

**Food Shopping in the Urban Environment: Parking Supply, Destination Choice and Mode Choice**

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**ABSTRACT**

This research contributes to literature on the influence of urban form on travel behavior. It examines the specific impact of surface parking lots at supermarkets. Past studies have demonstrated that design elements of a neighborhood (density, mix of uses, street connectivity, sidewalk condition, tree cover, etc.) have correlations with travel behavior (vehicle miles traveled, walking trip rates, transit ridership, etc.). In the present case, those elements are controlled by selecting supermarkets in six Philadelphia neighborhoods all characterized by urban design features associated with high rates of walking. Travel behavior of residents within a one-half mile catchment shed of each supermarket is examined. Using a quasi-experimental methodology, two design typologies for supermarkets are analyzed. Three of the supermarkets are auto-oriented, with large setbacks from the street and large surface parking lots, while the other three are pedestrian-oriented. They are not set-back from the street, their entrances open to a sidewalk rather than a surface lot, and their available parking is structured or priced, even though parking is still free with grocery purchases. Using a discrete choice framework, binary logit models were developed demonstrating that surface parking lots encourage automobile access over pedestrian access. Moreover, while surface parking lots were shown to influence mode choice, they were not shown to increase use of a supermarket among nearby residents.

## INTRODUCTION

This study investigates the influence of supermarket site design on food shopping access. Prior research demonstrates that decisions about food shopping (trip frequency, choice of destination and mode of transportation) vary based on household characteristics (e.g. size and income) and non-household characteristics (e.g. qualities of supermarkets and qualities of the built environment) (1-11). Scholars have tried to identify ways planners and policy makers can influence shopping travel patterns. Much research in this area aims to increase non-motorized mode share, with ultimate goals varying from reduced greenhouse gas emissions, oil consumption and road congestion to increased exercise and livability. Within this body of literature, the role of urban form in shaping travel habits is a key subject of study (1, 7, 12-22).

The present investigation examines a previously unexplored singular aspect of urban form on shopping travel patterns: the availability of surface parking lots. Past research has demonstrated that design elements of a neighborhood (density, mix of uses, sidewalk condition, tree cover, etc.) have a statistically significant impact on shopping travel behavior (1, 7, 13, 15-22). With a focus limited to food shopping, this study holds neighborhood design constant to evaluate the separate role of destination site design, specifically the presence or absence of a surface parking lot.

Using survey results from households in neighborhoods adjacent to 6 supermarkets in Philadelphia, PA, this paper shows that surface parking lots encourage automobile access over pedestrian access. Moreover, while surface parking lots are shown to influence mode choice, they do not show any advantage in terms of increased use of a supermarket by nearby residents.

## PREVIOUS RESEARCH

Travel models estimate a utility derived from travel decisions. A utility can be calculated for a package of choices including mode, route, time of day, and even the destination itself. For food shopping, a decision about destination or mode on any particular day is likely to take several contextual factors into account. A shopper might walk to a nearby supermarket with higher prices instead of driving to a distant supermarket with lower prices on a day when he or she is short on time. Other dynamic factors can include the weather, types of items needed or the location of other activities the shopper will participate in that day (5, 6).

The relative proximity of a market is key, as food shopping is more likely to be locally-based than any other type of shopping trip (6, 7), but it is not the only factor. Research has identified considerations in choosing a destination that include quality of goods, atmosphere, selection, crowds, prices, proximity to other destinations (e.g., workplace), or loyalty to a particular brand (6-8). Households tend to have a primary grocery store, though many also make trips to non-primary stores, up to 3 or 4 times over the course of a month (5, 7, 11). Some evidence suggests that a significant number of food trips are small, perhaps for only one or two bags of groceries (5, 2, 7, 11). In studies on the topic of mode choice, scholars frequently examine scales of urbanism, comparing areas of high and low “D variables”: density (population, employment, etc.), diversity (of land uses), design (street connectivity, street width, building setback, etc.), destination accessibility (e.g., average distance to destination), and distance to transit (1, 7, 13, 15-22).

Characteristics of shoppers themselves influence behavior. Studies demonstrate that income, ethnicity, number of children and number of available vehicles influence how often

people shop, where they shop, and how they get there (2, 4, 8, 9, 11). Bawa and Ghosh (2) suggest middle-income households are most pressed for time, making fewer shopping trips than either high- or low-income households. Rajamani et al. (21) found that higher income households in Portland, OR were more likely to drive to non-work destinations than lower-income households.

Ease of parking is a factor that has been suggested by other studies. Bell, Ho and Tang (3) assume parking as a component of a fixed cost variable in their model on supermarket choice. In an empirical study of consumers' shopping decision-making processes, Dellaert, et al. (6) encountered parking as a consideration, but not a statistically significant one. Van der Waerden et al. (22) observe that the probability of choosing particular parking lots can decrease as size of lot increases, perhaps because shoppers are averse to long walks through parking lots.

Recent research on mode choice pays particular attention to the question of self-selection, or the possibility that residents who choose to walk in "walkable" neighborhoods have chosen their environments purposefully, rather than fallen under the influence of them. Such a condition would seem to dim the prospects of using changes in urban form to influence behavior. However, studies have begun to demonstrate a statistically significant correlation between the built environment and travel behavior even after controlling for self-selection (12-20). Furthermore, the role of self-selection should not obscure the fact that demand for walkable communities in the US may well exceed current supply (23).

Past studies have reached the foreseeable conclusion that households far from shopping destinations are unlikely to make walking trips (7). Missing from the literature is a robust discussion of how the decision to drive 5 miles to a supermarket in a low-density exurb is different from the decision to drive one-half mile to a supermarket in a dense city. To address this gap, this research focuses only on households in dense urban environments living within a one-half mile walk shed of a supermarket. Understanding the effects of store design—in particular street setbacks and parking configuration—on travel behavior for this subset of shoppers could facilitate the development of policies that encourage (or discourage) walking as a strategy for reducing congestion and improving air quality and livability.

## **METHODOLOGY**

The present study considers six neighborhoods adjacent to full-service supermarkets. The neighborhoods, all in Philadelphia, PA, can be characterized as dense residential districts, consisting mostly of attached row-homes and apartment buildings. Retail is a common ground floor use. Surrounding street networks are grids with sidewalks on both sides of the street. Few, if any, buildings are set back from the street. The largest variations between neighborhoods are found in tree coverage and vacancy rates. Past research has demonstrated that shoppers will avoid crossing a major arterial on foot (7), so neighborhoods with these circumstances were avoided. Supermarkets adjacent to dense, walkable neighborhoods but along big box retail corridors were also avoided under the assumption that even nearby residents would most likely view them as automobile destinations. One supermarket was located near railroad tracks, but surveying was limited to households on the same side of the tracks as the supermarket.

This research focuses on supermarket design with respect to auto or pedestrian orientation. The supermarkets were chosen in two sets of three. Half the supermarkets were selected because their sites include a large surface parking lot and half were chosen because their sites have little or no surface parking. For the purposes of this paper, the former three are

referred to as “auto-oriented markets” (A1, A2 and A3) and the latter three are referred to as “pedestrian-oriented markets” (P1, P2 and P3) (Figures 1 and 2). While two of the pedestrian-oriented markets have above ground parking and one has a small side lot (15 spaces), they all exhibit urban design characteristics such as a zero setback from the street and a front door that opens directly onto a city sidewalk. By contrast, the “auto-oriented markets” have between 150 and 210 parking spaces, and setbacks from the street ranging between 190 and 280 feet (Table 1).

Rather than gathering data at supermarkets (*1, 11*), or broadly across the city irrespective of where or what kinds of food shopping opportunities exist (*7, 12-14, 16-20*), this study surveyed only those residents that live within a half-mile walking distance of a full-service chain supermarket. While the surveyed food shoppers represent a broad range of incomes and races, all live in neighborhoods that exhibit urban design characteristics consistently associated with high levels of pedestrian activity, including a high density and mix of land uses, street network connectivity, and the presence of sidewalks (*1, 7, 13, 15-22*).

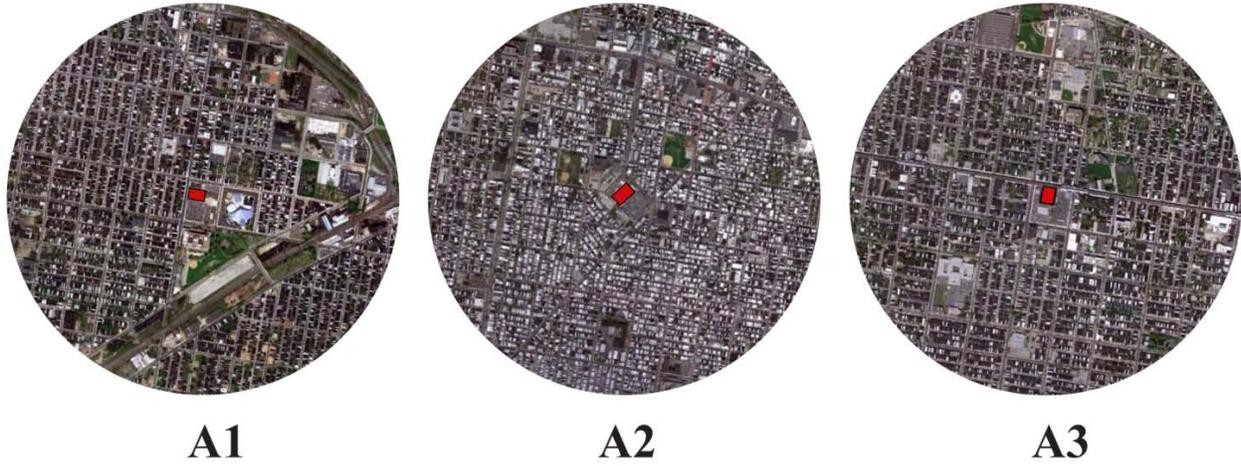
**TABLE 1 Supermarket Parking Supply**

	Number of Parking Spots Dedicated to Food Shoppers	Location of Parking	Parking Policies / Other Parking	Front Door Setback from Facing Street
A1	150	Surface lot between main street and front entrance	All parking food shoppers only	280 ft.
A2	210	Surface lot between main street and front entrance	All parking food shoppers only	260 ft.
A3	180	Surface lot between main street and front entrance	All parking food shoppers only	190 ft.
P1	24 (400) <sup>a</sup>	Above supermarket	400 parking spaces available to public at hourly and daily rates; 400 parking spaces available for university permit parking; free parking under 2 hours with \$10 food store purchase; \$3 parking under 4 hours with movie ticket purchase	0 ft.
P2	15	Surface lot to the left of front door along sidewalk	All parking food shoppers only	0 ft.
P3 <sup>b</sup>	30 (245) <sup>a</sup>	Above supermarket	245 parking spaces available to public at hourly, daily, and monthly rates; free parking under 2 hours with \$10 food store purchase	0 ft.
	116	Above supermarket	All parking food shoppers only	0 ft.

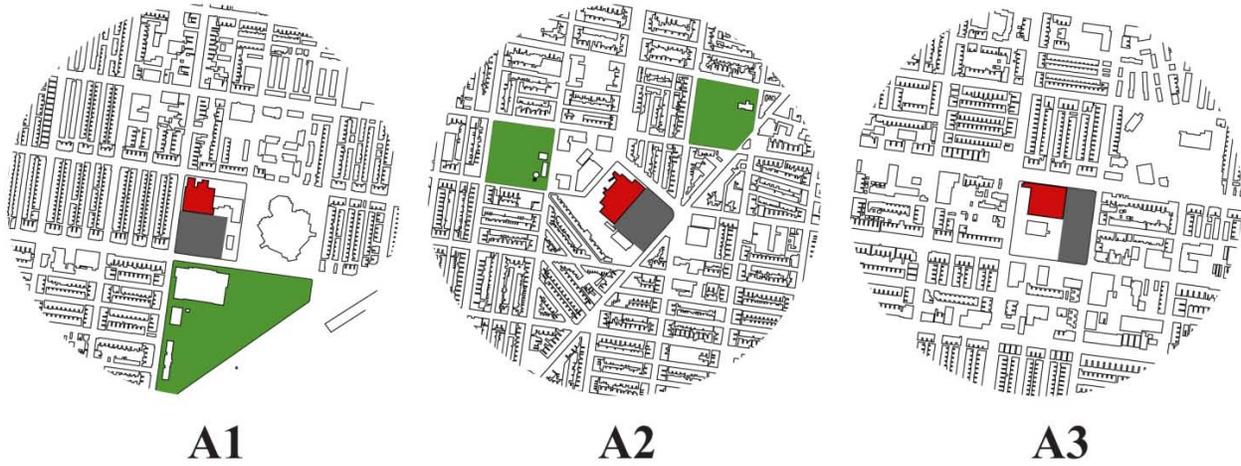
<sup>a</sup> Additional parking available but not dedicated for shoppers

<sup>b</sup> There are two pedestrian-oriented supermarkets adjacent to each other at this site

### Auto-Oriented Supermarket Study Areas (1/2-Mile Radius)



### Auto-Oriented Supermarket Site Designs (1/4-Mile Radius)



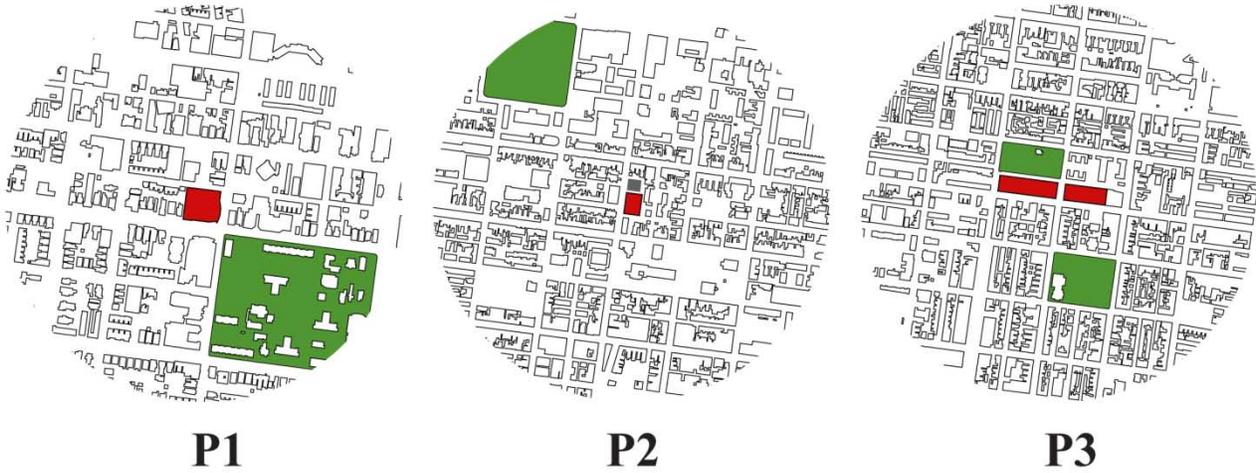
**■ Supermarket Footprint** **■ Open Space** **■ Surface Parking Lot** **□ Other Building Footprint**

FIGURE 1 Auto-oriented supermarket study areas and site designs.

### Pedestrian-Oriented Supermarket Study Areas (1/2-Mile Radius)



### Pedestrian-Oriented Supermarket Site Designs (1/4-Mile Radius)



■ Supermarket Footprint   ■ Open Space   ■ Surface Parking Lot   □ Other Building Footprint

**FIGURE 2** Pedestrian-oriented supermarket study areas and site designs. Note that P3 is comprised of two pedestrian-oriented supermarkets across the street from one another.

Data were collected using a 12-question postcard survey (Figure 3) distributed to 3,600 dwelling units, 600 per catchment area. The postcards were addressed and stamped; the instructions were that the primary food shopper of the household complete the survey and drop it in a mailbox. Because each survey asked about the nearby supermarket by name, each response could be classified according to market-neighborhood.

We employ a random utility discrete choice framework to analyze the choices of interest (24, 25). In this framework, theory suggests that a decision-maker derives utility from his/her choice of mode and/or destination. Utility ( $U$ ) is comprised of observed and unobserved elements. The observed portion is typically referred to as the systematic portion of utility. It is denoted  $V$  and is determined by characteristics of the person ( $i$ ) who is making the choice and the characteristics of the competing choices and/or other explanatory variables ( $j$ ). The remainder of the utility is captured in the residual term  $\varepsilon$  (24, 25). Hence utility is given as:

$$U = V + \varepsilon \quad (1)$$

The probability that a mode (walking, in this case) is chosen is a function of the probability that the utility for walking is higher than the utility for not-walking.

$$\begin{aligned} P_i(\text{walk}|\text{characteristics}_{ij}) &= \Phi(V_{\text{walk}} + \varepsilon_{\text{walk}}) \\ &= \Pr(V_{\text{walk}} + \varepsilon_{\text{walk}} > V_{\text{not walk}} + \varepsilon_{\text{not walk}}) \\ &= \Pr(\varepsilon_{\text{not walk}} - \varepsilon_{\text{walk}} < V_{\text{walk}} - V_{\text{not walk}}) \end{aligned} \quad (2)$$

The left-hand side of the equation is the probability that person ( $i$ ) walks to the grocery store, given the characteristics of person ( $i$ ) and the choice set or environment ( $j$ ) faced by person ( $i$ ). In this particular case, the environment variable pertains to the absence or presence of a surface parking lot at the supermarket.

We use the same methodological framework to study the probability that someone chooses his/her local supermarket. Equation (2) is modified:

$$\begin{aligned} P_i(\text{local supermarket}|\text{characteristics}_{ij}) &= \Phi(V_{\text{ls}} + \varepsilon_{\text{ls}}) \\ &= \Pr(V_{\text{ls}} + \varepsilon_{\text{ls}} > V_{\text{not ls}} + \varepsilon_{\text{not ls}}) \\ &= \Pr(\varepsilon_{\text{not ls}} - \varepsilon_{\text{ls}} < V_{\text{ls}} - V_{\text{not ls}}) \end{aligned} \quad (3)$$

The left-hand side is the probability that person ( $i$ ) chooses his/her local supermarket, given the characteristics of person ( $i$ ) and the choice set or environment ( $j$ ) faced by person ( $i$ ).

<p>1) How often do you make big food shopping trips?  <input type="checkbox"/> Every week      <input type="checkbox"/> Every month  <input type="checkbox"/> Every 2 weeks      <input type="checkbox"/> Never/Other: _____</p> <p>2) How often do you make small shopping trips?  <input type="checkbox"/> Every week      <input type="checkbox"/> Several times a week  <input type="checkbox"/> Every 2 weeks      <input type="checkbox"/> Never/Other: _____</p> <p>3) How often does your household use the <i>Fresh Grocer at 40th and Walnut</i>?  <b>For big trips:</b> <input type="checkbox"/> Always    <input type="checkbox"/> Sometimes  <input type="checkbox"/> Never, we use: _____  <b>For small trips:</b> <input type="checkbox"/> Always    <input type="checkbox"/> Sometimes  <input type="checkbox"/> Never, we use: _____</p> <p>4) If you shop there, how do you get there?  <input type="checkbox"/> Drive no matter what  <input type="checkbox"/> Walk no matter what  <input type="checkbox"/> Drive for big trips, walk for small trips  <input type="checkbox"/> Drive in a rush/bad weather, otherwise walk  <input type="checkbox"/> Other: _____</p> <p>5) How many blocks is that store from you? _____</p> <p>6) How many people are in your household?          Adults _____ Children _____</p>	<p>7) Which best describes your food shopping pattern, regardless of where you food shop?  <input type="checkbox"/> On the way home from work  <input type="checkbox"/> As part of a chain of several errands  <input type="checkbox"/> Completely separate trip</p> <p>8) If the main food shopper in your household also works full time, how does he/she get to work?  <input type="checkbox"/> Walk/Bicycle      <input type="checkbox"/> Public Transit  <input type="checkbox"/> Automobile      <input type="checkbox"/> Doesn't Work</p> <p>9) How many cars does your household own?  <input type="checkbox"/> One      <input type="checkbox"/> We only use car share  <input type="checkbox"/> More than one      <input type="checkbox"/> We don't drive</p> <p>10) What is your household's average yearly income?  <input type="checkbox"/> Less than \$20,000    <input type="checkbox"/> \$50,000-\$100,000  <input type="checkbox"/> \$20,000-\$50,000    <input type="checkbox"/> More than \$100,000</p> <p>11) What is the race/ethnicity of the food shopper?  <input type="checkbox"/> Black/African-Am.    <input type="checkbox"/> Latino/Hispanic  <input type="checkbox"/> White/Caucasian    <input type="checkbox"/> Other: _____</p> <p>12) Please rank (1-4) how important these factors are for your household in choosing a supermarket.          ___ How close it is      ___ How low the prices are          ___ Quality of items      ___ Atmosphere of the store</p>
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**FIGURE 3 Survey distributed to households.**

**RESULTS**

Response rates and demographic data from the survey and from the Census for each market-neighborhood are shown in Table 2. The largest discrepancies between the survey and the Census are for market-neighborhood P1, and are likely due to the fact that this is a university area with a combination of permanent and temporary residents. The following sections highlight differences by neighborhood and by access to automobiles. Results of the models show that, controlling for distance, number of children, store loyalty, auto ownership and other factors, residents of study areas near auto-oriented supermarkets are more likely to drive, even though they are less likely to own automobiles, than their counterparts living near pedestrian-oriented markets. We also show that the presence or absence of surface parking lots does not engender greater store loyalty.

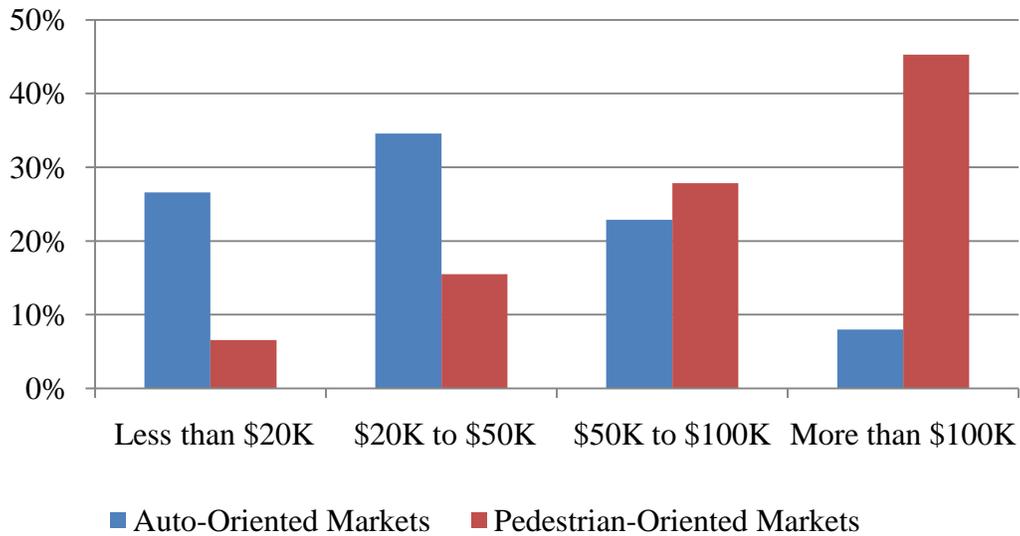
**TABLE 2 Response Rates and Neighborhood Characteristics**

	Response Rate	Household Income			Race/Ethnicity of Primary Shopper			Household Auto Ownership		
			Survey	Census <sup>a</sup>		Survey	Census <sup>a</sup>		Survey	Census <sup>a</sup>
A1	7.3%	<\$20K	39%	48%	White/Caucasian	2%	1%	No cars	27%	51%
		\$20-50K	32%	32%	Black/Af. Am.	89%	97%	One car	50%	34%
		\$50-100K	9%	17%	Other	9%	2%	More than one	16%	15%
		>\$100K	2%	3%						
A2	15.5%	<\$20K	13%	43%	White/Caucasian	86%	86%	No cars	15%	44%
		\$20-50K	33%	28%	Black/Af. Am.	1%	1%	One car	56%	39%
		\$50-100K	33%	24%	Other	13%	13%	More than one	25%	17%
		>\$100K	14%	5%						
A3	8.5%	<\$20K	41%	39%	White/Caucasian	4%	2%	No cars	45%	49%
		\$20-50K	39%	39%	Black/Af. Am.	90%	97%	One car	41%	40%
		\$50-100K	16%	21%	Other	6%	1%	More than one	10%	11%
		>\$100K	2%	1%						
P1	12.5%	<\$20K	20%	68%	White/Caucasian	69%	58%	No cars	25%	67%
		\$20-50K	32%	24%	Black/Af. Am.	11%	13%	One car	44%	21%
		\$50-100K	31%	7%	Other	20%	28%	More than one	20%	12%
		>\$100K	16%	1%						
P2	29.5%	<\$20K	1%	10%	White/Caucasian	92%	91%	No cars	6%	26%
		\$20-50K	7%	26%	Black/Af. Am.	2%	4%	One car	63%	58%
		\$50-100K	24%	26%	Other	6%	5%	More than one	25%	16%
		>\$100K	61%	38%						
P3	26.8%	<\$20K	6%	29%	White/Caucasian	84%	80%	No cars	17%	57%
		\$20-50K	17%	36%	Black/Af. Am.	5%	10%	One car	50%	40%
		\$50-100K	30%	22%	Other	11%	10%	More than one	14%	4%
		>\$100K	42%	13%						

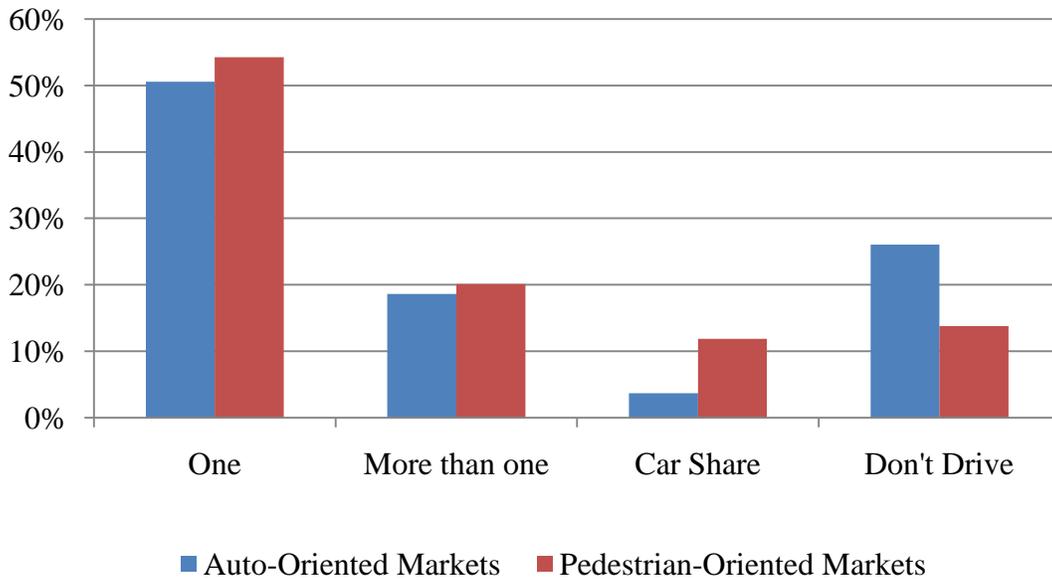
<sup>a</sup> Data is according to the census tract containing the supermarket itself, which is in every case somewhat smaller than the half-mile radius study area

**Neighborhood Differences**

In auto-oriented market-neighborhoods, residents were found on average to be poorer (Figure 4), disproportionately Black or African-American (46% compared to 5% in the other neighborhoods), own fewer cars (Figure 5), and are more likely not to be working—whether retired or unemployed (31% versus 24% not working).



**FIGURE 4 Income Distribution.**



**FIGURE 5 Ownership and Access to Cars.**

### Access Differences

In our sample, 10% of respondents indicated that they always drive to the grocery store, regardless of market-neighborhood. If you include those respondents who drive for “big trips” but walk for “small trips” (size interpreted by respondents), or who drive when they are in a hurry/during bad weather and walk when they are not, about 40% of respondents indicated that they drive sometimes to the store. Overall, 51% indicated that they always walk. The remainder use bicycles, take transit, receive deliveries or use other means. Limiting the sample to households that own cars or use car-sharing, the distribution shifts slightly. Among those households, about 45% drive for at least some trips while 44% of respondents always walk.

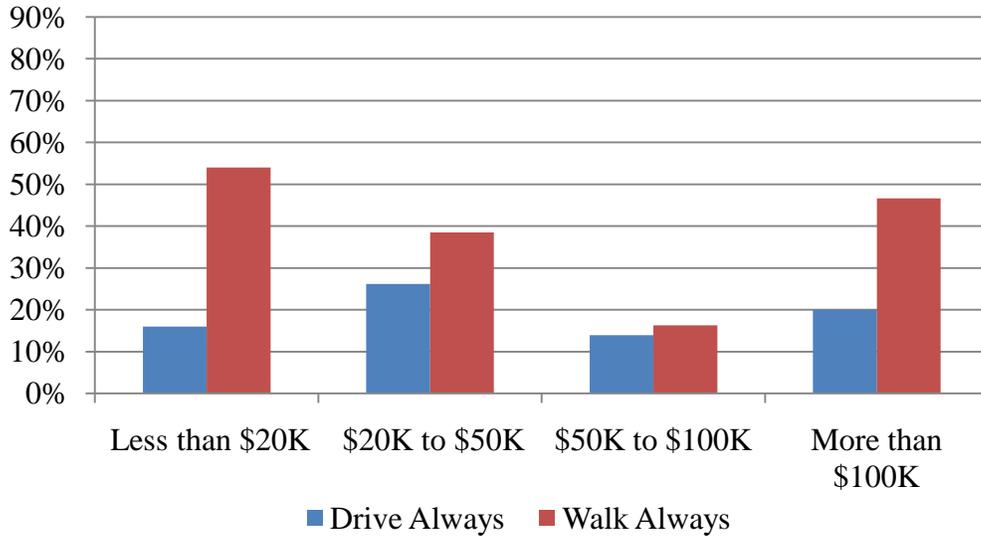
Table 3 shows each market-neighborhood’s respective access mode share. A1, A2 and A3 have the highest driving mode shares. Restricting the sample to households with access to automobiles, the drive mode shares increase but only slightly for the pedestrian-oriented market-neighborhoods. Drive always mode share rises from 0.6% to 0.8% in the P3 market-neighborhood. Conversely, the drive always mode share for A1’s market-neighborhood increases from 34% to 49% when controlling for household access to automobiles.

**TABLE 3 Grocery Store Access**

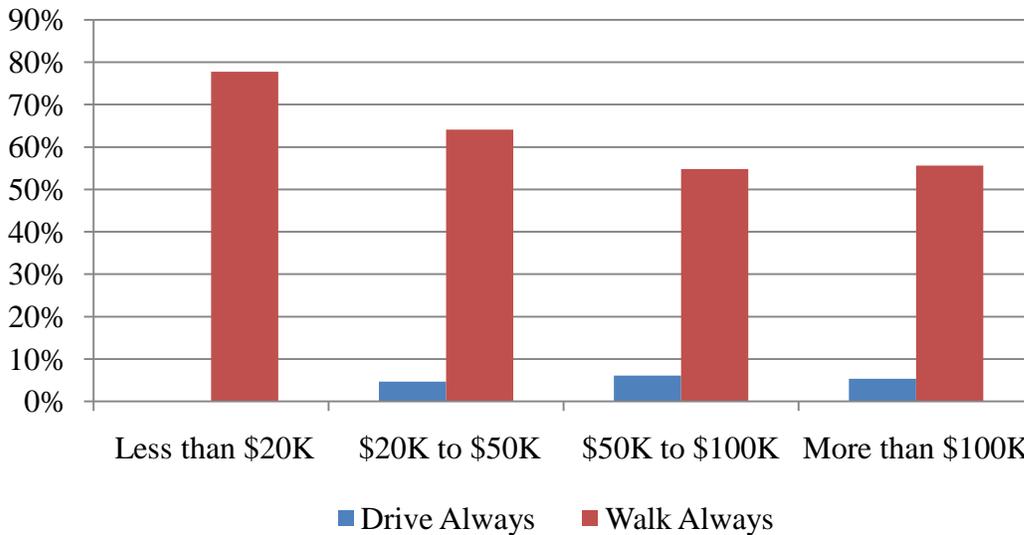
	Always Drive	Always Walk	Drive for Big Trips, Walk for Small Trips	Drive in a Rush or Bad Weather, Otherwise Walk	Other
A1	34.1%	38.6%	13.6%	2.3%	11.4%
A2	18.3%	35.5%	28.0%	10.8%	7.5%
A3	11.8%	41.2%	27.5%	7.8%	11.8%
P1	10.7%	52.0%	17.3%	6.7%	13.3%
P2	7.3%	51.4%	20.9%	13.6%	6.8%
P3	.6%	65.8%	16.8%	6.8%	9.9%
Total	10.0%	51.1%	20.5%	9.2%	9.3%

Over 50% of respondents always walk in each pedestrian-oriented market-neighborhood. At best, 41% of respondents always walk in auto-oriented market-neighborhoods. While 53% of respondents with access to an automobile always walk in pedestrian-oriented market-neighborhoods, only 22% of their counterparts in auto-oriented market-neighborhoods always walk.

Figures 6 and 7 show how income interacts with access mode. “Always walk” responses decrease with income until the highest income group for both pedestrian- and auto-oriented market-neighborhoods. The “always drive” response does not show an equivalent or reciprocal pattern.



**FIGURE 6 Access Mode by Income for Auto-Oriented Markets.**



**FIGURE 7 Access Mode by Income for Pedestrian-Oriented Markets.**

**Model**

A mode-choice model was devised using the framework described in the methodology section. The model determined the probability a person would walk as a function of car ownership, household size, income, distance from the supermarket, usual journey-to-work mode and usual shopping pattern (chain or independent trip). Approximately 90% of respondents walk sometimes, while just over 50% walk always. Given the consistent answer sometimes walking, we determined that more insight would be gained by modeling the probability that someone is a committed walker (i.e., that they always walk to the grocery store).

The results of a binary logit model are given in Table 4. Once factors exerting influence have been controlled, the variables that have a negative effect on a respondent's decision to always walk to the grocery store include increasing distance from the store, number of children (though number of adults in the household is not a factor), access to a car (ownership or car-sharing) and whether the store has a surface parking lot. It also seems to be the case that Black/African-American residents are more likely to drive than their white or other race counterparts.

**TABLE 4 Probability of Walking to a Nearby Supermarket <sup>a</sup>**

Variable <sup>b</sup>	B	S.E.	Exp(B)	Significance <sup>c,d</sup>
Distance from store (blocks)	-.270	.054	.764	***
Number of children	-.230	.129	.794	*
Always use the neighborhood store for big shopping trips	.544	.252	1.723	**
Shop on the way home from work	.785	.457	2.192	*
Pedestrian-oriented design (no surface parking lot)	1.041	.281	2.832	***
Own one car	-2.182	.389	.113	***
Own more than one car	-2.610	.477	.074	***
Use car share	-1.094	.503	.335	**
Black/African-American	-1.092	.465	.335	**

<sup>a</sup> Only significant variables are shown

<sup>b</sup> Reference variables: non-drivers, other race

<sup>c</sup> \*\*\* significant at  $\alpha = 0.99$ ; \*\* significant at  $\alpha = 0.95$ ; \* significant at  $\alpha = 0.90$

<sup>d</sup> Cox and Snell R-squared = 0.278; Nagelkerke R-squared = 0.371

It is not entirely surprising that more people drive to shop when parking is readily available, or that fewer people drive when parking is scarce. A question with a less obvious answer is whether or not a supermarket is disadvantaged by having a low parking supply. To address this issue, the probability that a household shops locally as a function of the same variable set was modeled. That analysis found that the presence or absence of a surface parking lot does not have a statistically significant bearing on whether a person shops always or never at their local store. These results are shown in Table 5.

**TABLE 5 Probability Respondent Always Uses Neighborhood Store for Big Trips<sup>a</sup>**

Variable <sup>b</sup>	B	S.E.	Exp(B)	Significance <sup>c,d</sup>
Distance from store (blocks)	-.109	.050	.897	**
Number of adults	.460	.149	1.584	***
Primary shopper does not work	-.653	.377	.520	*
Pedestrian-oriented design (no surface parking lot)	-.108	.270	.898	
Own one car	-1.204	.306	.300	***
Own more than one car	-1.801	.437	.165	***
Use car share	-.986	.411	.373	**
White	.680	.378	1.974	*

<sup>a</sup> Only significant variables, and pedestrian-oriented design, are shown

<sup>b</sup> Reference variables: non-drivers, other race

<sup>c</sup> \*\*\* significant at  $\alpha = 0.99$ ; \*\* significant at  $\alpha = 0.95$ ; \* significant at  $\alpha = 0.90$

<sup>d</sup> Cox and Snell R-squared = 0.278; Nagelkerke R-squared = 0.371

Neither income, nor the presence or number of children, nor shopping pattern is relevant to neighborhood store loyalty. Car ownership, employment status and increased distance from the store are all associated with decreased likelihood of always shopping at a local store. The presence or absence of parking was found not to be a significant factor with respect to store loyalty.

## DISCUSSION AND CONCLUSIONS

The results of this survey and modeling effort suggest that surface parking lots at urban supermarkets in Philadelphia, PA induce vehicular access without encouraging increased use of the supermarket among nearby residents. This finding adds to the debate about the impact of urban form on travel decisions and mode choice, but in a unique way that may have limited applicability in other environments. While most past research has examined scales of density, diversity, design and destination accessibility, this study purposefully set those scales aside. This approach was based on the assumption that some degree of each of those variables is a prerequisite for observing meaningful levels of walking activity. To that end, the study examined only households in neighborhoods of attached row-houses and apartment buildings (density), with significant retail opportunities (diversity), with grided street and sidewalk networks and zero setback (design), and within a half-mile of a supermarket (destination accessibility). Given this general environment, the present study demonstrated that the specific presence or absence of a surface parking lot had a separate statistically significant impact on mode choice.

This study represents a potentially valuable finding for influencing policy (zoning, parking requirements, design guidelines, etc.) but only in a limited set of circumstances. Without similarly positive aspects of urban form already in place (density, diversity, etc.), surface parking lots are less likely to impact mode choice significantly; in fact, their absence may simply inhibit use. But where a majority of nearby residents always walk to the store, the value of including the quantity of surface parking observed in this study is called into question. And given that they don't induce additional store loyalty among nearby residents, the opportunity costs of such

parking lots may be greater than their perceived value. Lots of such size could accommodate additional households or other retail, business or civic uses, all within less than one block of the supermarket. Since according to our survey, 62.4% of households use their local store always or sometimes for big trips and 88.3% of households use their local store always or sometimes for small trips, additional households could represent a significant pool of additional customers. Furthermore, the modeling effort demonstrated that distance (number of blocks) from stores did have an impact on store loyalty, suggesting that it would be in the best interests of supermarket owners to encourage high density adjacent to store entrances.

Still, there are unanswered questions about supermarket shopping in the market-neighborhoods studied in this research. Because the survey targeted nearby residents rather than all users of a particular supermarket, this research cannot help inform how many customers supermarkets are capturing beyond a half-mile radius. This question might interact with the problem of food deserts. As of 2005, Philadelphia suffered from the second lowest number of supermarkets per capita in an urban area, with an acute lack of access in lower income neighborhoods outside of the center of the city (26). The pedestrian-oriented markets in this study are all located within wealthy or gentrifying districts near the center of the city. In these areas, most residents live within a half-mile of a supermarket. Meanwhile, the automobile-oriented markets are located in neighborhoods further from the center of the city. While these neighborhoods are not necessarily less dense (all are comprised predominantly of row houses), their residents do not all enjoy supermarkets within a half-mile. Lower accessibility may increase the catchment area of these auto-oriented supermarkets and raise the value of large parking lots, despite the fact that nearby households have higher proportions of residents who never drive (26.1%) than households near pedestrian-oriented markets (13.8%).

These findings are applicable only in urban environments, which is in a sense a limitation. The study is also limited by the size and nature of the survey sample. Response rates were especially low from auto-oriented market-neighborhoods, which also tended to be lower income and have higher vacancy. Vacancy rates vary widely across the sampled market-neighborhoods, and that likely has an impact on decisions to walk. While the quasi-experimental methodology of this study sought identical environments in which to study the influence of surface parking lots, the reality of such research is a limited pool of potential subjects.

Future research should combine approaches by analyzing samples of nearby households as well as shoppers at a particular supermarket to develop a richer understanding of overall use patterns in urban environments. As the pedestrian-oriented markets in this study were associated with higher income neighborhoods (two of which might be considered gentrifying), future research could examine the role of land value in supermarket design or how supermarkets of different designs contribute to economic development. Data on the financial implications and outcomes for such supermarkets could add an interesting dimension. Future studies could also examine the impact of surface parking lots on other trip types. Food shopping is a useful topic to examine because nearly every household does it. However, in urban environments, the patterns of other trips may be similarly influenced by the presence or absence of surface parking lots.

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