

1 **EXPLORING THE CHARACTERISTICS OF SHORT TRIPS:**
2 **IMPLICATIONS FOR WALK MODE CHOICE**

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1 **ABSTRACT**

2 People undertake many short trips, which may be defined as those under five miles, or under two
3 miles, or even under one mile in length. Although these trips have lengths that make them
4 candidates for bicycling or walking, i.e., the use of sustainable non-motorized modes of
5 transport, it is found that a substantial share of these short trips are undertaken by car. Although
6 there has been some research into the reasons why short trips are not largely undertaken by walk
7 and bicycle, much remains to be learned about the nature of short trips and the potential
8 constraints that limit the ability of travelers to use non-motorized modes for these trips. This
9 paper offers a detailed examination of short trips, with a view to exploring the potential factors
10 inhibiting the use of walk and bicycle modes for these trips. The paper offers a detailed
11 descriptive analysis of short trips in two major metropolitan regions using data from the most
12 recent 2008-2009 National Household Travel Survey in the United States. It is found that trip
13 chaining patterns may be playing a significant role in preventing more walking and bicycling.
14 Based on a characterization of short trips in the survey data sets, the paper offers planning and
15 policy strategies that may help bolster the share of walking and bicycling for short trips.

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19 **Keywords:** *walking, short trips, travel analysis, pedestrians, mode choice, trip chaining*
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1 **INTRODUCTION**

2 This paper is concerned with answering the question: why don't people walk and bicycle more
3 when undertaking short trips (regardless of the definition used to identify short trips)? The
4 motivation to address this question stems from the recognition that a large percent of short trips
5 are undertaken by car (at least in the United States), when they are actually excellent candidates
6 to be undertaken by walk or bicycle. An examination of data from the latest edition of the 2008-
7 2009 National Household Travel Survey (NHTS) illustrates the reason why this exploration is
8 worthy of being pursued. In the Greater Phoenix metropolitan area based sample of this survey,
9 there are 4,407 households who report making 31,683 trips that are 50 miles in length or less. Of
10 these trips, the following is the trip length distribution:

- 11 • Less than 0.5 mile: 7.23%
- 12 • 0.5 to less than 1 mile: 7.92%
- 13 • 1 to less than 2 miles: 11.57%
- 14 • 2 to less than 3 miles: 13.12%
- 15 • 3 to less than 5 miles: 17.45%
- 16 • 5 to 50 miles: 42.71%

17 The trip length distribution, which is not very unusual for a typical large metropolitan area in the
18 country, shows that 15 percent of trips are less than 1 mile in length and more than one-half (57.3
19 percent) are actually less than 5 miles. Surely, these trip lengths can be navigated by walk or
20 bicycle, particularly in the warm and sunny climate of the Greater Phoenix metropolitan area
21 (summer heat notwithstanding) where terrain is largely flat. An examination of the modal shares
22 in each of these trip length bins suggests that many of the short trips are being undertaken by
23 auto. While it could be argued that this may be due to the inadequate bicycle and pedestrian
24 infrastructure (non-motorized network supply) in the Greater Phoenix metropolitan region, the
25 reality is that there is an extensive network of bicycle and walking paths throughout the region
26 (The Planning Center, 1999; Sprinkle Consulting, Inc., 2007). In addition, it is found that the
27 statistics pertaining to the Greater Phoenix metropolitan area are not unique; similar statistics
28 (with a few rare exceptions) are found in cities across the country. Of the trips less than 0.5 miles
29 long in the Greater Phoenix area survey sample, 45 percent are undertaken by personal vehicle;
30 among trips 0.5 to less than 1 mile long, 57 percent are undertaken by personal vehicle. When
31 trip length reaches the one mile mark, the modal share of auto trips jumps to values exceeding 90
32 percent. What is it about these very short trips (those less than 1 mile in length, leave alone those
33 between 1 and 5 miles in length) that contributes to such a high share of auto mode use? That is
34 the question addressed in this paper through an exploration of the survey sample data sets.

35 Basic descriptive statistical analysis of the modal patterns of short trips is presented in
36 this paper for survey samples drawn from the Greater Phoenix and Southern California (Greater
37 Los Angeles) regions. In the interest of brevity, a more in-depth analysis of the trip chaining
38 patterns involving short trips is conducted and reported only for the Greater Phoenix
39 metropolitan region survey sample. Both of these metropolitan areas are large urban regions that
40 are characterized by high levels of auto mode use, dispersed land use patterns of development,
41 and favorable weather and terrain for walking and bicycling. It was therefore considered
42 interesting to explore the short trip travel behavior characteristics for these two areas, both of
43 which have reasonably large survey sample sizes in the 2008-2009 National Household Travel
44 Survey (NHTS) data set to work with.

45 The next section provides a brief review of some past studies related to the central
46 question of this paper. The third section offers a description of the data sets and survey samples.

1 The fourth section provides a descriptive statistical analysis of short trips in the two data sets.
2 The fifth section offers a more in-depth trip chaining analysis of short trips. Concluding thoughts
3 and policy implications are discussed in the sixth and final section.
4

5 **REVIEW OF SOME LITERATURE**

6 There is an extensive body of literature dedicated to the measurement and analysis of factors
7 influencing the use of non-motorized modes of transportation (e.g., Iacono, et al, 2010;
8 Kitamura, et al, 1997; Rodriguez and Joo, 2004; Waddell and Nourzad, 2002). It is beyond the
9 scope of this paper to offer a comprehensive review of such a vast body of literature. Within the
10 scope of this paper, the focus of inquiry is on the reasons why the auto mode is used so
11 extensively to undertake short trips. The most relevant work in this context is that by Mackett
12 (2003). His paper deals with largely the same question. Among the possible reasons why the car
13 is used for short trips, his survey study found that the top four reasons are: the need to carry
14 heavy goods (usually, but not always in the context of shopping), the need to chauffeur another
15 individual (particularly when taking children to and from school or other activities), being in a
16 hurry and the need to be on time at the appointed destination, and because the car is needed for
17 another trip before returning home (trip chaining). While this study does not have sufficient data
18 to further lend evidence on the first and third factors in the list, it can shed further light on the
19 second and fourth factors through an in-depth analysis of short trip characteristics and trip
20 chaining patterns.

21 In addition, Mackett (2003) explored the role of socio-economic and demographic
22 characteristics in shaping mode choice for short trips. He finds that men are more likely to be car
23 drivers because their journeys tend to be longer. In addition men indicate that they choose the car
24 for the convenience factor, because they need the car at work, or because of bad weather.
25 Women are more likely to use the car on a short trip because they are giving a ride to a family
26 member or friend, need the car for another trip (trip chaining), or because it is dark (safety
27 considerations). Young people (aged 17-29) are more likely to use the car for the sake of
28 convenience or because they need it for another trip (chaining). The elderly (60+) are more likely
29 to use the car as well, with the top reasons for doing so being the need to carry goods, or bad
30 weather. In the study, Mackett (2003) found that 22 percent of trips had no alternative mode of
31 transportation despite repeating prompting on the part of the interviewer. Drivers indicated that
32 they would switch modes from car driving if transit, bicycling, and walking infrastructure and
33 services were improved. Being personally organized and having favorable weather were other
34 key factors that would motivate individuals to shift.

35 In an earlier work, Mackett (2001) reported on the policies that would stimulate people to
36 get out of their cars for short trips. He reports that improving transit services and enhancing
37 density and diversity of destinations reachable within short distances would positively contribute
38 to mode switching. It was also found, however, that 33 percent of the respondents felt that they
39 would have to take personal action (for example, in being organized) to bring about a mode shift
40 (in other words, regardless of what is done on the supply side, there is a large percent of travelers
41 where the shift has to happen on the user side). Eriksson, et al (2008) explore ways in which
42 habitual car use patterns may be broken; interestingly, they find that those with a stronger
43 habitual car use behavior are more likely to break away when a deliberate intervention is
44 implemented. De Nazelle, et al (2010) focus on short trips as an opportunity to reduce mobile-
45 source emissions. As a large share of these trips is undertaken by auto, the authors explored
46 whether mode shifts to non-motorized modes for these short trips would help reduce emissions.

1 They find that savings in emissions are modest, but substantial enough to make a meaningful
2 difference and for the most part, exceed the savings in emissions from other federal
3 interventions.

4 A series of studies have looked at walking behavior in the context of the built
5 environment and user socio-economic and demographic characteristics. Boer, et al (2007) note
6 that higher land use density and diversity, and a greater prevalence of four-way intersections are
7 associated with higher levels of walking. Greenwald and Boarnet (2001) note that built
8 environment densities do affect walking, but such effects tend to be localized in nature. The most
9 important determinant of walking behavior appears to be trip distances, and hence there is reason
10 to believe that enhanced neighborhood level urban densities and form could influence walking
11 behavior. Tilt (2010) explores the demographic, environmental, and attitudinal factors that
12 influence walking trips to parks. Adults with children tended to make more walking trips to
13 parks; in addition, the perceived greenery or vegetation influenced walking behavior. King, et al
14 (2003) found that convenience of destinations (proximity and desirability of destinations) is key
15 to walking levels among older women.

16 Overall, it can be seen that there is much interest in exploring ways in which walking
17 mode shares can be increased. While previous studies shed some light on factors that influence
18 walking behavior, additional insights are needed regarding the composition and nature of the
19 short trips to fully understand the constraints that may be preventing people from walking for
20 short trips. This paper is intended to offer a detailed analysis of short trips and explore
21 characteristics of these short trips that may be impeding the adoption of walk as the preferred
22 mode of transportation.

23 24 **DATA DESCRIPTION**

25 The data for this study is derived from the 2008-2009 edition of the National Household Travel
26 Survey (NHTS), a survey that is conducted by the US Department of Transportation on a
27 periodic basis to measure and quantify personal travel in the nation. The data set includes a
28 national sample of more than 150,000 households. In order to focus the analysis to specific
29 geographical areas, two survey samples were extracted from this national sample – a survey
30 sample residing in the Southern California region and a survey sample residing in the Greater
31 Phoenix metropolitan region in Arizona. Both of these regions had large sample sizes in the
32 2008-2009 version of the NHTS because these jurisdictions purchased additional samples with a
33 view to having a sample size large enough that would support model development and travel
34 behavior analysis activities at the local level.

35 As mentioned in the introduction, there is a clear drop-off in the walk mode share at the
36 one mile threshold. Trips less than one mile in length have walk mode shares of about 50 percent
37 in both survey sample data sets. For trips greater than one mile in length (even in the immediate
38 next category of 1-2 mile long trips), the walking mode share drops dramatically to just about 8
39 percent and the personal vehicle mode share goes up to more than 90 percent (in the Greater
40 Phoenix metropolitan area). The figures for the California data set are very similar to these. For
41 this reason, this paper adopts the definition that trips *less than 1 mile in length* are short trips. It
42 appears that such trips are truly candidates for walking, while those one mile or more are not
43 good candidates for walking. In both survey sample data sets, the share of bicycle trips is so
44 small (at about 2-3 percent) with no clear discernible pattern. As such, bicycle is not included
45 within the scope of this paper. This paper focuses exclusively on the choice of personal vehicle
46 or walking. Much of the analysis in this paper is presented for trips that are less than one mile in

1 length with a view to comparing traits of those short trips undertaken by walk against traits of
 2 those undertaken by personal vehicle. Table 1 presents an overview of the respective survey
 3 samples after this short-trip extraction process was completed.

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TABLE 1 Person and Household Characteristics by Study Regions

Characteristic	Study Region	
	Maricopa County	Southern California
Households (N)	1,748	2,572
Average Household Size	2.60	2.79
1 person	18.8%	16.2%
2 persons	42.7%	37.3%
3 persons	14.3%	17.3%
≥ 4 persons	24.2%	29.2%
Average Vehicle Ownership	1.98	2.19
0 auto	3.5%	2.4%
1 auto	28.8%	24.3%
2 autos	45.1%	42.8%
≥ 3 autos	22.6%	30.5%
Annual Household Income		
Less than \$25 K	23.1%	21.0%
\$25 K to less than \$80 K	47.5%	41.3%
\$80 K or more	29.3%	37.7%
Urban	82.3%	94.5%
Urban Cluster	3.9%	1.6%
Non-Urban	13.8%	3.9%
Persons (N)	2,210	3,224
Average Number of Short Trips by Car or Walk	2.17	2.25
Worker	50.5%	55.8%
Non-Worker	49.5%	44.2%
Male	40.8%	45.1%
Female	59.2%	54.9%
16-24 years	6.8%	6.3%
24-44 years	23.9%	25.0%
45-64 years	39.4%	44.2%
65 years or older	29.9%	24.5%
Short Trips (N)	4,800	7,255

6

7 The profiles of both survey samples are fairly similar. The Southern California sample is larger
 8 in comparison to the Greater Phoenix sample. Average household size and car ownership values
 9 are slightly larger in Southern California. A larger percent of households in the Southern
 10 California sample fall into the high income category. The percent of non-urban households is
 11 considerably larger in the Greater Phoenix sample. With respect to person attributes, once again

1 the profiles match up quite well. In both samples, the average short trip frequency (by walk or
2 personal vehicle) is over two trips per day. About one-half of the sample comprises workers.
3 Persons in the Greater Phoenix sample tend to be older as evidenced by the higher proportion of
4 persons in the 65 years and over category. The analysis is limited to persons 16 years and above,
5 as those under 16 years of age may not have the ability to make independent mode choice
6 decisions regarding the use of the automobile (an adult or licensed driver would have to make
7 that decision jointly with the child).

8 9 **DESCRIPTIVE ANALYSIS OF SHORT TRIPS**

10 This section presents a descriptive analysis of short trips in the respective regions to see if there
11 are any key differences between short trips undertaken by personal vehicle and those undertaken
12 by walk. Table 2 presents an analysis of short trip mode choice by trip purpose. Several
13 interesting trends are noticeable in the table. For trips with destination home and work, however,
14 there is no distinct pattern of mode choice. There is an approximately equal split between
15 personal vehicle and walk in these trip purposes. In the Greater Phoenix region, school and
16 religious activities are more likely to be undertaken by personal vehicle (73.4%) in comparison
17 to Southern California (50.4%), possibly due to weather and safety (or lack thereof) of routes to
18 and from school. It is also likely that going to school entails carrying book bags, and the need to
19 carry a load may motivate some to use the personal vehicle. Medical dental (short) trips tend to
20 be auto-oriented as well. This is consistent with expectations as those who are old or sick may
21 find it hard to walk to their doctor's appointment. Also, the need to be on time may motivate the
22 use of the car. The trend is more pronounced in Greater Phoenix than in Southern California.
23 Shopping/errands and social/recreational activity groups show opposing trends. Consistent with
24 Mackett (2003), shopping trips are much more likely to be undertaken by auto – for three
25 possible reasons: shopping trips are chained with other trips leading to a long trip chain (even
26 though the shopping trip leg may be very short), shopping trips may be joint activities with
27 several people in the travel party, and shopping trips may entail the carrying of goods which is
28 hard to do by walk. On the other hand, social recreational activities lend themselves very well to
29 walking and both regions show a high percent of walking for these trips. Similarly, family
30 personal business trips show a high percent of walking; the absence of the need to carry a load
31 and the possibility that these trips are undertaken alone (as opposed to with others) may
32 contribute to the higher walking share for these trips. The personal vehicle is naturally the
33 preferred mode for transporting someone; eat meal activities also show a propensity to be
34 undertaken by personal vehicle with a more lopsided mode share in the Greater Phoenix region.
35 Overall, it can be seen that short trips undertaken by car tend to be more for shopping and
36 transporting someone, while short trips undertaken by walk tend to be more for social recreation
37 and family personal business.

38 An analysis of mode share by travel party size also shows key differences between walk
39 and personal vehicle short trips (tabulation omitted in the interest of brevity). For short trips
40 where the individual is traveling alone, it is found (in both data sets) that upwards of 60 percent
41 of the trips are undertaken by walk. This walk mode share drops dramatically to just 4-5 percent
42 when an additional person is added to the travel party. This finding clearly suggests that joint
43 activities are much more likely to be pursued by personal vehicle regardless of distance.
44 Essentially, 98 percent of all short *walk* trips are undertaken *alone*, a finding that is remarkably
45 consistent across both data sets.

1 **TABLE 2 Mode Choices by Trip Purpose for Two Study Regions**

Trip Purpose		Greater Phoenix			Southern California		
		Vehicle	Walk	Total	Vehicle	Walk	Total
Home	Count	773	906	1679	1041	1356	2397
	% within Trip Purpose	46.0%	54.0%	100.0%	43.4%	56.6%	100.0%
	% within Mode Share	31.4%	38.7%	35.0%	30.1%	35.7%	33.0%
Work	Count	112	98	210	188	228	416
	% within Trip Purpose	53.3%	46.7%	100.0%	45.2%	54.8%	100.0%
	% within Mode Share	4.6%	4.2%	4.4%	5.4%	6.0%	5.7%
School/ Daycare/ Religious	Count	69	25	94	62	61	123
	% within Trip Purpose	73.4%	26.6%	100.0%	50.4%	49.6%	100.0%
	% within Mode Share	2.8%	1.1%	2.0%	1.8%	1.6%	1.7%
Medical/ Dental services	Count	29	5	34	32	21	53
	% within Trip Purpose	85.3%	14.7%	100.0%	60.4%	39.6%	100.0%
	% within Mode Share	1.2%	0.2%	0.7%	0.9%	0.6%	0.7%
Shopping/ Errands	Count	774	222	996	1152	420	1572
	% within Trip Purpose	77.7%	22.3%	100.0%	73.3%	26.7%	100.0%
	% within Mode Share	31.5%	9.5%	20.8%	33.3%	11.1%	21.7%
Social/ Recreational	Count	163	682	845	239	950	1189
	% within Trip Purpose	19.3%	80.7%	100.0%	20.1%	79.9%	100.0%
	% within Mode Share	6.6%	29.1%	17.6%	6.9%	25.0%	16.4%
Family personal business	Count	69	204	273	97	345	442
	% within Trip Purpose	25.3%	74.7%	100.0%	21.9%	78.1%	100.0%
	% within Mode Share	2.8%	8.7%	5.7%	2.8%	9.1%	6.1%
Transport someone	Count	228	56	284	322	114	436
	% within Trip Purpose	80.3%	19.7%	100.0%	73.9%	26.1%	100.0%
	% within Mode Share	9.3%	2.4%	5.9%	9.3%	3.0%	6.0%
Meals	Count	237	134	371	323	279	602
	% within Trip Purpose	63.9%	36.1%	100.0%	53.7%	46.3%	100.0%
	% within Mode Share	9.6%	5.7%	7.7%	9.3%	7.3%	8.3%
Total	Count	2458	2342	4800	3458	3797	7255
	% within Trip Purpose	51.2%	48.8%	100.0%	47.7%	52.3%	100.0%
	% within Mode Share	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

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3 As expected, vehicle ownership plays a key role in shaping mode choice for short trips.
4 The walk mode share of short trips for individuals who live in households with zero vehicles is
5 88.3 percent in the Greater Phoenix area and 84.6 percent for the Southern California region. As
6 soon as households have one more vehicles, the share of walk drops dramatically. Regardless of
7 whether households have one, two, or three or more vehicles, the share of walk trips is less than
8 50 percent in the Greater Phoenix region. The share is just above 50 percent for the Southern
9 California region for one and two vehicle households, but under 50 percent for 3 or more vehicle
10 owning households. It appears that the availability of a vehicle affords the opportunity to chain
11 short trips with other trips into a longer trip chain and pursue the chain by auto; this close linkage
12 between trip chaining and mode choice has been found in previous studies (Ye, et al, 2007).

1 Nearly 60 percent of the short trips in the Greater Phoenix area, and 55 percent of the
2 short trips in the Southern California region, are made by females suggesting that females
3 account for a greater share of short trips than males. It appears that females are more auto
4 oriented in the pursuit of short trips. In the Greater Phoenix area, it is found that females account
5 for 55.8 percent of short walk trips; this percent jumps to 63.5 percent for short auto trips.
6 Similar differences are seen for the Southern California region sample. It is found that 53.6
7 percent of all male trips are by walk; the corresponding percent for females is lower at 45.6
8 percent. The Southern California region sample also exhibits similar behavioral pattern, albeit
9 with more modest differences. There are several reasons why females are more inclined to use
10 the automobile. As noted in previous studies, females are more likely to be transporting someone
11 (such as a child), fulfilling household obligations and maintenance activities (shopping), and
12 have concerns regarding personal safety (Gustafson, 2006; Foster, et al, 2004).

13 It should be noted that extensive analyses was undertaken to identify other noteworthy
14 dimensions or characteristics that could distinguish between walk and personal vehicle use for
15 short trips. In the interest of brevity, many tabulations are not furnished in this paper. In general,
16 it was found that many other factors played no meaningful role in distinguishing personal vehicle
17 and walk short trips. A brief synopsis of findings is as follows:

- 18 • *Person age*: The mode shares (between walk and personal vehicle) for short trips
19 remained fairly steady across all age groups. It does not appear that older individuals are
20 less inclined to walk.
- 21 • *Driver license holding*: As expected, driver license holding played a key role in mode
22 choice. While 71 percent of all non-driver trips were by walk, only 47 percent of all
23 driver trips were by walk. It is possible that drivers are able to chain their short trips into
24 longer auto tours. These percentages are for the Greater Phoenix sample, and are similar
25 to those reported by the Southern California region sample.
- 26 • *Day of week*: There was no discernible impact of day of week on short trip mode share.
27 In both the Greater Phoenix and Southern California regions, it was found that short trips
28 on weekend days (Saturday and Sunday) exhibited a slightly larger mode share for
29 personal vehicles relative to weekdays. It is possible that short trips on weekend days are
30 chained as part of longer discretionary activity and shopping tours.
- 31 • *Time of Day*: A time of day based analysis was performed only for the Greater Phoenix
32 area survey sample. It is found that the walk mode share for short trips undertaken after 7
33 PM (night period) is quite high at 68.7 percent. On the other hand, walk mode share for
34 short trips undertaken mid-day is only 36 percent. While 21.3 percent of all short walk
35 trips happen at night, nearly 50 percent of all personal vehicle walk trips happen at mid-
36 day. The auto mode share is higher in the PM peak period (3-7 PM) than in the AM peak
37 period (6-9 AM). It is likely that PM short trips involve transporting someone and
38 engaging in trip chains (as individuals are likely to engage in discretionary activities in
39 the evening than in the morning), and hence auto mode shares in the PM peak are higher.
40 Weather may be contributing factor for larger walk shares in the night (when
41 temperatures in the Greater Phoenix area are likely to be lower and pleasant for walking).
- 42 • *Trip length*: There is a noticeable difference in mode shares at the 0.5 mile threshold. So,
43 within trips that are less than 1 mile in length, an examination of mode shares for trips
44 that are less than 0.5 mile in length versus those that are 0.5 to 1 mile in length exhibits a
45 reversal in modal split. While trips less than 0.5 mile have a 55 percent walk share, trips
46 between 0.5 and 1 mile have a 43 percent walk share. These values, calculated for the

1 Greater Phoenix sample, are similar to those reported by the Southern California region
2 sample.

- 3 • *Household income*: Mode shares for auto and walk remain rather steady across income
4 categories, although there is a weak tendency towards a higher auto mode share with
5 increasing income (in both Greater Phoenix and Southern California). Higher income
6 levels may be associated with higher levels of car ownership, thus contributing to this
7 weak tendency.

8 Although the descriptive analysis provided valuable insights into the factors affecting mode
9 choice, further in-depth analysis was undertaken on the Greater Phoenix data set to understand
10 trip chaining and time of day constraints that may motivate individuals to use the personal
11 vehicle even for short trips less than one mile in length. As both metropolitan regions
12 investigated in the descriptive analysis phase of the study exhibited virtually identical patterns, it
13 was considered sufficient to perform the more complex trip chaining analysis for one region.

14 **TRIP CHAINING ANALYSIS FOR GREATER PHOENIX METROPOLITAN AREA**

15 Trip chaining may be a deterrent to alternative mode use in general and walking in particular
16 (Ye, et al, 2007). When trips are chained into longer (multi-stop) tours, then the true distance of
17 the travel event is no longer short. If an individual commutes 50 miles to work, and then shops at
18 a store 0.5 mile from home on the way home from work, then this individual has traveled
19 upwards of 100 miles on the complete tour. The fact that there is a 0.5 mile shop-to-home short
20 distance trip is rather irrelevant to the mode choice process (although the use of the personal
21 vehicle likely facilitated the stop-making event) as the mode choice is dictated by the commute
22 distance. If an individual used transit on the other hand, then it is entirely possible that the
23 individual would have returned straight home from work, and then pursued the shopping activity
24 in a separate home-based shopping tour (with just one stop). Presumably, it would have been
25 possible to walk in the separate short home-based shopping tour. Thus, trip chaining patterns
26 play a key role in shaping mode choice (and vice-versa) in the context of short trips.

27 Table 3 presents an analysis of the number of stops in the trip chains that include a short
28 trip segment and the consequent implications for mode shares. The table shows some interesting
29 patterns that are consistent with expectations and may explain, to a considerable degree, why
30 personal vehicle mode share for short trips is so high. Consider one-stop trip chains. These are
31 trip chains in which there are just two short trips; the short trip to the destination (less than one
32 mile) and the short trip back to the anchor location (usually home, but may also be work). For
33 these tours, the total tour length is likely to be approaching two miles presenting a challenge to
34 the adoption of the walk mode. In other words, the walk mode share for trips that are less than
35 0.5 mile or 1 mile in length is just about 50 percent (and not higher) because the total length of
36 the tour involving even a one-stop chain is unlikely to be favorable to the use of the walk mode.
37 In the table, it can be seen that, one-half of all walk short trips fall within one-stop chains. On the
38 other hand, only 36.5 percent of all personal vehicle short trips fall within one-stop chains. It is
39 noteworthy that short trips even with multi-stop chains exhibit high walk mode shares. A further
40 investigative analysis revealed that these chains tend to be multimodal tours. The individual is
41 walking the short trip to a bus or rail stop, or a parking facility. This short walk trip is but one leg
42 in a multi-leg trip chain. The remainder of the trip chain (with the exception of the short trip) is
43 being undertaken by a mechanized mode. The table should therefore be interpreted with care; the
44 seemingly high walk mode shares apply only to and are calculated based on the short trip leg
45

1 segment within the multi-stop (and generally multimodal) tour. The mode shares do not depict
 2 the modal split for the primary mode of the tour.

3

4 **TABLE 3 Distribution of Number of Stops per Trip Chain by Modal Split**

Number of Stops in The Chain		Mode Share		Total
		Personal Vehicle	Walk	
1 Stop	Count	671	970	1641
	% within Stops	40.9%	59.1%	100.0%
	% within Mode Share	36.5%	50.2%	43.5%
2 - 3 Stops	Count	703	604	1307
	% within Stops	53.8%	46.2%	100.0%
	% within Mode Share	38.2%	31.3%	34.7%
4 - 5 Stops	Count	302	211	513
	% within Stops	58.9%	41.1%	100.0%
	% within Mode Share	16.4%	10.9%	13.6%
6 - 7 Stops	Count	119	113	232
	% within Stops	51.3%	48.7%	100.0%
	% within Mode Share	6.5%	5.8%	6.2%
8 or more Stops	Count	45	34	79
	% within Stops	57.0%	43.0%	100.0%
	% within Mode Share	2.4%	1.8%	2.1%
Total	Count	1840	1932	3772
	% within Stops	48.8%	51.2%	100.0%
	% within Mode Share	100.0%	100.0%	100.0%

5

6 Table 4 presents an analysis where the modal shares are examined in relation to the
 7 fraction of the total tour length that is accounted by short trips. For example, suppose a trip chain
 8 is a one-stop chain with two short trips. Then short trips account for 100 percent of the tour
 9 length. On the other hand, if the short trip is chained with a series of other longer trips, then the
 10 short trip may only constitute a small fraction of the total tour length. The sample sizes for the
 11 proportion categories of 0.5 to 0.75 and 0.75 to 0.99 are too small to be included in the analysis.
 12 Therefore, those rows are suppressed in the table. Once again, a clear pattern may be discerned.
 13 When the short trips account for 100 percent of the tour length, walk enjoys a 62.5 percent mode
 14 share (in this row, the tour consists of nothing but short trips). On the flipside, it is somewhat
 15 disconcerting to note that, even when a tour consists of nothing but short trips, auto mode share
 16 is as high as 37.5 percent. Further investigative analysis revealed that many of these tours
 17 involve shopping, transporting someone, or other considerations that would motivate the use of
 18 the private automobile. In situations where the short trip is only a small fraction of the total tour,
 19 the walk mode shares fall to 37.8 percent and 42.2 percent for the two fractional categories
 20 included in the table. Travelers are less likely to walk when the short trip is part of a longer tour.
 21 Once again, it should be noted that the walk mode shares of 37.8 and 42.2 apply just to the short
 22 trip leg in the chain, and not the primary mode of the tour as a whole. If one were to examine the
 23 primary mode of the tour (determined based on distance traveled by different modes in a
 24 multimodal tour), then the walk mode share is extremely small.

25

26

1 **TABLE 4 Modal Shares by Fraction of Total Tour Length Covered by Short Trips**

Ratio of Short Trip Length to Total Distance Traveled in the Chain		Mode Share		Total
		Personal Vehicle	Walk	
Less than 0.25	Count	912	555	1,467
	% within Fraction	62.2%	37.8%	100.0%
	% within Mode Share	49.6%	28.7%	38.9%
0.25 to 0.50	Count	129	94	223
	% within Fraction	57.8%	42.2%	100.0%
	% within Mode Share	7.0%	4.9%	5.9%
1.00	Count	767	1,277	2,044
	% within Fraction	37.5%	62.5%	100.0%
	% within Mode Share	41.7%	66.1%	54.2%
Total	Count	1,840	1,932	3,772
	% within Fraction	48.8%	51.2%	100.0%
	% within Mode Share	100.0%	100.0%	100.0%

2

3 **CONCLUSIONS**

4 This paper presents a detailed investigation of the nature of short trips with a view to
 5 understanding why these short trips do not claim a larger walk (and bicycle) mode share. With
 6 increasing interest in sustainability and mitigating the adverse energy and environmental impacts
 7 of auto travel on communities and quality of life, transportation planning professionals are
 8 seeking ways to reduce greenhouse gas emissions and the energy footprint of personal travel.
 9 Presumably, short trips those are less than one mile in length represent “low-hanging fruit”.
 10 Given that short trips are excellent candidates for walking and bicycling, perhaps there are
 11 substantial gains to be had in this domain by shifting travelers from auto to walk and bicycle for
 12 these trips. Shifting travelers to the walk mode for these kinds of trips are likely to yield personal
 13 and public health benefits as well due to the physical activity associated with walk and bike use.

14 In this study, short trips are isolated and analyzed for two different survey samples in the
 15 United States. The survey samples are drawn from the 2008-2009 National Household Travel
 16 Survey for the Southern California and Greater Phoenix metropolitan regions. It is found that
 17 there is clear cutpoint at the one mile threshold. Trips below this length enjoy walk mode shares
 18 of 50 percent, while trips greater than one mile in length see walk mode shares of just a few
 19 single digit percentage points. Therefore, short trips are defined in this paper as those trips which
 20 are less than one mile in length.

21 An extensive analysis and characterization of short trips is performed to understand how
 22 and why these trips have the mode shares that they do. In general, there are certain key findings
 23 that can be taken away from the analysis:

- 24 • Short trips undertaken by auto are more likely to be shopping trips or trips that involve
 25 transporting someone.
- 26 • Short trips undertaken by walk are more likely to be family/personal business trips and
 27 social recreational trips.
- 28 • Females are more inclined to use the personal vehicle as a mode of transport, even for
 29 short trips, presumably because they transport someone (child) and undertake more of
 30 the household maintenance activities necessitating a fair amount of trip chaining and
 31 movement of household goods and cargo (e.g., shopping bags).

- 1 • Short trips undertaken by auto are more likely to involve multiple people in the travel
2 party.
- 3 • When short trips are chained into multi-stop tours, then the modal share for walk
4 drops considerably. Trip chaining generally leads to the formation of long tours, and
5 hence the personal vehicle becomes a more preferred mode for such tours. In
6 multimodal tours, the short trip may still be undertaken by walk – thus the walk share
7 for short trips remains high even in multi-stop and long trip chains.
- 8 • Trip chaining appears to be a clear deterrent to walking.

9
10 Further investigative analysis is warranted to determine the extent to which short trips can truly
11 be switched to the walk mode. Many factors would have to align themselves for this to happen.
12 The estimation of multivariate statistical models would help in the identification of the
13 combinations of factors that could bring about significant shifts to non-motorized mode use, and
14 isolation of the impacts of each factor in a multivariate setting. The estimation of such a model
15 remains a future exercise. Pending such an exercise, however, it is possible to take some lessons
16 away from the analysis presented in this paper.

17 First, it appears that the fraction of short trips that are truly candidates for mode switching
18 is really small. If all of the short trips that involve transporting someone, joint activity
19 engagement, shopping (and transport of cargo or goods), harsh weather conditions, and trip
20 chaining in a longer multi-stop tour are removed from the set of candidate trips, then there are
21 precious few remaining short auto trips that are amenable to switching to the walk mode. What
22 is necessary, then, is to design built environments and create avenues to overcome these
23 constraints. Enhancing neighborhood accessibility to destination opportunities through the
24 increase in density and diversity of land uses would potentially reduce the need for trip chaining,
25 and make it possible to engage in more frequent shopping activities characterized by lighter
26 payloads. Individuals would be able to engage in more short home-based tours that are amenable
27 to walking and bicycling. The provision of neighborhood parks, sports facilities, schools and
28 playgrounds, and other child amenities would make it possible for children to walk or bike on
29 their own to these destinations. Short trips that are currently undertaken to chauffeur children can
30 be eliminated if such built environments were created. An aspect that has not been covered in
31 this paper at all is that of the supply (network) side of the research question. Pedestrian and
32 bicycle facilities must be well-connected and safe so that individuals would feel comfortable
33 walking and bicycling, and can access a range of destination options by non-motorized modes of
34 transportation.

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