and walking were 1.53% and 16.17%, respectively, while the 2017 NHTS results show a reduction in these shares to 1.34% for biking and 12.97% for walking. In addition, the use of public transit has trended down over this period, from 2.91% to 2.09% for all types of local bus and from 0.99% to 0.81% for rail-based forms of transit, excluding Amtrak and commuter rail. These shifts appear to be balanced by an approximate 3.5 percentage point increase in the use of private vehicles, and a 0.4 percentage point increase in the use of hired vehicles as well as a small increase in the use of commuter rail and Amtrak. The values presented in Table 1 are weighted to account for population distribution and demographics at the time of each survey; the weights provided in the publicly available data are applied to produce the values in this table.

Table 1. Weighted Mode Shares for Consolidated Travel Modes

Grouped Modes (for Consistency)	Weighted Count 2012*	Weighted and Expanded Count 2017*	Standard Error 2017	Confidence Interval 2017 (as percent)	Weighted Share 2012	Weighted and Expanded Share 2017	Percent Change in Share from 2012 to 2017
Airplane	382.22	49934754.09	7869595.28	+/- 31%	0.10%	0.16%	60%
All local bus types	11333.97	664094446.1	53379947.60	+/- 16%	2.91%	2.09%	-28%
Amtrak; bus and comm rail	488.45	88589610.79	7809818.36	+/- 17%	0.13%	0.28%	115%
Bicycle	5943.11	427724099.4	25364963.18	+/- 12%	1.53%	1.34%	-12%
City-to-city bus	7.37	6405980.756	1758594.57	+/- 54%	0.00%	0.02%	0%
Ferry or boat	56.05	21749519.7	5523833.42	+/- 50%	0.01%	0.07%	600%
Metro, rapid, trolley	3830.83	259048386.3	12565597.76	+/- 10%	0.99%	0.81%	-18%
Motorcycle	873	83704147.59	20198827.09	+/- 47%	0.22%	0.26%	18%
Paratransit	258.27	35056481.67	11697823.71	+/- 65%	0.07%	0.11%	57%
Private shuttle bus	603.71	78035341.49	11112452.84	+/- 28%	0.16%	0.25%	56%
Private vehicle	297614.56	25454330265	202567922.00	+/- 2%	76.52%	79.97%	4%
Rental	606.76	44313791.24	8105122.16	+/- 36%	0.16%	0.14%	-13%
School bus	2400.33	212837711.1	24656886.63	+/- 23%	0.62%	0.67%	8%
Something Else	1248.08	107370506.7	13824083.38	+/- 25%	0.32%	0.33%	6%
Taxi or hired car	421.28	170656177.3	27394288.19	+/- 31%	0.11%	0.54%	391%
Walk	62879.18	4127847356	124691548.60	+/- 6%	16.17%	12.97%	-20%

*Counts are weighted and therefore not whole numbers. 2017 values are expanded, 2012 are not.

1. Weights applied here are contained in the data used for this analysis; new weights were not computed here. For details on the weighting procedures, see section 3. methodological differences.

The percent change from 2012 to 2017 (i.e., the percent increase or decrease over/under the 2012 share of the 2017 share) for each mode is represented graphically in Figure 1. Most changes are less than about a 20% increase or decrease in mode share. For ferry/boat and taxi and hired car the changes are many fold. For taxi and hired car, this is not surprising as there has been steady growth in the use of on-demand ridehailing services, such as Uber, over this time period.

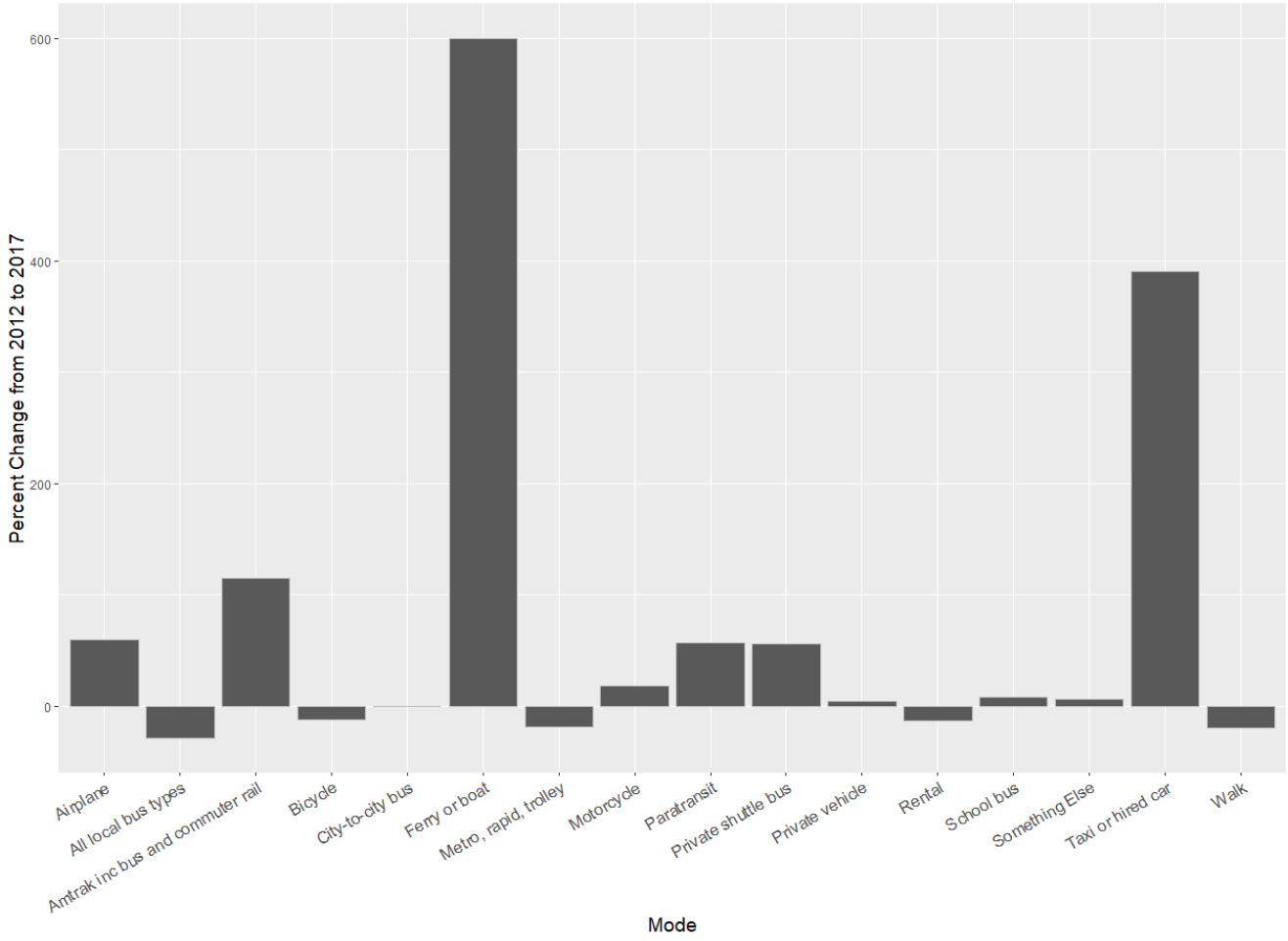

Figure 1. Percent Change in Mode Shares in Preliminary Review of Data from 2012 to 2017

Although there is some uncertainty in the values, for the modes focal to this study (biking, walking and transit use) we have 95% confidence that the true values are within 6-16 % of the estimated mode shares. Even if the true values are at the extreme margins of these intervals, we would still see a decrease in walking (i.e., adding 6% to the 2017 value, and subtracting 6% from the 2012 value), though we would see more of a flat line for biking and transit use.

If we consider the changes in mode share to represent real shifts in the use of active travel modes, we would consider the effects of factors known to influence mode choices. These factors could include changes in the socio-demographics of Californians over this period; notably there has been a decrease on the white population share and an increase in the share

of Hispanic Californians. This change may be related to shifts in where people live; with growing portions of the population located in suburban areas or urban fringe areas that are farther from commercial and job centers, and likely to have lower quality bicycle and pedestrian facilities. Other relevant factors might include larger portions of the workforce represented by older individuals, who are less likely to travel by bicycle and walking as they age. In addition, there could be changes as Millennials mature and shift away from biking and walking and towards private vehicle use. That is, shifts in race, geographies, and age may be affecting mode shares.

A related influence on mode shares could be lingering impacts of the Great Recession of 2009 that could have impacted the 2012 CHTS results. During the recession, there were increases in walking and biking in response to higher gas prices and unemployment rates, among other things (Beuhler et al. 2020). Although economic recovery happened fairly quickly, there may have been slower return to the purchase of vehicles, and the trend away from the observed increases in walking and biking.

These changes in mode share could also be the result of methodological differences between the two survey years. Methodological differences occur in the sampling and survey administration, as well as during the data processing and analysis stages. The survey implementation for each year was reviewed, and we explore the impacts of notable differences. The primary difference in the implementation is that some households in 2012 had mobile GPS units recording their travel activity, in addition to their self-reported travel diaries.

Post-survey data processing can also have an impact on results. First, the use of GPS units in the 2012 CHTS allowed analysts to observe differences in self-reported versus GPS recorded trips. Differences were evaluated, and tendencies for trips to be over- or under-reported based on trip and traveler characteristics were determined. Following this process, trip correction factors were computed and applied to the entire data set. The other difference in data processing involves different processes of weighting. While there are small differences throughout the process, these are not expected to have large impacts on results as the same socio-demographic characteristics were used both years. In this study we evaluate the impacts of weighting differences including the incorporation of time and gender in 2017, but not in 2012.

In the next section we provide an overview of potential events, demographic shifts, and other factors that may impact mode use and therefore lead to these changes over time. In section 3 we evaluate the methodological differences between the survey years and the related impacts on results. Section 4 presents a number of alternatives for measuring mode shares and mode share changes to be considered as potential performance metrics. Finally, in section 5 we dig deeper into the potential impacts of shifting demographics and other factors by through a closer examination of descriptive statistics.

2. Background

Trends in Biking and Walking

There is a body of research tracking changes in biking and walking using the NHTS datasets over time. The last three iterations of the NHTS offer some insight into the changes observed over the period from 2012 to 2017, in California. In one review of changes in active modes over time, Le et al. (2019) point out that such studies vary in the metrics used to evaluate changes, as well as the scale of analysis (ranging from neighborhoods to the national level). These methodological differences could result in different outcomes. This study shows peaks in walking and cycling in 2009, when examining results from the 2001, 2009, and 2017 NHTS datasets (Le et al. 2019).

The Le et al. (2019) study finds an increase in bicycle and pedestrian traffic counts over the period from 2004 to 2016, while controlling for baseline infrastructure and other conditions, and allowing the type of facility and weather to vary by year. They also note that looking at ACS data for the same period, bike/ped travel seems to level off, although NHTS data indicates a decrease. In addition, the presence of bicycle facilities is important in the bike models, but the central finding is that bike and walk counts increased over time.

Some geographically specific studies find similar trends; increases in the use of active modes, such as walking; over the period from 2001 to 2009 an increase in walking is found using data collected by the Southern California Association of Governments in 2001 and the 2009 NHTS data (Joh et al. 2015). A Seattle-based study finds bicycle counts increase over the period from 2011 to 2015 using data collected at 50 sites throughout the city, four times each study year (Chen et al. 2017). This study also finds that bicycle infrastructure is relevant as well as the presence of bodies of water, and, understandably, flatter terrain (Chen et al. 2017).

Though these results show an increase in biking and walking over the period ending in 2009, Buehler et al. (2020) use only the 2001 and 2017 NHTS data to evaluate trends in biking and walking. The authors note that during the recession (2009), there were increases in walking and biking in response to higher gas prices and unemployment rates, among other things (Beuhler et al. 2020) and that trends including 2009 as a (end) point might not reflect background, or longer-term shifts in mode use. Taking the period from 2001 to 2017, this study finds that walking rose slightly while biking remained relatively stable. A few key factors: higher levels of education, lower car ownership, and high-density neighborhoods are factors associated with increases in walking. In addition, walking and cycling were lower among 5–15-year-olds in 2017 than 2001 while walking and cycling increased among other groups (Buehler et al. 2020). While our study suggests a decrease in the period from 2012 to 2017, this is a short period within the timeframe explored in the Beuhler et al. study and should not be viewed as a contradictory result.

Other work exploring factors influencing active mode use with the 2017 NHTS data found that among the top factors were population density, availability of different modes at the household level (and household vehicle count separately), household income, and household size and

number of trips (Tribby and Tharp 2019). Barriers to bicycling more among the participants in the 2017 NHTS include safety and infrastructure needs, as perceived by participants (Porter et al. 2020).

Factors Affecting Trends

Beyond the Great Recession of 2009 there are not many clear factors that contribute to these trends over time. Factors that might be associated with shifts in biking and walking are expected to be changes among the factors known to be important to biking and walking. These might include shifts in where people live and the quality of bicycle and pedestrian facilities available to them (even if infrastructure itself has not changed substantially, where people live in relation to it might change), demographic changes that are large enough to be reflected in population level shifts in mode use, and cultural or social changes that might be driving mode share changes.

In addition, there is an increase in the use of shared use mobility services; modes such as Uber and Lyft, and a growing body of evidence that ridehailing adopters would have used active modes, or public transit, had ridehailing not been available (for example Metropolitan Area Planning Council 2018). These modes could be attracting previous pedestrians and cyclists. There is some evidence that Uber and Lyft are replacing trips that would have otherwise been made by transit (Clewlow and Mishra 2017). In addition through the replacement of trips made with alternative modes, it is estimated that these services will add billions of miles of VMT across major U.S. cities (Schaller 2018).

Shaheen et al. (2018) distinguish between three interrelated sets of factors into which we can organize much of what concerns the present study. These are period effects, related to things like the shifts in demographics, and/or the Great Recession. In addition, they identify lifecycle, or age effects that relate shifts in activities or mode choices that occur during different stages of life, and cohort effects that are changes among members of a specific generation.

One major shift in California's demographics over the time period of interest here is the shift in the proportion of the population that is Hispanic. In 2000, 47% of California's population was white while 33% was Hispanic, but by 2018 37% was white and 39% was Hispanic (Public Policy Institute of California). What these changes can tell us about changes in mode shares may be critical to how walking and bicycling are encouraged for Californians in the future. Further, more than a quarter of California residents are immigrants, another factor that could play a role in travel behavior. As this number grows, the impacts on travel behavior may become even more pronounced.

Although immigrants including Hispanic populations are more likely to use alternative modes (Tal and Handy 2010), as these residents have a longer tenure in the U.S., they shift to more driving, and this assimilation may cause changes in mode shares (Blumenberg 2009), especially when immigrant or minority groups make up a larger portion of the population. It is possible these shifts have become more pronounced since Blumenberg's study, or it is possible that as the population has increased these patterns are more observable in data such as those used

here. An important note here is that the Hispanic population includes both immigrants and native-born Hispanic individuals.

Other major topics that are growing coverage in the travel behavior literature include cohort impacts, or the ways that different age groups travel—and this could impact outcomes in two ways. First, through the distribution of the population, and the working population specifically that are in different age groups. Second, through lasting changes made by members of a particular cohort or generation. There are mixed results about whether travel behavior patterns of Millennials will stick, or if this generation will travel more like older generations in the years to come.

Some current differences among cohorts include a drop in the rate of possession of a driver's license among specific age groups; for example, the number of 19-year-olds with a license decreased by 18% over the period from 1983 to 2014 (Schoettle and Sivak, 2016). However, other work accounting for a variety of factors in travel behavior changes found that the only one that seemed to actually matter is socio-demographics, even when including cohort and period effects (Da Silva et al. 2019).

Another possible generational effect might be that more baby boomers are working for longer than other generational groups at similar ages to the baby boomers current ages (i.e., more people in the 60-70 year old age group are working, and thus commuting.) And these older age groups are less likely to bike and walk, and for shorter distances (Shaheen et al. 2018) and potentially less likely to bike and walk for their commutes, even if they might have at younger ages. In the descriptive statistics section of this report, we explore how these factors relate to changes in the mode shares over time.

3. Methodological Differences

There are differences in the methods between the two survey years that may contribute to the differences in mode share estimates. These include sampling methods, the modes of survey recruitment and participation (retrieval), and the content of the questionnaires, i.e., how questions are asked and what response options are provided. In addition, there are different methods used to process, weight, and analyze the data once it has been collected. In this section we identify the differences that could impact outcomes and evaluate whether and how to account for any of these differences when analyzing changes in mode shares between 2012 and 2017. In addition to differences between these two surveys, for the 2017 NHTS we also identify notable changes from past implementations of the NHTS. For each potential difference, we provide a discussion of the expected impacts on outcomes, and relevant analyses.

Survey Recruitment and Implementation

Different survey delivery methods and questionnaire modes can result in response rate variations across groups of interest and/or other biases in the data. While there are some differences in the two survey years, they are not substantial, and thus not expected to meaningfully impact results. A summary of survey recruitment and retrieval methods are

presented in Table 2. One primary difference is the use of GPS data collection in the 2012 CHTS. This difference is more relevant to data processing outcomes, and is discussed in more detail below, in consideration of the trip correction factor.

The most notable difference in recruitment and retrieval is that the NHTS offered small incentives in recruitment materials sent out to participants, whereas the CHTS only sent incentives to those households that did participate. This small difference in the delivery of incentives is not expected to have a large impact.

Table 2. Survey Recruitment and Retrieval Methods

Survey Stage	2012 Methods	2017 Methods
Recruitment	Delivery by mail with participation by phone or online	Delivery by mail, paper survey and mail back; online and telephone available if requested ($2 incentive) Follow up recruitment mailings to non-responding households included instructions for how to participate online or by telephone
Travel Log or Retrieval	Mail delivery or packet or box (for GPS participating households). Reminders by email, phone or text where possible. Participation online, by phone or mail back	Delivery by mail ($5 incentive) Email and phone or text message reminders when possible Participation online, by telephone or a combination
GPS Component	Subset of households with wearable, in-vehicle, or in vehicle with on board diagnostic	None
Language	Survey administered in Spanish and English	Survey administered in Spanish and English

Survey Instrument

The fundamental goal of both surveys is to gather all travel information for every member of each participating household, over a 24-hour period. Thus, the content of the surveys, and the format of the questionnaires is very similar, though there are some differences that have the potential to impact the outcomes of interest to this study.

Travel Modes

One difference between survey years is the set of mode choices; presented in Table 3. For bike and walk, two of the modes of interest here, there is not a difference in the way they are presented in the two surveys. Therefore, there is no expected difference in the correct selection of these modes either for specific trips, or for other questions asking about their use.

There are differences in the transit options presented; namely in the 2012 CHTS the transit options were delineated with much more detail than in the 2017 NHTS. The California specific survey allows this type of specificity which is not possible at the national level. The transit options in the 2012 CHTS can largely be consolidated into the options in the 2017 NHTS.

The other key difference in the presentation of travel modes is in private vehicles. The 2017 survey includes many different vehicle types as separate modes (Pickup truck, Car, SUV, and Van are each listed separately) but does not ask the respondent to specify whether they were a driver or a passenger as a component of the mode choice question. In 2012 the mode choice question does ask whether the traveler is the driver or passenger but does not include each vehicle type as a different mode; Auto/Van/Truck are listed as one mode option.

Table 3. Original Modes as Compiled into Consolidated Modes

Consolidated Mode	Mode Choice in 2012	Mode Choice in 2017
Airplane	Plane	Airplane
All local bus types	Airbart /LAX Flyaway, Other Bus, Public Transit Shuttle, Rapid bys, Express Bus / Commuter Bus (Golden Gate, AC Trans), Local Bus, Rapid Bus	Public or commuter bus
Amtrak including bus and commuter rail	Amtrak Bus, Ace, Amtrak, Caltrain, Metrolink, Coaster/Sprinter, Other Rail	Amtrak / Commuter rail
Bicycle	Bike	Bicycle
City-to-city bus	Greyhound bus	City-to-city bus (Greyhound, Megabus)
Ferry or boat	Ferry / Boat	Boat / ferry / water taxi
Metro, rapid, trolley	Other Rail, Metro Orange / Silver Line, Bart, Metro Red / Purple Line, VTA, Muni Metro, Blue/Green/Gold Line, Sacramento. SRT, Street Car / Cable Car / Trolley	Subway / elevated / light rail / street car
Motorcycle	Motorcycle / Scooter / Moped	Motorcycle / Moped
Paratransit	Dial-a-Ride / Paratransit (Access Services)	Paratransit / Dial-a-ride
Private shuttle bus	Private Shuttle (Supershuttle, Employer, Hotel), Other Private Transit	Private / Charter / Tour / Shuttle bus
Private vehicle	Auto / Van / Truck Driver, Auto / Van / Truck Passenger, Carpool / Vanpool	Pickup truck, Car, SUV, Van
Rental	Rental Car / Vehicle	Rental car (Including Zipcar / Car2Go)
School bus	School Bus	School bus
Something Else	Other private, Wheelchair/ Mobility scooter, Other Non Motorized	RV (motor home, ATV, snowmobile), Golf cart / Segway
Taxi or hired car	Taxi / Hired Car / Limo	Taxi / limo (including Uber / Lyft)
Walk	Walk	Walk

Loop Trips

Next, we consider "loop trips", or trips that start and end at the same location. The 2017 NHTS differed from past iterations of the NHTS since it asked respondents to report trips as loop trips and provide the total trip distance in miles or in blocks. In previous years for loop trips, respondents were asked to report the furthest distance they travelled, away from the trip start/end location. According to the 2017 survey report (Westat 2018), this may result in fewer trips than previous versions of the NHTS, and this change has been cited as a potential reason for a downward trend in the bike and walk mode shares from 2009 to 2017 (Le et al. 2019).

In the 2017 data processing description, loop trips are addressed as follows: "The majority of edits performed applied to cases when reported trips did not meet the definition of a trip (e.g., a loop walk trip for exercise or for walking the dog, walk trips to access or egress from public transit), in these cases the trip was removed." (Westat 2018 p. 23). However, an examination of the data reveals that the loop trips have not been removed.

In 2012, loop trips should have been reported whenever their purpose (e.g., exercise or walk the dog) was not tied to the purpose of the previous trip. Loop trips made from home were considered valid trips, however a walk trip made in a park, after driving to the park, was not.

Loop trips observed in the GPS data for 2012 were compared to respondent reported loop trips. A total of 2,637 loop trips were identified, 1,969 of which were reported by participants. Further, 3,797 other non-transportation or on-site trips were found that were not required to be reported. Any GPS-recorded loop trips (work-related, external to external, and on-trips such as on a campus) were removed for the analysis used to define the trip correction factors. This included trips that were work-related, external to external, loop and on-site travel trips were removed if they did not have matching reported trips. Loop trips were not removed from the data otherwise; as they are still present.

For both 2012 and 2017 the documentation related to loop trips was not completely clear. However, the data for both years contain loop trips. It is beyond the scope of the present study to re-evaluate trips to determine whether some subset of loop trips should be removed. Here, we consider the removal of all loop trips. For both years, removing the loop trips results in a shift in mode shares. Shifts in mode shares are minimal, though some are notable. In 2017 there is an approximate 1.5% shift away from walk trips to private vehicle trips, and in 2012 there is an increase in the share of bicycle trips and the share of private vehicle trips, but a reduction in the share of most transit trips and in walk trips. These shifts in mode share correspond with the modes used most frequently for loop trips. Since these differences are small, and the loop trips seem to be treated similarly in each year, loop trips are retained in our analysis.

Trip Distance

In 2017 Google Maps was used for routing the shortest path for motorized travel on the road network. Non-motorized modes, like walk and bike, had the shortest path calculated using

network routes paths. Shortest path distances were generated by the Google Maps API. These distance estimates are provided in the trip file for all reported trips. This method of estimating trip distance is different from past iterations of the NHTS and may result in impacts to outcomes when comparing the 2017 NHTS data to outcomes of previous implementation of the NHTS (Lawson 2018).

In 2012 a software called TripBuilder was used. This is an interactive mapping tool, that uses Google Maps. TripBuilder was used in the online survey as well as in the CATI survey. Participants would first input the locations they travelled to, and then re-construct their travel for the day. They were shown a google map of each trip as it was entered, and though the report does not state this explicitly, the trip distance is presumably calculated through Google Maps shortest path. Participants could select to use Google Transit for transit trips.

Ultimately, both the CHTS and the NHTS used the Google API and Google Maps to estimate trip distances. This was done either by respondents themselves as they recorded trips in the online systems, or by interviewers assisting with telephone survey responses. Since trip distances are determined in similar ways, we do not expect a difference in trip distance estimation to result in substantial effects.

Walking and Biking

One aim of this study is to evaluate how the use of different performance measures for walking and biking may produce different results. The key methodological difference related to walking and biking is that in 2012 respondents were asked if they had made any trips by walking, biking, and transit in the past week. In 2017, this question was also asked, and in a second question they were asked how many of those trips were for exercise. The following are displayed as they are presented in survey documentation:

> In the past 7 days, how many times did [you] ride a bicycle outside including bicycling to go somewhere or for exercise?
>
> How many of these bicycle rides were strictly to exercise? but they were also asked if the trip was for exercise.

In the 2012 survey respondents were told to include all trips for walking and biking. The survey question looks like this:

> In the past week, how many times did [you] [this person] take a walk outside, including walking the dog and walks for exercise? [RANGE: 0-50] Please enter the number of walks taken in the past week. 98 I do not know 99 I prefer not to answer
>
> In the past week, how many times did [you] [this person] ride a bicycle outside, including bicycling for exercise? [RANGE: 0-50] Please enter the number of bicycle rides taken in the past week.

Similar questions were asked in each survey for transit use, however in 2012 the question asked about transit use in the past week, whereas in 2017 the question asks about transit use in the past 30 days. The impacts of this difference are discussed below, in the evaluation of the use of different performance metrics.

Weighting Procedures

Both the NHTS and CHTS employ weighting procedures to produce population level estimates for a number of outcomes of interest, such as the total number of daily trips, and annual VMT. This section describes the procedures used in each survey year to produce the final weights used in the analyses and includes an evaluation of the impacts of any notable differences.

Sample and Recruitment

Sampling strategies are designed to minimize disproportionate representation from geographic areas, household types, or respondents with different characteristics. Where disproportionate representation does occur, it may be addressed through weighting procedures, to estimate representative statistics for the population, based on the sample of respondents that ultimately participate. There are differences in the way weighting was carried out, and the variables used in the weighting procedures for the two survey years, that could impact the outcomes of interest to this study. Since weighting aims to address the imperfect nature of sampling, this section begins with a review of thee sampling strategies used in each year.

The 2017 NHTS used address-based sampling, with address information obtained from the USPS based list of the firm Marketing Systems Group. (This differs from past iterations of the NHTS that used Random Digit Dialing sampling procedures.) The address list was updated on a monthly basis, and survey sampling was based on addresses available in January and September 2016. The addresses to which the surveys were distributed were stratified by Metropolitan Statistical Area (MSA), information related to population size and the availability of heavy rail. Addresses were grouped into the following strata:

- MSAs with access to heavy rail transit and more than 1 million people,
- MSAs with more than 1 million people but no access to heavy rail transit,
- MSAs with fewer than 1 million people, and
- Non-MSA addresses (i.e., rural areas or small towns).

Households were randomly selected from each strata to receive survey recruitment materials. Prisons, medical facilities, fraternities, sororities, and dorms are excluded from the sample. In addition to the national level sampling strata, the California add-on included households from each of eight county groups, with the number of recruited households proportional to the county group's population. The county groups were also subdivided into the federal strata, such that there were one to three subgroups in each county group, resulting in a total of 16 strata in California for the NHTS.

The 2012 CHTS survey was also sampled based on addresses, though they used a different vendor (name was not provided) to gather addresses. For the CHTS, additional information

from the vendor was used to identify and oversample households that were considered hard to reach. A stratified random sample that was disproportionate to the distribution of households by county of residence was drawn. The four hard to reach groups were:

- large households (i.e., 4 or more member households)
- low-income households (i.e., households with annual income less than $25,000)
- younger population (i.e., 25 years of age or less)
- Hispanic population
- zero-vehicle households

Overall, the CHTS used thirty sampling strata, and oversampled in the groups noted above. In the 2012 sample there were also special targeted groups that were not recruited through a probability-based sampling procedure and are therefore not weighted based on the probability of being selected. These include a set of households selected by the California Energy Commission drawn from two sources: a 2009 database from the Department of Motor Vehicles (DMV), and a vehicle owner database from the University of California at Davis. In addition, an intercept sample was conducted among Kern County transit users.

The 2017 NHTS survey was conducted from March 31, 2016 through May 8, 2017. The first assigned Travel Day was April 19, 2016 and the last assigned travel date was April 25, 2017. In 2012, the CHTS was started on February 2, 2012, and the final surveys were collected February 14, 2013. Each survey collected responses for one year.

Though there are differences in the sampling strategy, both used stratified random sampling, though the basis for the strata were not identical. With some exceptions discussed below, disproportionate representation in the final samples is largely addressed through the weighting procedures for each year.

Sample Weights

In the 2017 report on the weighting procedures, it is noted that in 2009 household characteristics collected in the recruitment survey were found to be related to participation in the retrieval survey. The 2017 base weights incorporate this finding to generate weights that produce the most accurate estimates possible (2017 weighting report).

Both the NHTS and CHTS weighting begin with weighting each household based on the probability of being selected. This “base weight” is equal to the inverse of the probability of being selected and can vary across strata. Though we do not go into the details of this process here, both are based on the evolving sample, and set of addresses available during survey implementation to inform each iteration of recruitment and retrieval. This is noted in the 2012 report; weights were computed based on an evolving sample, and for each household the probability of being selected is based on the sample being used at the time the household was recruited; this was evolving over the course of the survey period.

The 2017 household weights raking process used: heavy rail strata, race (black or not), Hispanic status, home ownership, number of household vehicles, month, day, and combined values

using household size and number of household workers. The NHTS data was also adjusted to allocate the responses based on the 12 months of the year and 5 or 7 days of the week for the 5-day and 7-day weights, respectively. Five-day weights excluded Federal Holidays.

One other potentially relevant difference in the weighting procedures is the geography at which weights were applied. In 2017 weights were apparently adjusted at the 16 strata used in sampling, whereas in 2012 they were adjusted to match state level distributions.

Person weights were based on the geographic factors: heavy-rail adjustment, race (black or not), Hispanic status, combined factor for age and gender, pairs of months, and days of the week. Trip weights also incorporate the travel day, to represent an annualized weight.

In 2012 the final weights were developed at the county level, but demographic controls were balanced at the statewide level only. Ultimately weights were computed by county. Further, samples for the Energy Commission were equal to 1, and drawn from specific sampling frames. Weights were also computed for the groups that were oversampled—those six listed above and a transit oversample group.

In 2012 the raking process used a set of demographic variables: household size, household income, number of workers, number of vehicles, county of residence. These were balanced using statewide distributions, a potentially important difference from the 2017 process (however, these differences can only be evaluated by producing new weights for one or both of the datasets and examining the effects on the data). Once the weights were finalized, an expansion factor was used to bring the total up to the total number of households in the state. This is one factor for all households but used in conjunction with the weights. Person weights were raked using Hispanic status, ethnicity, age, employment, and county of residence. These were all using the state distributions. Final weights were expanded. Unlike the 2017 weighting procedure, in 2012 they did not include gender or day and month in the weights.

Finally, for the 2012 CHTS, trip correction factors were applied to the data, in order to reflect differences between the trips reported in travel diaries and trips observed through GPS data collection. These were computed from data at the statewide level and applied at the statewide level only.

Overall, the weighting procedures for the two survey years are quite similar, though there are a few differences that warrant further evaluation. These include gender; gender was included in the 2017 weights, but not those of 2012. Similarly, day and month were included in the 2017 weighting procedures, but not in 2012. Finally, we evaluate the impacts of the trip correction factors applied to the 2012 data.

Gender

Gender was incorporated in the weighting procedures in 2017, but not in 2012. In this section we evaluate the impact of this difference, by adding a post-hoc gender adjustment at the person level to the 2012 data. As a starting point, we note that a Chi-squared test result indicates there is a significant difference ($p < 0.001$) in the mode shares for trips made by males

and females in the 2012 data. For example, only 1.0% of trips made by women were by bicycle, while bicycle trips accounted for 2.4% of trips made by men. Though these differences are expected, and do not on their own suggest a need for weighting, it does indicate that without proper weighting there could be a bias in trip mode shares, if men or women are disproportionately represented.

A preliminary look at the unweighted data from both years indicates that there are 52% females and 47% males, with approximately 1% not answering in both survey years. However, once the samples are weighted, there are larger differences; in 2017 the weighting reduces the difference in these shares; 49.67% of the weighted sample is male and 50.33% is female (of those that reported gender). In the weighted 2012 data, 48.2% are male, and 51.8% are female. The 2012 ACS data (US Census Data Tables) indicates that there were 98.9 males for every 100 females in the California population; the population was 49.7% male, and 50.3% female.

With these state-wide population level proportions, we can compute a gender adjustment for the weights in the 2012 data. To produce the correct weight, the target proportion is divided by the sample proportion. The result is the factor, the weight, that needs to be applied to that subset of the sample. This process is more complex when weighting on more than one variable simultaneously, but for this exploration, we look at one variable, with only two possible values. These adjustments are applied to the 2012 person weights with trip correction factors; the weights used in the production of Table 1. This adjustment weights each female's trip less than without the adjustment, (0.9750 times) and each male's trip a little more, (1.032 times).

Once these adjustments were made to the weights, weighted trip mode shares were produced for the full set of modes in the 2012 data, since this allows for a better examination of the impacts of this gender adjustment. By and large, there are no substantial impacts resulting from this adjustment, as shown in 4.

Table 4. 2012 Weighted Trip Mode Shares with and without Gender Adjustments to Weights

Mode	Gender adjusted count	Gender adjusted percent	Weighted count	Weighted percent
Walk	62749.59	16.14%	62879.18	16.17%
Bicycle	6006.61	1.55%	5943.11	1.53%
Wheelchair or scooter	371.99	0.10%	372.33	0.10%
Other non-motor	556.43	0.14%	550.09	0.14%
Auto - van - truck driver	192738.3	49.61%	192817.6	49.57%
Auto - van - truck passenger	102373.7	26.35%	102597.5	26.38%
Car-vanpool	2195.67	0.56%	2199.43	0.57%
Motorcycle	887.71	0.23%	873	0.22%
Taxi or hired car	420.75	0.11%	421.28	0.11%
Rental	606.4	0.16%	606.76	0.16%
Private shuttle bus	605.21	0.16%	603.71	0.16%

Mode	Gender adjusted count	Gender adjusted percent	Weighted count	Weighted percent
Greyhound	7.38	0.00%	7.37	0.00%
Airplane	383.69	0.10%	382.22	0.10%
Other private	326.08	0.08%	325.66	0.08%
Local or rapid bus	10549.89	2.71%	10581.05	2.72%
Express or commute bus	338.08	0.09%	339.29	0.09%
Metro orange-silver	223.72	0.06%	225.44	0.06%
School bus	2410.06	0.62%	2400.33	0.62%
Public transit shuttle	278.57	0.07%	279.23	0.07%
Airbart LAX Flyaway	11.68	0.00%	11.76	0.00%
Paratransit	257.1	0.07%	258.27	0.07%
Amtrak bus	20.21	0.01%	19.97	0.01%
Other bus	122.42	0.03%	122.64	0.03%
Bart, Metro red-purple	1836.98	0.47%	1833.97	0.47%
Ace, Amtrak, Caltrain, Metrolink, Coaster/Sprinter	470.64	0.12%	468.48	0.12%
VTA,Muni Metro,Blue/Green/Gold Line,Sacrmnto. SRT	1514.54	0.39%	1510.86	0.39%
Street car to trolley	100.75	0.03%	100.28	0.03%
Other Rail	159.26	0.04%	160.28	0.04%
Ferry or boat	56.56	0.01%	56.05	0.01%

Weighting by Day and Month

Another difference between the weighting procedures for the two surveys is the incorporation of month and day adjustments in the 2017 NHTS. While both surveys aimed to evenly distribute responses across days of the week and months of the year, there is no fail-safe way to ensure this occurs. In this section we explore the impacts of day and month weighting in 2017, using a post-hoc method similar to that applied to gender. First, we examine the distribution of the sample by the month of the year for each survey. We compare the unweighted distribution to the weighted distribution. These are shown in Figure 2 and Figure 3 for 2017 and 2012, respectively. For each survey year, the distribution of the sample across months of the year is more uniform once weights have been applied. Although both sampling strategies aim to collect a sample that is evenly distributed across the months of the year, neither survey was able to do this. The effect is greater for the 2017 NHTS, since months of the year were incorporated into the weighting procedures. Note that if the sample were perfectly evenly distributed across the months there would be 8.3% of the sample in each month.

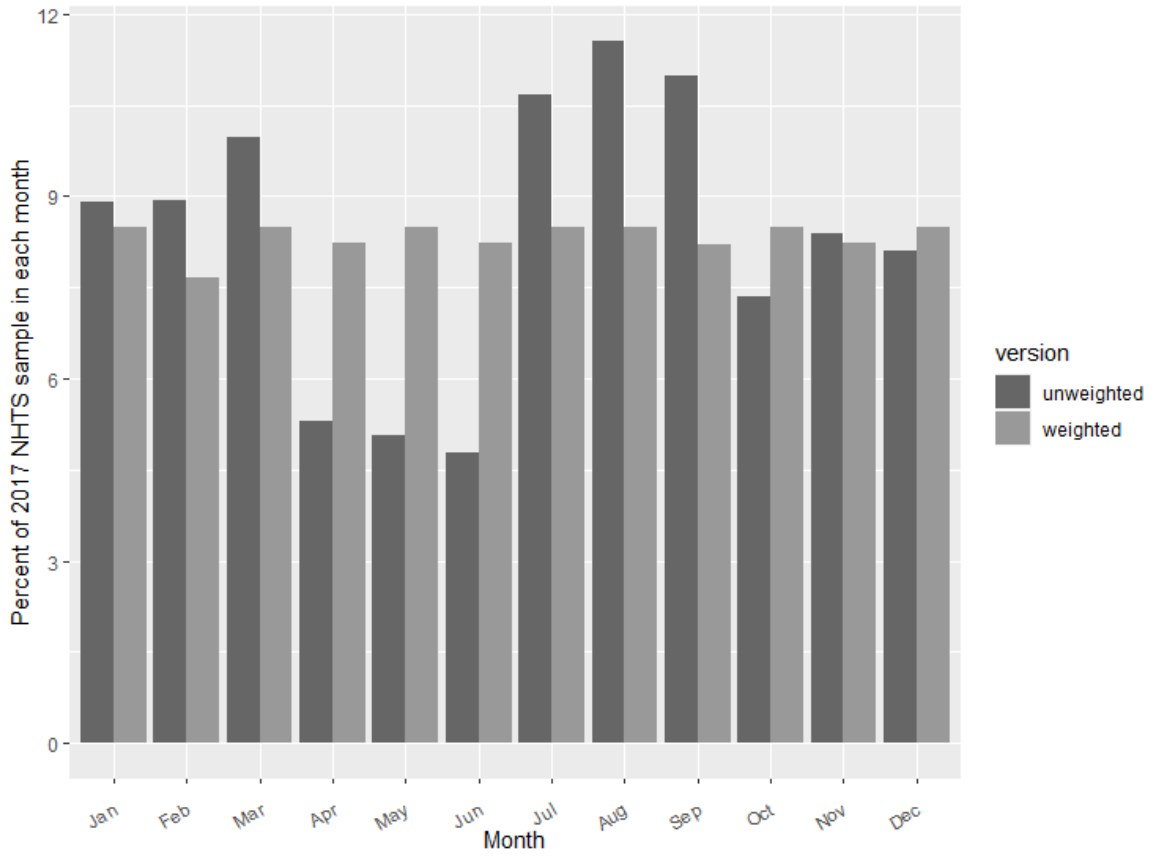

Figure 2. Distribution of households by month: Weighted (HH) 2017 Data

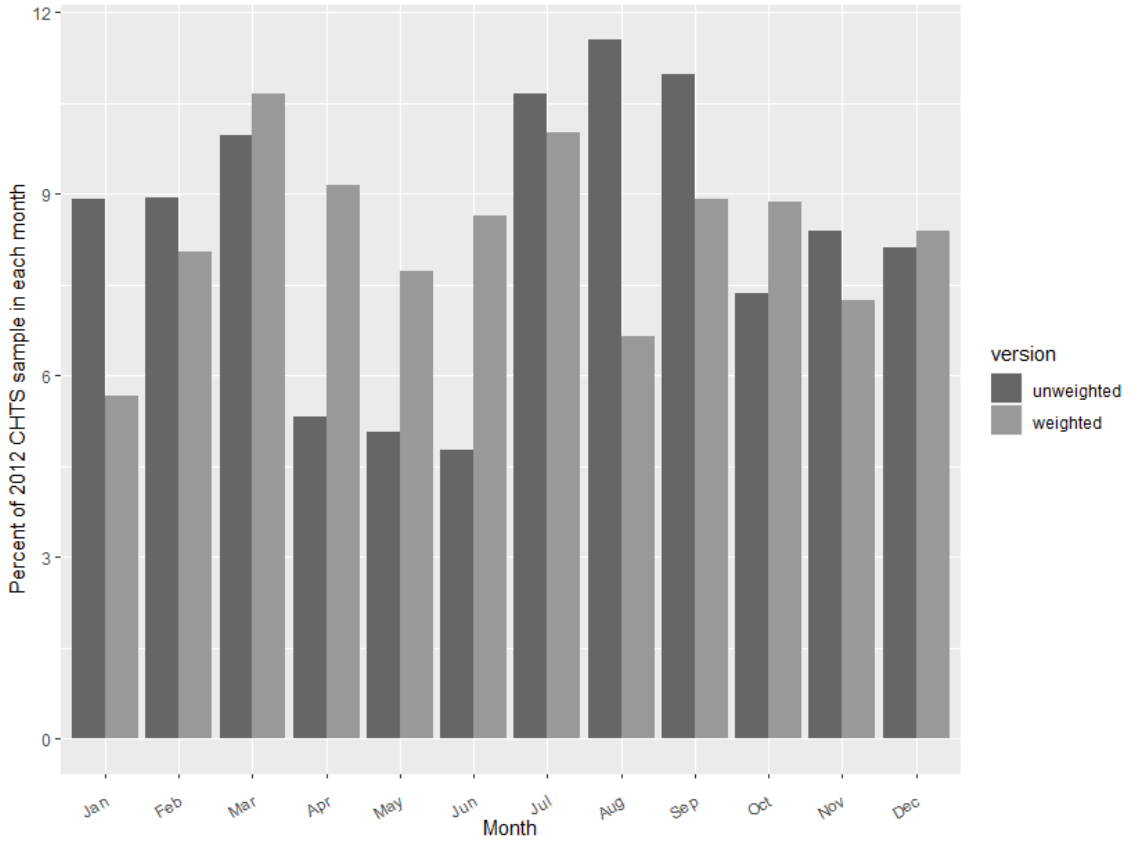

Figure 3. Distribution of Households by Month; 2012 Weighted Data

Since the process of weighting for the 2017 data incorporated these time-based adjustments at the household level, and then subsequent weights took this as a starting place, this process cannot be replicated for the 2012 data. However, since the distribution of months over the year does not change, target values are known. We introduce a post-hoc weighting adjustment to the 2012 data to evaluate the impact of the difference in the weighting methods.

Adjusting the weights in this way involves comparing the current distribution of the sample across months, to the known distribution of months over the year, i.e., to the target of 8.3%. The weights are produced at the household level, shown in Table 5, but the adjustments are applied to the final trip weights.

Table 5. Distribution of 2012 Households by Month and Post-hoc Weight Computations

Month	Initial count of households	Initial percent of households	Adjustment factor (8.3/initial percent)	Adjusted count of households	Adjusted percent of households
Jan	2407.217	5.67 %	1.470	3537.94	8.3%
Feb	3413.496	8.05 %	1.035	3533.64	8.3%
Mar	4521.733	10.66 %	0.782	3534.81	8.3%
Apr	3880.922	9.15 %	0.911	3534.54	8.3%
May	3280.389	7.73 %	1.078	3536.43	8.3%
Jun	3666.482	8.64 %	0.965	3536.34	8.3%
Jul	4246.534	10.01 %	0.833	3535.24	8.3%
Aug	2826.245	6.66 %	1.251	3536.34	8.3%
Sep	3781.816	8.92 %	0.934	3533.09	8.3%
Oct	3767.506	8.88 %	0.938	3535.57	8.3%
Nov	3072.169	7.24 %	1.151	3536.11	8.3%
Dec	3554.484	8.38 %	0.994	3534.69	8.3%

These factors are incorporated into the full trip dataset and applied to the already existing weights—so that they are increased or reduced by the adjustment factors in Table 6. The trip mode shares for the full set of travel modes in the 2012 survey are presented in Table 7, for both the month adjusted weights, and the trip correction factor weights. There are slight differences here as there were with gender, but none are substantial enough to incorporate this adjustment into the final analysis. However, it is likely worthwhile to include day, month, and gender in the weighting procedures for future instances of the CHTS.

Table 6. 2012 Trip Mode Shares with and without Month Adjustments to the Weight

Mode	Adjusted Count	Adjusted Percent	Weighted Count	Weighted Percent
Walk	63432.13	16.24%	62879.18	16.17%
Bicycle	5934.03	1.52%	5943.11	1.53%
Wheelchair or scooter	365.73	0.09%	372.33	0.10%
Other non-motor	545.15	0.14%	550.09	0.14%
Auto - van - truck driver	193005.69	49.40%	192817.6	49.57%
Auto - van - truck passenger	103327.75	26.45%	102597.5	26.38%
Car-vanpool	2191.93	0.56%	2199.43	0.57%
Motorcycle	863.05	0.22%	873	0.22%
Taxi or hired car	422.07	0.11%	421.28	0.11%
Rental	595.8	0.15%	606.76	0.16%
Private shuttle bus	620.39	0.16%	603.71	0.16%
Greyhound	7.16	0.00%	7.37	0.00%
Airplane	377.25	0.10%	382.22	0.10%
Other private	330.98	0.08%	325.66	0.08%

Mode	Adjusted Count	Adjusted Percent	Weighted Count	Weighted Percent
Local or rapid bus	10792.88	2.76%	10581.05	2.72%
Express or commute bus	336.12	0.09%	339.29	0.09%
Metro orange-silver	227.54	0.06%	225.44	0.06%
School bus	2436.73	0.62%	2400.33	0.62%
Public transit shuttle	271.77	0.07%	279.23	0.07%
Airbart LAX Flyaway	11.77	0.00%	11.76	0.00%
Paratransit	262.01	0.07%	258.27	0.07%
Amtrak bus	17.9	0.00%	19.97	0.01%
Other bus	125.12	0.03%	122.64	0.03%
Bart, Metro red-purple	1865.75	0.48%	1833.97	0.47%
Ace, Amtrak, Caltrain, Metrolink, Coaster/Sprinter	465.26	0.12%	468.48	0.12%
VTA, Muni Metro, Blue/Green/Gold Line, Sac. RT	1544.9	0.40%	1510.86	0.39%
Street car to trolley	106.95	0.03%	100.28	0.03%
Other Rail	156.27	0.04%	160.28	0.04%
Ferry or boat	54.34	0.01%	56.05	0.01%

The 2017 data is also weighted by day of the week, but there do not appear to be any major differences in the days of the week for the 2012 data; i.e., they are already quite evenly distributed across days of the week. Any adjustment factors would likely be much smaller than those for gender or month, and therefore are not explored here, since neither of those adjustments resulted in substantial impacts[1].

Trip Correction Factors

An additional difference in the data processing between 2012 and 2017 results from the use of GPS devices for 2012. Using GPS devices to record travel allowed analysts to compare diary-reported travel and observed travel with the GPS devices. The trip correction factors (TCF) applied to the data in 2012 "correct" the diary-reported trips for all participants based on the differences found for those participants assigned to GPS data collection.

The trip correction factors are computed based on logistic regression models for both trips found to be under-reported (present in GPS data, but not in diary reported data) and over-

[1] This is also true despite the fact that the description of data collection for 2012 indicates that some portions of the sample were restricted to Tuesday, Wednesday and Thursday; presumably because these days were viewed as more typical in terms of commuter patterns, or potentially in terms of charging patterns – since this sampling strategy was requested by the California Energy Commission for those respondents with GPS devices in the CEC requested samples.

reported (present in diary reported data, but not GPS data). The under/over-reporting of trips does not mean that trips were left out, or erroneously added; it means that they were not recorded along the protocol desired by the analysts. For example, a home-based work trip, that involved a stop for gas en-route should be reported as two separate trips. One from home to the gas station, and one from the gas station to the workplace. This is described as two under-reported trips, and one over-reported home-based work trip. As demonstrated in this example, this single record contains both under and over-reporting of trips, however once under and over-reported trips were identified, separate models were estimated, based on trip characteristics to find coefficients to produce trip counts. The results of the two models are ultimately combined into one trip correction factor that is applied to each trip record.

The final factors for correction are applied to different types of trips—based on the amount of time a person stopped at a given location, as this was found to be the most important factor in predicting whether a trip was omitted. This process results in a final trip corrected weight for all trips in the sample and reflects the likelihood of trips being over or under reported based on trip duration, stop duration, number of trips made by the respondent, and the education level of the respondent.

We evaluate the impact of the trip correction factor on the 2012 results. This involves applying the trip corrected weights and comparing that to the person weights.

Table 7. Comparison of 2012 Weighted Results and 2012 TCF Weighted Results

Travel Mode	Weighted count	Weighted percent	TCF weighted count	TCF weighted percent	Percentage point difference
Airplane	432	0.13%	382	0.10%	-0.03
All local bus types	10,002	2.91%	11,334	2.91%	0.00
Amtrak inc bus and commuter rail	482	0.14%	488	0.13%	-0.01
Bicycle	5,361	1.56%	5,943	1.53%	-0.03
City-to-city bus	8	0.00%	7	0.00%	0.00
Ferry or boat	57	0.02%	56	0.01%	-0.01
Metro, rapid, trolley	3,500	1.02%	3,831	0.99%	-0.03
Motorcycle	846	0.25%	873	0.22%	-0.03
Paratransit	285	0.08%	258	0.07%	-0.01
Private shuttle bus	580	0.17%	604	0.16%	-0.01
Private vehicle	266,325	77.47%	297,615	76.52%	-0.95
Rental	574	0.17%	607	0.16%	-0.01
School bus	2,294	0.67%	2,400	0.62%	-0.05
Something Else	1,124	0.33%	1,248	0.32%	-0.01
Taxi or hired car	419	0.12%	421	0.11%	-0.01
Walk	51,507	14.98%	62,879	16.17%	1.19
Total	343,797	100%	388,947	100%	---

The differences in the mode shares are very small fractions of a percentage point for all modes except for walk and private vehicle. The application of the TCF seems to shift some private vehicle trips to walk trips; presumably, there is more over-reporting of private vehicle trips than under-reporting, or a good deal of under reporting walk trips. It seems more likely that participants would under report walk trips, as they may consider a whole round trip to the grocery store for example, as a single trip.

The decrease in private vehicle trips is 0.95 percentage points. Although there are impacts to the outcome of interest in this study, the overall change does not impact the primary focus; to evaluate why there are changes in mode shares between 2012 and 2017. A change of 1.19 percentage points does represent approximately 1/3 of the observed change and would bring down the difference between 2012 and 2017 for walking, from 3.2 percentage points to 2.4 percentage points. However, there is still a decrease of roughly the same magnitude, in the walk mode share of trips. There are not likely to be any substantial changes in the final outcomes or recommendations of this study based on this difference.

Though there are differences in the weighting procedures, none of the differences have a substantial impact on the outcomes related to trip mode shares, so none of the adjustments related to weighting are retained in the analysis.

Comparing Apples to Apples

In addition to the differences in the weighting procedures, the application of weights to analysis may differ between the datasets. We have determined that there are no substantial impacts on the outcomes of interest resulting from the differences in weighting procedures. However, the weights applied in the initial analyses generate estimates at different scales. In 2012 the trip correction factor trip weights do not expand the estimates to population level values. On the other hand, the 2017 trip weights appear to expand the values to population level estimates. This expansion is not noted specifically in the weighting procedures documented for the 2017 survey. It is likely that because the weights aim to bring the sample shares to the population shares an implicit part of this process is expanding the sample size up to the population.

There are several weights that are used within the analysis for a particular year. These include weights for households, for each person, and for each trip. At the base of all of these weights, are the household weights. The household weights are the starting point for the person weights. Trip weights and any adjustments related to trip weights are made to the person weights. Table 8 summarizes the weights present in each of the survey data sets.

Table 8. Sample Weights Produced for Each Survey Year

Weight Type	2012 CHTS	2017 NHTS CA
Household	Base weights reflect the probability of being selected, and raking procedures used the variables: household size, household income, number of workers, number of vehicles, county of residence—using statewide distributions of these variables.	Base weights reflect the probability of being selected, and raking procedures used the variables: heavy rail strata, race (black or not), Hispanic status, home ownership, number of household vehicles, month, day, and combined values using household size and number of household workers. Seems to be already expanded to reflect the full set of households in CA.
Expanded household	Expansion Factor = N(Universe)/N(Surveyed. This translates to a survey universe of 12,433,172 households.	None
Person	Starts with household weight, and uses raking procedure for Hispanic Status, Ethnicity, Age, Employment Status, and County of Residence	Starts with household weight as a base and each of the six categories used in this weighting step, which included the MSA/heavy rail original sampling strata, race, ethnicity, sex by age categories, travel month, and travel day of the week.
Person Expanded	Person expansion is the same as the expanded household; but for the population of CA—each weighted person is adjusted to expand up to population level estimates, to reach the total of 36,969,200 persons.	The trip weights are expanded versions of the person weights; multiplied by 365 in order to represent travel for a whole year.
Trip	Trip weights are based on the person weights, aside from the trip correction factors	Five- or seven-day weights for trips; expanded for trips but based on the person weight. Expansion factor is included in these weights as noted above; the trip weight are equal to the person weights multiplied by 365.
Trip Correction Factor	Overall, Corrected Trips = (Diary-recorded Trips) x (Trip Correction Factor) = 67,890*1.135 = 77,071, but estimated factors area applied to the data based on	None

The 2017 NHTS contains two trip weights: one for 5-day (weekday) analysis and one for 7-day analysis. Further, both surveys have adjustments that expand the data to population levels for an average day, and in 2017, for the entire year. Here, we focus on the trip weights.

The expansion factors should not impact the relative values estimated but comparing un-expanded outcomes to those that have been expanded leaves one wanting for values similar in magnitude. The values of most similar magnitude are the weighted 2017 data, and the weighted and expanded 2012 data. These terms are what are used in the data and the reports, though the terms are not used in the same ways across the two survey years.

Table 9. Most Similar Weighted Estimates

Travel Mode	Expanded Person Weight 2012 Count	Person weighted (7-day) 2017 Count	Standard Error 2017	Confidence Interval as %	Expanded Person Weight 2012 Share	Person weighted 2017 (7-day) Share	Percent change in Share from 2012 to 2017
Airplane	146,279	219,189	26412.47	+/- 24%	0.13%	0.18%	80%
All local bus types	3,388,912	2,242,592	168950.7	+/- 15%	2.91%	1.86%	-36%
Amtrak inc. bus and comm. rail	163,260	277,494	20845	+/- 15%	0.14%	0.23%	77%
Bicycle	1,816,472	1,509,225	80632.43	+/- 10%	1.56%	1.25%	-18%
City-to-city bus	2,756	22,343	6857.494	+/- 60%	0.00%	0.02%	0%
Ferry or boat	19,423	61,519	15262.14	+/- 49%	0.02%	0.05%	400%
Metro, rapid, trolley	1,185,923	831,307	47244.37	+/- 11%	1.02%	0.69%	-30%
Motorcycle	286,719	293,977	63485.93	+/- 42%	0.25%	0.24%	9%
Paratransit	96,570	111,135	32853.88	+/- 58%	0.08%	0.09%	29%
Private shuttle bus	196,473	290,499	40690.89	+/- 27%	0.17%	0.24%	50%
Private vehicle	90,235,151	97,459,942	1211653	+/- 2%	77.47%	80.85%	6%
Rental	194,498	296,270	69337.32	+/- 46%	0.17%	0.25%	56%
School bus	777,136	612,451	70743.23	+/- 23%	0.67%	0.51%	-18%
Something Else	380,802	407,941	56650.05	+/- 27%	0.33%	0.34%	6%
Taxi or hired car	141,837	774,842	85000.68	+/- 22%	0.12%	0.64%	482%
Walk	17,451,520	15,131,548	389553.5	+/- 5%	14.98%	12.55%	-22%
Total	116,483,730	120,542,275	---	---	100%	100%	---

This approach does represent a departure in each year, from the weights used in the values available for the initial comparison of the data. For 2012, this is the expanded data versus not expanded; and seems fine. For 2017 the weights shift from the 5-day weights, which were used in the Caltrans Codebook (provided to us for this study), because we choose to use the 7-day weights as that seems more likely to match up with the process used in the 2012 data.

Figure 4 presents the percent change in mode share based on the data shown in Table 9. For the most part the patterns are similar to those in Figure 1; most changes in mode share are less than about a 20% increase or decrease.

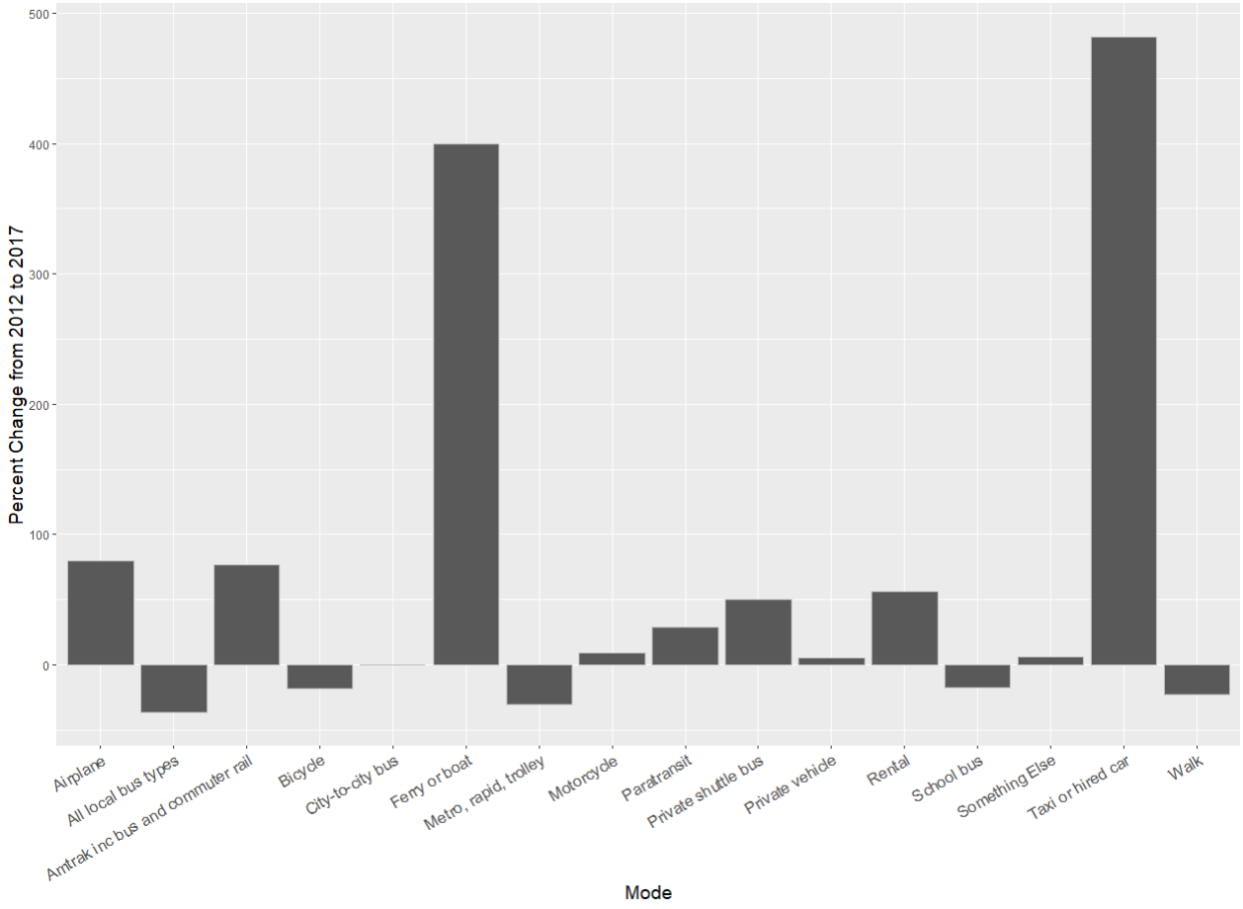

Figure 4. Percent Change from 2012 to 2017 in Similarly Weighted Estimates

However, if we consider this as a sensitivity analysis, there are really no substantial differences in the outcomes for the mode share shifts for trips. Indeed, all of the potential weights were compared across the two years, to determine whether any of the approaches to weighting would result in different outcomes or shift the outcomes of interest in such a way that the results of this study would be different. However, the results and the mechanics of the different approaches suggest that there is perhaps preferred weighting at least for comparison's sake; since they are more similar in the magnitude of values—i.e., each year has an approach that produces an estimate for the number of trips etc. on a daily basis.

4. Performance Metrics

In this section we present different means of evaluating shifts in mode use to determine how sensitive the observed changes in mode share are to performance metric format. We also explore these different metrics to examine how each highlights different aspects of travel that should be considered with respect to walking and biking targets and strategies. For example, if the bike mode share of trips can be attributed to a relatively small portion of the sample making many bicycle trips, this would have different implications than if a moderate portion of the sample is making some bicycle trips. The performance metrics reviewed here can be categorized into three groups:

- Trip based: presented above and is based on the share of trips by different modes, regardless of the distance traveled or the duration of the trip. Other trip-based metrics include the share of trips for work, school, or other purposes.
- Traveler based: the share of *persons* using the modes of interest; *usual* mode to work or school, and what proportion of the sample makes *any* trips by bicycle, by walking, etc.
- Trip attribute based: the share of the total distance or time traveled by different modes. This includes person-mile-travelled weighted mode shares, (or person-minute).

Trip mode

The bulk of the preceding analysis covers trip mode. Here, we present analysis of trip attributes; namely travel distance and travel time for the two survey years.

Usual mode to work

The usual mode to work is asked of each household member over the age of five, who reports working or going to school. There is a reduction in biking as the usual commute mode, from 2.15% in 2012 to 1.66% in 2017. However, we see an increase in the share of people who report that their usual mode to work is walking; from 2.55% of participants in 2012 to 2.76% of participants in 2017. This change is in the opposite direction of changes presented throughout this report, however it is quite small and likely reflects only some degree of stability in walking as a commute mode.

Table 10. Weighted Mode Shares for Usual Mode to Work

Mode	2012 Count	2012 Share	2017 Count	2017 Share
Airplane	43.53727	0.11%	25196.29	0.16%
All local bus types	1802.16	4.58%	489689	3.20%
Amtrak inc. bus and commuter rail	153.0734	0.39%	159175.2	1.04%
Bicycle	844.6197	2.15%	253981.8	1.66%
City-to-city bus	6.098627	0.02%	6098.947	0.04%
Ferry or boat	23.52122	0.06%	20121.22	0.13%
Metro, rapid, trolley	798.7593	2.03%	355381.2	2.32%
Motorcycle	154.5661	0.39%	91333.49	0.60%
Paratransit	14.26945	0.04%	13098.51	0.09%
Private shuttle bus	66.88335	0.17%	66502.74	0.43%
Private vehicle	34199.82	86.92%	13228877	86.47%
Rental	66.3438	0.17%	10697.97	0.07%
School bus	8.086407	0.02%	14438.9	0.09%
Something Else	142.473	0.36%	93615.12	0.61%
Taxi or hired car	18.92578	0.05%	46898.29	0.31%
Walk	1002.342	2.55%	422898.6	2.76%

Usual mode to school

The patterns for usual mode to school are quite different and likely reflect a methodological difference we have not been able to identify. The shift from 2.55% of school trips by walking to 17.78% is likely not the true change in the walk share for school trips. There may be some difference in how private vehicle trips, versus walk trips were reported.

Table 11. Weighted Mode Shares for Usual Mode to School

Mode	2012 Count	2012 Share	2017 Count	2017 Share
Airplane	43.53727	0.11%	5452.077	0.09%
All local bus types	1802.16	4.58%	112955.9	1.84%
Amtrak inc. bus and commuter rail	153.0734	0.39%	1826.026	0.03%
Bicycle	844.6197	2.15%	129206	2.10%
City-to-city bus	6.098627	0.02%	NA	NA
Ferry or boat	23.52122	0.06%	NA	NA
Metro, rapid, trolley	798.7593	2.03%	8706.915	0.14%
Motorcycle	154.5661	0.39%	548.6198	0.01%
Paratransit	14.26945	0.04%	0	0.00%
Private shuttle bus	66.88335	0.17%	13702.86	0.22%
Private vehicle	34199.82	86.92%	4182892	68.07%
Rental	66.3438	0.17%	1840.926	0.03%
School bus	8.086407	0.02%	555640.7	9.04%
Something Else	142.473	0.36%	39974.66	0.65%
Taxi or hired car	18.92578	0.05%	NA	NA
Walk	1002.342	2.55%	1092639	17.78%

Walk or bike in past week

Looking at walking and biking in the past week, and the share of individuals that have walked in the past week: in 2012 approximately 80% had taken at least one walk trip in the past week, whereas in 2017 that number fell by about six percentage points, to 74%.

For biking the numbers are more dramatic. The proportion of the sample that reported any biking trips in the past week in 2017 (13%) is less than half that of 2012 (30%).

These numbers do line up generally though with the initial outcomes related to trip mode shares for walking and biking. There is a larger decrease in biking (a greater percentage point decrease, as well as a greater proportional decrease. Walking was about 13% less in 2017, whereas biking was about 20% less). However, it is possible that there is a difference in the data for 2012 and 2017 that could be driving up the difference in the shares of individuals biking in the past week.

Distance weighted trip mode shares

The bulk of the preceding analysis covers trip mode. Here, we present analysis of trip attributes; namely travel distance and travel time weighted shares for the two survey years. First, the distance weighted trip mode shares, for each survey year. The distance weighted mode shares are fairly consistent across the survey years, with the bulk of the miles attributed to private vehicle trips (after airplane trips, which are removed from the analysis here, since they far

outweigh all the other modes for distance). Despite the similar overall patterns, there are notable differences.

Distance weighted trip mode shares weight each trip by the distance travelled in order to account for the share of trip miles made by each mode, rather than simply the count of trips made by each mode. The trip weights are also applied.

Bicycle trips represent 0.71% of the total miles travelled in 2012, but only 0.31% of the total miles in 2017. There is also a notable difference in the proportion of miles travelled walking; 1.7% in 2012 to 1.04% in 2017. These decreases follow the same pattern as the decreases for trip mode shares. These changes are fairly small and seem to be balanced by small increases in the distances travelled in taxis and hired cars, private shuttles, and commuter rail. This may represent shifts associated with the increased prevalence of shared use mobility options such as Uber and Lyft over this time period, as well as private shuttles in the Silicon Valley area.

Table 12. 2017 Mode Shares Weighted by Distances Traveled

Mode	2012 Distance weighted sum	2012 Distance weighted share	2017 Distance weighted sum	2017 Distance weighted share
Airplane	221,591,577.93	---	288,929,866.11	---
All local bus types	15,874,577.60	1.72%	17,145,242.43	1.68%
Amtrak and comm rail	7,018,576.10	0.76%	9,540,546.87	0.93%
Bicycle	6,574,575.65	0.71%	3,181,738.18	0.31%
City-to-city bus	215,618.01	0.02%	451,278.89	0.04%
Ferry or boat	229,669.50	0.02%	764,483.25	0.07%
Metro, rapid, trolley	12,063,296.90	1.31%	12,246,971.80	1.20%
Motorcycle	3,345,059.19	0.36%	3,581,739.15	0.35%
Paratransit	910,990.77	0.10%	1,125,952.56	0.11%
Private shuttle bus	2,789,130.47	0.30%	6,966,688.42	0.68%
Private vehicle	840,250,548.86	91.19%	930,810,316.40	91.05%
Rental	7,142,123.62	0.78%	7,668,212.42	0.75%
School bus	5,283,482.75	0.57%	3,457,425.92	0.34%
Something Else	2,608,825.81	0.28%	5,312,318.05	0.52%
Taxi or hired car	1,487,280.08	0.16%	9,368,200.99	0.92%
Walk	15,618,591.09	1.70%	10,660,308.42	1.04%

Travel-time weighted trip mode shares

Further analysis is needed to compare the travel-time weighted mode shares for 2012 and 2017, as the 2012 data yields results that appear to be incorrect. However, the 2012 report (Caltrans 2013) does include average travel times by mode. These values were used to create approximate travel time weighted mode shares for comparison. This was done by multiplying the total weighted number of trips by each mode, by the average travel time for that mode.

The proportions of the total travel time across all modes were computed, and then aggregated by the consolidated modes used throughout this report.

There are only small differences between 2012 and 2017 for travel time weighted mode shares. There is a small decrease in biking, and a small decrease in walking. The percentage point difference for bicycle is somewhat larger than that of trip mode shares, while the percentage point difference is much smaller for walk. There is also a small increase in the duration of local bus trips.

Table 13. 2017 Travel Time Weighted Mode Shares and Trip Mode Shares

mode	Approximated total time 2012	2012 Approximate travel time weighted share	2017 travel time weighted sum	2017 travel time weighted share
Airplane	87,872.38	0.00%	47,597,184.16	---
All local bus types	225,378.98	3.32%	120,262,609.15	4.37%
Amtrak and comm rail	36,831.34	0.54%	25,381,566.58	0.92%
Bicycle	108,164.60	1.59%	31,320,165.84	1.14%
City-to-city bus	905.04	0.01%	1,571,398.29	0.06%
Ferry or boat	3,615.23	0.05%	2,590,481.50	0.09%
Metro, rapid, trolley	79,121.00	1.16%	50,785,705.26	1.84%
Motorcycle	19,555.20	0.29%	7,659,833.95	0.28%
Paratransit	9,710.95	0.14%	3,756,698.32	0.14%
Private shuttle bus	18,232.04	0.27%	17,012,275.12	0.62%
Private vehicle	5,478,737.97	80.62%	2,175,270,735.57	79.00%
Rental	20,569.16	0.30%	12,031,420.54	0.44%
School bus	72,730.00	1.07%	17,726,265.91	0.64%
Something Else	26,155.35	0.38%	13,567,459.05	0.49%
Taxi or hired car	11,079.66	0.16%	18,774,041.21	0.68%
Walk	685,383.06	10.08%	255,806,383.95	9.29%

The performance metrics we evaluated do result in different degrees of change from 2012 to 2017 than the initial comparison of mode shares. Largely the changes for trip attribute-based mode shares are smaller for walking, and for the usual mode to work, in the opposite direction actually. Interestingly for biking, as a mode to work there is almost no change, but the distance and time weighted changes are greater. These results point to the need for the use of different performance metrics when setting goals for biking and walking, and also that different groups (i.e., commuters) may or may not need targeted outreach to increase the use of active modes.

5. Descriptive Statistics

In this section we present differences between the 2012 and 2017 mode shares, with respect to different household and individual characteristics. The selected characteristics have consistently been found to be related to mode choice, however in this section we evaluate whether these relationships changed over the study period in CA and/or whether the relationships are the same, but changes in California's demographics have resulted in shifts in mode share. For example, males are known to bike more, if somehow there were fewer males in the population this would cause a decrease in biking, even though the underlying relationship that males bike more would not change.

Although the sampling and weighting processes described above strive to produce population estimates for all of the values of interest that are representative of the state as a whole, there are limitations to weighting. Weights cannot account for every characteristic that is relevant to travel behavior, and there may be differences in factors such as land use, or other important variables that could impact results.

It was not possible to explore questions related to age or cohort impacts because the age information is almost entirely redacted from the 2017 data.

There is a difference in the way that the Hispanic population travelled in 2012, compared to 2017. This is quite notable, and though immigrant groups including Hispanic groups use alternative modes of transportation more and private vehicles less (except for carpooling); there is some evidence that immigrants' travel behavior assimilates once they have spent more time in the new area. This pattern is stronger among Hispanic immigrants (Blumenberg 2009).

Our results show that Hispanic groups have shifted from biking and walking towards driving. It is likely that this does not account for the total shift, since there are changes among other groups as well, but there are two notable patterns in this table. First, the changes in Hispanic mode shares between 2012 and 2017 are greater than the changes among those in other groups. Second, the differences between Hispanic mode shares and other groups are greater in 2012 than in 2017, suggesting shifts among the Hispanic populations of California are greater than those of others.

These shifts among Hispanic groups may also impact overall changes in mode shares due to the background shift in California's demographics over this period. In 2000, 47% of California's population was white while 33% was Hispanic, in 2018, 37% was white and 39% was Hispanic (https://www.ppic.org/publication/californias-population/). This change is reflected in the sample for this study. A review of the unweighted proportions finds that the 2012 sample was approximately 14% Hispanic. This share increased 10 percentage points by 2017 to about 24%. This difference is minimized through weighting procedures, and the weighted samples are 35% and 36% Hispanic in 2012 and 2017, respectively. If these weighted proportions were altered to reflect the differences more acutely, there might be more dramatic changes in the mode shares for this portion of the population. The Hispanic population makes up at least one third of the sample and changes in this group appear to be reflected in overall population level changes.

Table 14. Weighted Trip Mode Shares for Hispanic and Non-Hispanic Groups

	Hispanic 2012		Not Hispanic 2012		Hispanic 2017		Not Hispanic 2017	
Mode	count	percent	count	percent	count	percent	count	percent
Airplane	60.10	0.04%	298.98	0.12%	42971.74	0.10%	175540.91	0.23%
All local bus types	6603.45	4.85%	4620.57	1.88%	973713.11	2.22%	1261009.29	1.65%
Amtrak inc bus and commuter rail	113.43	0.08%	375.01	0.15%	54906.88	0.13%	222587.40	0.29%
Bicycle	1619.15	1.19%	4262.52	1.73%	350765.45	0.80%	1156126.44	1.51%
City-to-city bus	1.61	0.00%	5.61	0.00%	9851.75	0.02%	12491.17	0.02%
Ferry or boat	9.95	0.01%	44.49	0.02%	13377.71	0.03%	48141.58	0.06%
Metro, rapid, trolley	1251.48	0.92%	2540.45	1.03%	148088.31	0.34%	682542.76	0.89%
Motorcycle	188.75	0.14%	672.47	0.27%	34647.72	0.08%	259329.15	0.34%
Paratransit	90.39	0.07%	167.04	0.07%	54039.87	0.12%	57095.18	0.07%
Private shuttle bus	119.04	0.09%	481.18	0.20%	59421.78	0.14%	231077.64	0.30%
Private vehicle	94176.25	69.13%	198145.38	80.45%	36491149.94	83.11%	60769895.09	79.54%
Rental	195.09	0.14%	399.87	0.16%	20623.45	0.05%	275521.99	0.36%
School bus	1416.78	1.04%	923.78	0.38%	356468.89	0.81%	255794.50	0.33%
Something Else	469.79	0.34%	767.90	0.31%	156973.62	0.36%	250886.27	0.33%
Taxi or hired car	115.21	0.08%	293.19	0.12%	211407.22	0.48%	563435.22	0.74%
Walk	29807.71	21.88%	32310.91	13.12%	4927647.82	11.22%	10179916.74	13.32%

We also look at changes in mode shares by gender, to evaluate whether there are notable changes in the use of modes by each group, and whether those changes might contribute to overall shifts in mode shares over the period of interest. Some of the patterns for Hispanic and non-Hispanic groups are also apparent for Male and Female groups; the shares are much more similar for walking in 2017 than in 2012. However, for bicycle shares are higher for both males and females in 2012 than in 2017, and the difference between males and females is roughly the same in both years. Here, we also see the expected patterns for changes, when considering the overall changes presented at the beginning of this report, small decreases in biking and walking. Interestingly there is a greater decrease in biking among males than females, though the decrease in walking is greater for females (by percentage points). Unlike the population differences when it comes to the proportion of Hispanic individuals, there are not notable differences in the makeup of the California population in 2012 to 2017 in terms of gender. Though there are small differences in the makeup of males and females in the sample, the target shares, based on population estimates are quite similar; a little over 50% female and a little less than 50% male in both years.

Table 15. Weighted Trip Mode Shares by Gender

	Male 2012		Female 2012		Male 2017		Female 2017	
Mode	count	percent	count	percent	count	percent	count	percent
Airplane	212.41	0.12%	169.82	0.08%	112853.38	0.19%	106335.35	0.17%
All local bus types	4804.72	2.68%	6511.72	3.13%	979942.00	1.68%	1261422.32	2.04%
Amtrak inc bus and commuter rail	276.35	0.15%	201.07	0.10%	157509.75	0.27%	118756.91	0.19%
Bicycle	4081.32	2.27%	1841.46	0.89%	1076308.98	1.84%	431899.95	0.70%
City-to-city bus	3.73	0.00%	3.64	0.00%	10571.09	0.02%	11771.82	0.02%
Ferry or boat	36.25	0.02%	18.19	0.01%	37813.46	0.06%	23705.82	0.04%
Metro, rapid, trolley	1920.64	1.07%	1889.64	0.91%	486991.60	0.83%	343087.93	0.55%
Motorcycle	705.09	0.39%	167.92	0.08%	247539.45	0.42%	46437.43	0.07%
Paratransit	101.38	0.06%	156.05	0.08%	54566.11	0.09%	56568.94	0.09%
Private shuttle bus	317.67	0.18%	281.75	0.14%	152764.23	0.26%	137735.19	0.22%
Private vehicle	136809.67	76.21%	159593.25	76.73%	46789994.79	80.06%	50535811.42	81.60%
Rental	285.17	0.16%	321.22	0.15%	152568.50	0.26%	143576.94	0.23%
School bus	1336.33	0.74%	1047.52	0.50%	314106.83	0.54%	298343.70	0.48%
Something Else	725.42	0.40%	522.66	0.25%	283254.81	0.48%	124685.73	0.20%
Taxi or hired car	189.01	0.11%	224.90	0.11%	399135.67	0.68%	375706.77	0.61%
Walk	27713.39	15.44%	35039.04	16.85%	7189757.86	12.30%	7917158.75	12.78%

6. Conclusions and Recommendations

This study reviewed the changes in mode share in the California-wide 2012 California Household Travel Survey and the California add-on sample of the 2017 National Household Travel Survey. We explored potential factors contributing to the observed changes in mode share over the time period between these two surveys. We evaluated impacts related to methodological differences as well as the potential effects of shifts in demographics.

In the evaluation of methodological differences several key differences were identified, including the geographic scale used in weighting; the entire state in 2012, and the sampling strata in 2017. Other differences in the weighting procedures included the inclusion of gender and months of the year in 2017, but not in 2012. Using a post-hoc approach to weighting the 2012 data with these variables resulted in some impacts, but not substantial changes in the outcomes. We also reviewed differences such as the way loop trips are accounted for and didn't find any substantial differences.

In addition to the differences in the weighting procedures we examined the effects of the use of GPS data in 2012 and a transportation correction factor that was applied to the data in that year. The correction factor is derived using multinomial logistic regression comparing the GPS recorded trips and respondent reported trips. This factor is applied to the full data set and modifies the weight of trips in the data to reflect typical patterns of over-and under-reporting of trips.

Overall, there were small impacts resulting from methodological differences, but none substantial enough to alter the outcomes of interest. However, the resulting differences as well as the thorough review of reports, data dictionaries etc. for the two survey years does highlight a need for more detail to be included in the description of analytic methods—specifically how the publicly available data has been treated before it is made available, or how the publicly available data differs from the data used in relevant reports.

We also explored the use of different performance metrics on the outcomes of interest. There were variations in the results looking at different performance metrics, however the overarching results indicate a decreased in walking and biking over the period of interest here. However, the changes are in some cases of a different magnitude than the changes in trip mode share on its own. We recommend the consideration of a variety of performance metrics in goal setting and outreach to increase the use of active modes.

Changes in the Hispanic population of California are likely a factor impacting changes in walking and biking, but these changes might be underestimated, since these groups have historically been undercounted. Our results suggest that the use of alternative transportation modes among Hispanic groups has decreased much more than that of non-Hispanic groups. The increasing proportion of California's population made up of Hispanic groups will likely result in even greater effects of this shift into the future. While there are not changes in the population with respect to gender, there are differences in the changes in mode shares for men and

women. We find larger decreases in walking and biking among men, though it is possible this reflects the higher starting point for males. This outcome may also relate to changes in mode shares resulting from the Great Recession, if this led to greater impacts on men's travel.

One future avenue that could better illuminate the changes over this time period would be to use datasets that contain travel behavior information for the intervening years, or the time period between the Great Recession and the 2012 CHTS, such as the American Time Use Survey.

The major finding of this study is that the shifts in mode shares appear to be real. That is, they do not seem to be the result of methodological differences. We have begun to identify some of the key areas that might contribute to these changes; demographic shifts, and likely the Great Recession, however more research is needed to tease out how these impacts are affecting changes in mode share and what strategies might lead to increased bicycling and walking.

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Data Management

Products of Research

This study used two publicly available data sources. The 2017 National Household Travel Survey data, and the California Household Travel Survey data.

The National Household Travel Survey data can be downloaded from the Oak Ridge National Laboratory here: https://nhts.ornl.gov/. The following citation is recommended for users of the data: U.S. Department of Transportation, Federal Highway Administration, 2017 National Household Travel Survey. URL: http://nhts.ornl.gov.

The California Household Travel Survey data can be downloaded from the National Renewable Energy Lab here: https://www.nrel.gov/transportation/secure-transportation-data/download.html. You must register as a user in order to download the data. The following citation is recommended: Transportation Secure Data Center. (2017). National Renewable Energy Laboratory. Accessed Jan. 15, 2017: www.nrel.gov/tsdc

Data Format and Content

The data can be downloaded in a variety of formats from the sources noted above.

Data Access and Sharing, and Reuse and Redistribution

See above.