

Driving Smart: Car2Go in Austin and Beyond

ABSTRACT

Carsharing, a service that allows individuals the use of a private vehicle without the burden of ownership, is expanding rapidly around the world. In the United States, for-profit and non-profit organizations are emerging and expanding at high rates. Daimler Auto Group is entering this market with its Car2Go, a carsharing organization with a fleet composed entirely of Smart Fortwo vehicles, beginning with a pilot program in Austin, Texas. This paper compared the Austin market with successful carshare markets in order to determine the likelihood of success for Car2Go. Using new surveys and analysis of previous literature, this research has found that the highly-educated and high-income populations found residing in downtown Austin and working or studying at the University of Texas are likely to be strong markets for future carsharing services.

CHAPTER 1 - INTRODUCTION

1.1 Background and Motivation for Research

Much of the low-density urban development that has occurred in the United States over the last several decades has been enabled by and designed around the automobile. The resultant automobile dependency has led to a variety of environmental and social problems, including air and noise pollution (Kearney and De Young, 1996), greenhouse gas emissions (Walsh, 1993), traffic congestion (Schrank and Lomax, 2007), and a dependence on foreign oil (Rutledge, 2006). Additionally, vehicle ownership carries a significant financial burden, with the average vehicle costing its owner \$9,519 per year (AAA, 2010), despite its being used for only about one hour per day (Shaheen et al., 1998). Most efforts to reduce automobile usage have focused on public transit, but carsharing may help to fill the space that remains between public transit and private vehicle ownership.

Carsharing is a specific type of car rental that allows individuals or businesses to rent vehicles by the hour or minute, as opposed to traditional car rentals that are based on day- or week-long rentals. Most carsharing organizations charge a membership fee, a deposit that is refundable upon leaving the organization, hourly fees, and mileage after a certain number of free miles (Shaheen, 2008). The carsharing service handles all costs of ownership, including purchasing, maintaining, insuring, and fueling the vehicle. This type of service draws users who only need a car on an occasional basis, allowing these individuals the benefits of private vehicle access without the demands of car ownership. In combination with public transit availability, walking, bicycling, and carpooling, carsharing allows an individual a variety of transportation alternatives beyond private vehicle use. Carsharing also tends to reduce car ownership over time

(Cervero et al., 2007); Zipcar estimates that for every three members, a new car goes unsold (Maynard, 2009).

In the fall of 2009, Daimler joined the ranks of existing carshare operations in the U.S. with its first American pilot program. Based on a successful pilot program in Ulm, Germany, Daimler is operating a fleet of its Smart ForTwo vehicles in Austin, Texas, in an operation called Car2Go. The Smart ForTwo vehicle has a very distinctive appearance, commonly described as “cute,” which will help the vehicle to stand out from other carshare vehicles, and its uniqueness may also draw increased interest from potential Car2Go members. Car2Go joined the former Austin Car Share (ACS), a nonprofit with seven vehicles already in located around the city. Since Car2Go’s entrance into Austin, ACS has closed down, citing the emergence of Car2Go as one of the primary factors.

Initial plans call for concentrations of Car2Go vehicles in two primary locations: the central business district (CBD) of Austin and the University of Texas at Austin (UT). According to its promotional literature, Daimler suggests that Car2Go would be an appropriate service for those who primarily drive alone, who occasionally need a car for short trips, and who would like the car to be “ideally, right around the corner” (Car2Go, 2009). After this initial entrance into the Austin market, Car2Go intends to expand throughout the metropolitan area. The organization has partnered with the City of Austin to provide free parking in any city-owned parking space, as well as several dedicated Car2Go parking spaces around the focus neighborhoods. Given that the carsharing vehicles are all Smart ForTwos, parking will be of limited concern due to their very small size.

Car2Go represents the first entry of a major car manufacturer into the carsharing market. Existing carsharing operations have not been vehicle-specific, instead purchasing a range of

vehicle types and manufacturers. Daimler's proposal is also unique among existing carsharing operations in that cars will not need to be returned to any particular location, whether it be their starting point or a designated Car2Go location. Instead, vehicles may be taken on one-way trips and left wherever is convenient for the user. Daimler's business model is unclear, but is potentially based more on marketing of their brand, particularly the Smart ForTwo vehicle, than on management of a profitable operation. If marketing is indeed the focus, as it may well be in an era of falling new vehicle sales ("Report Puts Brakes", 2009), the vehicular variety and potential cost of retrieving vehicles will be relatively unimportant. If, however, profitability is key to Daimler's operation, analysis will need to be done in order to determine whether the principal tenet of their carsharing operation – the lack of specified locations for their vehicles – is too costly to sustain.

This paper looks at economic and demographic characteristics of members of existing carshare programs. Based on previous research as well as new data collected for this purpose, the analysis will determine whether or not UT and the Austin CBD are appropriate locations for Daimler's Car2Go program. The remainder of Chapter 1 looks at previous research into carshare user characteristics. Chapter 2 considers the sociodemographic characteristics of the Austin metropolitan area, those associated with UT, and individuals living in Austin's CBD. Chapter 3 explains the intent, structure, and distribution of the survey created for this analysis, and Chapter 4 reviews the results of the survey. Chapter 5 provides concluding remarks and suggests directions for future analyses and planning.

1.2 Literature Review

Physical characteristics of a neighborhood have significant impacts on the level of support that carsharing receives. Celsor and Millard-Ball (2007) found that neighborhood and

transit characteristics of an area are “more important indicators for carsharing success than the individual demographics of carsharing members.” Increased household densities lead to increased use of carshare (Cervero and Tsai, 2004). Streets on which parking is limited or restricted show greater support for carsharing than streets that provide easy parking (Abraham, 1999). Another important predictor of carsharing usage is the distance to the nearest vehicle (Katzev, 2003); studies have shown that individuals are generally willing to walk up to 400m, but distances beyond this show a significant decline (Abraham, 1999).

Low vehicle ownership is one of the most common characteristics of carshare members (Millard-Ball, et al. 2005; Zhou et al., 2008). Celsor and Millard-Ball (2007) found that low vehicle ownership in a neighborhood has the strongest correlation with the level of carsharing service in the neighborhood. In San Francisco, City CarShare members were more likely to use the service heavily if they lived in zero-car households (Cervero et al., 2002a); in fact, most City CarShare users do not own cars but substituted a carshare vehicle for a walking or bicycling trip (Cervero, 2002). Additionally, Steininger et al. (1996) found that more than half of European carshare members did not own a car prior to membership. It must be noted, however, that carsharing vehicle usage tends to decrease after its initial introduction to a metropolitan area; many of the members attempt using the service for its novelty value, but the usage patterns tend to decline from their early peak (Cervero, 2007). In the case of City CarShare, Cervero (2007) also found that the initial decreases in overall vehicle use declined in the third and fourth years of the carsharing organization’s operation.

Personal characteristics of individuals using carshare are also important. Members of carsharing organizations tend to be relatively young. Many researchers (Steininger et al., 1996; Taylor, 2003; Cervero et al., 2002a and 2002b; Brook, 2004; Lane, 2005) have found that a

majority of members are in their late twenties to their early forties, with “thirty-somethings” being the most common users. Studies have shown mixed results with regard to the gender split of carshare users. Loose et al. (2006) and Cervero (2002, 2002a, 2002b, 2004, 2007) found that women are the primary members, but Taylor (2003) showed that, in Europe, membership is 66% male.

In most organizations, carshare members are highly educated, generally having earned at least a bachelor’s degree (Shaheen and Rodier, 2005; Taylor, 2003; Steininger et al., 1996; Lane, 2005; Brook, 2004). These high levels of education often lead to professional employment (Shaheen and Rodier, 2005) and lower unemployment rates than the general population (Steininger et al., 1996). Correspondingly, studies have generally shown that typical carshare users have higher-than average incomes (Shaheen and Rodier, 2005; Steininger et al., 1996; Millard-Ball et al., 2005; Taylor, 2003). However, interest in carsharing is also present among those with lower-than-average incomes (Abraham, 1999; Taylor, 2003). These individuals may consider a private vehicle too expensive to purchase and maintain, but are still in need of a car for occasional driving trips. Use of carshare vehicles by individuals is primarily for personal business, such as errands and doctors appointments, and for social and recreational trips (Cervero, 2002). Many of these trips are concentrated in evenings and weekends (Hope, 2001), resulting in reduced vehicle availability at those times. In areas with limited personal vehicle availability, the primary use of carsharing is local residential and neighborhood use (Barth et al., 2006).

Carshare users tend to share important unquantifiable characteristics. Burkhardt and Millard-Ball (2006) have found that carshare users tend to “be considered to be social activists, environmental protectors, innovators, economizers, or practical travelers,” and Shaheen and Rodier (2005) have shown that typical CarLink (San Francisco) members exhibit “sensitivity to

congestion, willingness to try new experiences, and environmental concern.” Members often show “at least a vague interest” in environmental issues (Taylor, 2003). Generally, carshare users tend to be those who walk, bicycle, and use transit more than average members of their community (Loose et al., 2006). Longer membership durations generally lead to more frequent use of shared cars (Katzev, 2003). Carsharing is not a concept that will appeal to the entire population of any metropolitan area, but certain subgroups have shown to be highly receptive to the idea. Generally, highly-educated and relatively young urban residents are the best prospects for a carsharing organization’s members. This analysis continues to examine the downtown Austin residential population and the UT daytime population to determine their sociodemographic characteristics and how closely these specific subgroups match the characteristics of existing carshare members in other cities.

CHAPTER 2 – SOCIO-DEMOGRAPHIC CHARACTERISTICS OF AUSTIN AND UT

As shown in previous literature, demographics may be an indicator of the likelihood that an individual will become a carshare member and user. Because of this, it is necessary to consider the demographics of the two primary groups that Daimler is targeting with its Car2Go program: those working or residing in Austin’s CBD and UT students, faculty, and staff. UT faculty and staff are expected to behave similarly to the metropolitan area population, but students have a unique set of demographics and travel behavior that require separate consideration.

2.1 Population and Density

Table 1 below describes the general population of these focus areas.

Table 1: Population of Car2Go Focus Regions

Region	Population
Downtown Austin (residential)	8,000, but increasing due to several residential condominium projects coming online
Downtown Austin (employees in CBD)	67,000
Downtown Austin (employees within one mile of 6 th Street and Congress, a central downtown intersection)	90,000
University of Texas (student)	51,000
University of Texas (faculty and staff)	24,000
University of Texas (total)	75,000

The density of the Austin metropolitan area is approximately 2,600 persons per square mile, or an average of approximately 4 persons per acre. However, certain regions of Austin are significantly denser than this. Using net residential densities (in which the population is compared to the residential land instead of the total land), the Mueller redevelopment (in central Austin) is most dense. The UT, Triangle (in north Central Austin), downtown, and West University districts make up the top five most densely populated areas, all of which have at least

470 persons/acre on a net basis (Comparative Neighborhoods, 2005). Additionally, because new condominium development is occurring downtown and new zoning restrictions have been put in place around the university area allowing taller developments to be built, the densities of these districts are likely to continue to increase in coming years.

In these dense neighborhoods, parking can be a concern, as it is in all dense urban neighborhoods. Because Car2Go has partnered with the City of Austin to provide free parking spaces as well as dedicated spaces, parking is unlikely to be a problem for Car2Go drivers as it would be for those driving a private vehicle.

2.2 Income

Incomes for the residents of the Austin CBD and metropolitan area can be seen in Table 2 below, along with national averages for comparison. The typical member of an existing carshare organization has an above-average income, indicating that CBD residents may well be a successful market. According to results of a survey completed by ACS in 2009, a plurality of members (35%) reported yearly household earnings of \$45-65,000, but a significant number (15%) also reported household earnings of more than \$100,000. Because the membership profile of ACS is likely to be the best indicator of Car2Go members, Daimler can expect that their service, like others around the country, will appeal largely to those of higher-than-average incomes.

Table 2: Income Comparisons

	Austin CBD	Austin Metro	National
Median Household/Family Income	\$105,000	\$48,227	\$50,007
Median Per Capita Income	\$36,400	\$28,000	\$26,178

On the other hand, income for students at the University of Texas is more challenging to gauge. Faculty are relatively high income, with a mean salary of \$96,332 (Faculty Salary, 2010).

Staff incomes will be comparable to those of the city as a whole, but students have no general population with which they can be compared. While anonymous family income data could be obtained through the university, the student's actual disposable income may bear little correlation to the family's income. Given the wide variety of possible family situations, some students may be receiving plenty of spending money from their parents or other family members while others work to earn disposable income or simply do without. Additionally, car ownership, which is often used successfully as a surrogate for income, is not readily available for the student population, nor may it be as reliable an indicator as it is for the general population. Students often choose, either on their own or at the request of their parents, a residential location that is highly convenient to the campus as well as to necessary services, negating the need for a vehicle. Housemates may also choose to share a vehicle, perhaps because of limited parking availability, which may have little or nothing to do with the income situation of the individual students. As a result of these uncertain income dynamics, a general assumption was made that, while there may be great variation in student incomes, this demographic will generally be very sensitive to pricing.

2.3 Age

The median age of Austin residents is 32.2 years (Austin Population, 2008), which is slightly younger than the national median of 36.7 years (CIA World Factbook, 2008). Residents of the downtown census tract are slightly older, with a median age of 39.8 years (Census Tract 11, 2009); as of 2008, 27% of buyers were under 30 years old and another 35% were between 35 and 44 (Heimsath, 2008). Based on the findings of previous studies, most American carshare users are under age 45, indicating that a majority (62%) of downtown residents will fall into this category. The youthful nature of carshare users also bodes well for the UT market. Only six

percent of UT undergraduate students are 25 years or older, and the average age of an undergraduate is 21 years (The University of Texas at Austin, 2008). The ages of faculty and staff can be expected to be very similar to the ages of the overall Austin metropolitan area, which are generally younger than national averages.

2.4 Education

Educational levels among residents of downtown and metropolitan Austin can be seen in Table 3 below, compared to national averages. Carshare members tend to be among the most highly-educated individuals in a region (Cervero, 2002, 2004, 2007), suggesting that downtown residents may be a strong carsharing market. Students at UT can also be considered to be among the more highly-educated members of society, as they are working toward, at minimum, a bachelor's degree. Staff members likely have similar educational backgrounds as the Austin metropolitan area. Faculty will be among the most highly-educated members of society and most will hold a doctorate. Overall, those affiliated with the University of Texas are very likely to have significantly higher levels of education than the general population.

Table 3: Education Levels

	Bachelor's Degree	Master's or Greater
Downtown Austin residents	79%	24%
Metropolitan Austin	43%	15%
National	27%	7%

2.5 Vehicle Ownership

Of occupied housing units in 2007, 7.3% had no vehicles available. 43.5% had one vehicle, and the remainder had at least two vehicles (Austin city, 2009). Home locations can have some effect on vehicle ownership rates; 30% of those buying condos in downtown Austin worked in Austin's CBD as of 2008 (Heimsath, 2008). This urban lifestyle and proximity of

home and work locations is reflected in vehicle ownership levels among CBD residents that are approximately half that of suburban residents (Bhat, 2004).

Student vehicle ownership is more difficult to accurately gauge. A 2004 study by Harris Interactive revealed that 72% of college students aged 18 to 30 own or have access to a vehicle (“College Students”, 2004). This value has likely held nearly steady since then, and may even be slightly higher among Texas students, since vehicle ownership in the state tends to be higher than the national average (Texas QuickFacts, 2009). However, like many college campuses, parking is a serious challenge at UT. Many students are thus discouraged from attempting to bring a vehicle to campus, particularly if they live close enough that walking, bicycling, or transit are viable options. Student parking permits are sold to those who reside in on-campus housing but likely do not provide an accurate representation of overall vehicular ownership. Approximately 10,000 beds are available on campus, accounting for only a small fraction of the university’s 51,000 students. Those who live off-campus are expected to have significantly different vehicle ownership rates than those who live on-campus, but it is not possible to accurately determine what these rates would be. Generally, however, it can be assumed that student vehicle ownership is markedly lower than vehicle ownership for the Austin metropolitan area.

2.6 Travel Behavior

More than 90% of Austin’s commuting population traveled to work in private vehicles, both alone and in carpools (Austin city, 2009). At the same time, just over 2% of commuters used public transit to reach their workplace. These numbers are somewhat higher for workers in the CBD region, however; 45% of all bus routes run through the downtown area (Executive Summary, 2005), and approximately 4% of downtown workers use transit to commute (Austin CBD, 2006). Transit commuters could be a strong market for Car2Go because of the lack of

convenient transportation alternatives available once the individual has reached his or her workplace. If carsharing vehicles are readily available and easily accessible, transit users could run errands, make doctor visits, and otherwise make use of the carsharing service throughout the day.

While the daily population of the UT campus is approximately 75,000, there are only 14,109 parking spaces available on campus (PTS: FAQ, 2008). Clearly, a significant number (approximately 80%) of those traveling to campus do so by some means other than private vehicles. Additionally, 80% of UT students do not live on campus (The University of Texas at Austin, 2008). However, 68% of those who travel to UT on a regular basis (including students, faculty, and staff) live within 8 km (5 miles) of the campus (UT Bicycle Plan, 2007). Many students use the UT Shuttle system, the largest university shuttle system in the country, to commute to campus: 7.5 million shuttle rides are provided each year (PTS: Shuttles, 2008). Because of this, even students who own a vehicle may not have access to it on campus throughout the day. Given that a large majority of the 75,000 people who travel to the UT campus on a daily basis are using public transportation, biking, or walking, this population may form a significant market for the short-term use vehicles available through Car2Go.

Many of the socio-demographic characteristics of the UT daytime population and downtown residents correspond with the findings of previous studies, indicating that these two markets may be a promising market for Car2Go. However, it is possible that demographics alone will not tell the whole story; in order to determine actual attitudes toward carsharing, this analysis includes a survey that was provided to these groups. With more specific information about the individual opinions, the results of this analysis will provide a much greater level of accuracy.

CHAPTER 3 – SURVEY DESIGN AND PURPOSE

In order to compare the attitudes and perceptions of Austin residents to those determined in previous literature, a survey was conducted. This internet-based survey, for which the questions asked are available in the Appendix, requested a variety of demographic information, focusing on that which had previously been found to be significant in an individual's decision to use a carsharing service. Additionally, the survey asked stated preference questions in an attempt to determine the respondent's likelihood of using carshare services in general and the Car2Go model in particular. Using these data in combination with the results of other studies, it may be possible to determine the likelihood of success of the Car2Go organization in Austin.

Internet surveys are inherently biased towards younger, more educated and computer-literate individuals. In many surveys, this bias can lead to suspicion as to the accuracy of results. For this purpose, however, the individuals toward whom the survey is biased are those who are most likely to be involved in a carsharing organization. Carsharing organizations require moderately advanced levels of technology in order to manage the fleets, determine a car's location, unlock a vehicle with a user's personal identification card, and handle the charges accrued for each trip. Individuals who are most comfortable using technology to take an internet survey are likely to also be quite comfortable with the technology required to operate a carsharing organization.

The survey has three sections: one demographics section followed by two "what if" scenarios. One of the scenarios asks for stated preferences regarding general carsharing programs, and the second focuses on the same stated preferences for a carsharing program that uses exclusively Smart ForTwo vehicles. The demographics questions are based on results of previous literature, asking for the respondent's age, gender, education level, and income, as well

as vehicle availability and driver's licensing status. Additionally, the respondent is given the option to provide the nearest cross streets to his or her home and workplace, which will help to determine the geographical location of those amenable to carsharing programs.

The two scenarios are designed to compare the interest in a Car2Go-type program (which focuses on Smart ForTwo vehicles) and a traditional carsharing organization with a wide range of vehicle types available. In both cases, the respondent is asked whether he or she would be likely to join such a program, how far he or she would be willing to walk to reach a carshare vehicle, the types of trips for which he or she would likely use a carshare vehicle, and whether he or she would like to have the option of a one-way rental. In comparing the stated preferences of respondents under both scenarios, the viability of Car2Go can be compared to the viability of a standard carsharing service. This comparison may prove useful to Daimler as it determines its final business model. However, the survey results may only be used to determine how likely carsharing members would behave upon the introduction of a program with Car2Go's features; the results do not necessarily indicate the likelihood of the general population to join Car2Go or any other carsharing organization.

The survey was distributed through a variety of channels, including University of Texas transportation distribution lists, the City of Austin bike forum users, and ACS members. ACS was particularly helpful in this regard, providing a list of their members who allowed their contact information to be shared. All of the survey outreach was conducted electronically, through email and online forums.

CHAPTER 4 – SURVEY RESULTS

There were 115 responses to the online survey. The sample population responded to the survey over the course of approximately one month, with the first response on June 11, 2009, and the last response and cutoff point on July 4, 2009. Existing carshare members (those who belonged to ACS) account for 74% of the sample population, and students account for 30%.

4.1 Socio-Demographics of Respondents

The survey provided five categories for household income: \$0-5,000, \$5,000-24,999, \$25,000-69,999, \$70,000-149,000, and \$150,000 or more. Assuming a value of \$175,000 for the highest income category and using category midpoints for the other four, the sample population has a mean household income of \$68,438. This value is substantially higher than the mean Austin area household income of \$48,227. However, it is interesting to compare mean incomes for two subpopulations: those who responded that they are students and those who are not. Using the same calculation method as before, the mean household income among students is \$37,132, and the mean household income among non-students is \$80,696. (18% of those who responded that they are students also claim to work, which may account for a relatively high student income.) This difference in mean incomes is significant. There are no further questions related to money (i.e., membership fees, hourly costs, etc.) on the survey; without further information, one might reasonably assume that students, with a much lower disposable income, will be far more sensitive to pricing of a carshare service than will non-students.

All of those who responded to the question of age were between 18 and 65 and thus fit into a closed age category (that is, no individual was in the “65 years or more” open-ended age category). Because of this, it is possible to estimate the average age of the sample population using the midpoints of each age category. Using this method, the average age of the respondents

is 34.5 years, slightly older than the Austin median age of 32.3 years and slightly younger than the national median of 36.7 years. With regard to age, the sample population is representative of the metropolitan area population.

The sample population is a highly educated group of people. 86% of respondents have earned at least a bachelor's degree, and 36% have earned a master's degree; both of these educational characteristics are much higher than national averages (27% and 7%, respectively) and Austin averages (43% and 15%, respectively).

Respondent households hold a mean of 0.8 vehicles each, with a median vehicle holding of one. This is significantly below the Austin area mean vehicle holding of 1.7 vehicles per household. Again, it is interesting to compare subgroups of the sample population. Student and non-student respondents hold nearly the same mean number of vehicles in each household (0.7 and 0.8, respectively). Members of ACS, however, hold a median value of zero vehicles per household. 45 of the 85 ACS members' households do not have any vehicles available. Non-members hold a mean value of 1.2 vehicles per household; this value is still below the Austin area mean vehicle holding of 1.7, but is twice the ACS members' mean holding of 0.6 vehicles per household. These low vehicle ownership numbers are particularly interesting when considering that the entire sample population has a higher-than-average household income. In most situations, higher income leads to higher vehicle ownership, but this sample population does not follow the usual patterns; it is likely that these individuals with high incomes and low vehicle ownership rates will form a very strong market for carsharing.

No questions were asked about current travel behavior, so this analysis cannot determine the distribution of trip mode chosen by the respondents. However, given the above parameters,

particularly the low vehicle ownership levels of the sample population, it is possible to conclude that this sample is less likely to travel in a private vehicle than the general population.

Figure 1 shows the reported locations of the respondents' homes throughout the Austin metropolitan area.

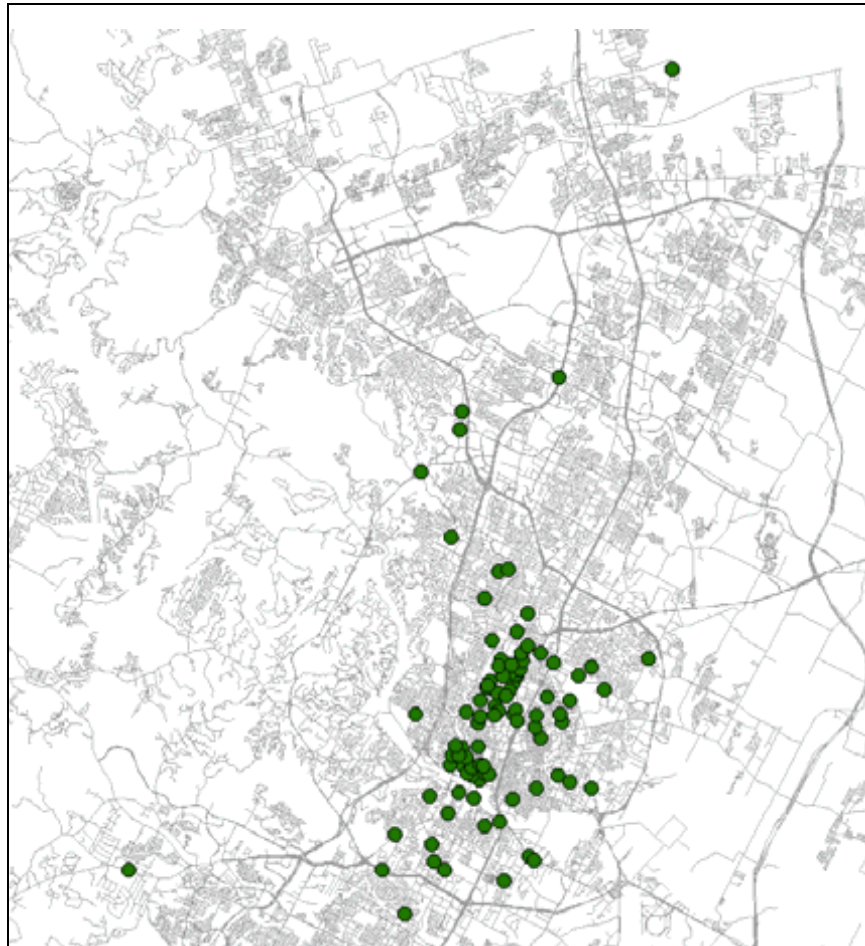


Figure 1: Survey Respondents' Home Locations

A large proportion of the respondents live in downtown Austin and near the UT campus. Additionally, a significant number of respondents live in the area north of UT's campus known as Hyde Park. Not all respondents live in the central portion of the city, however; one respondent lives in Round Rock, a northern suburb of Austin, and another lives in far southwest Austin, as well as many who are scattered throughout the metropolitan area.

Given that 74% of the respondents were ACS members, the residential locations of the sample population are not surprising. Individuals are unlikely to choose to become carshare members if the vehicles are not conveniently located for them; ACS provided cars in the downtown, UT, and Hyde Park areas of the city. Many of those who are not existing carshare members are students who choose to live near the UT campus for their own convenience. While there are many respondents who do not live in one of these three primary locations (downtown Austin, UT campus area, and Hyde Park), carsharing organizations would be most likely to locate their vehicles near the greatest concentrations of individuals' home locations.

Figure 2 shows the reported locations of the respondents' work or school locations.



Figure 2: Survey Respondents' Work/School Locations

Again, there are significant clusters of work or school locations. More than one-third of respondents (40) work or attend school within the UT campus boundaries. Another 21 respondents work within the CBD boundaries. Outside of these two locations, there are no clear clusters of employment locations; instead, employment is scattered somewhat evenly throughout the northern and southern sections of the city and is located almost exclusively along major arterials. Carsharing operators would likely look to concentrate their vehicles in the UT and CBD regions of Austin to provide easy access to the largest possible number of users. This confirms previous work by Celsor and Millard-Ball (2007), which found that the strongest possibilities for successful carsharing in Austin were areas very near to downtown, including the CBD itself and the university neighborhoods.

4.2 Discussion of Results

Overall, responses to both scenarios (traditional carsharing with a variety of vehicle types vs. carsharing with only Smart ForTwo vehicles) were generally similar, with respondents showing a slight but statistically insignificant preference for having access to a variety of vehicle types. Under both scenarios, a substantial majority (80%) wished to have one-way carsharing use available. This desire indicates that Car2Go may be able to attract users, possible even those who already belonged to ACS, because of its one-way advantage.

Those who claimed no interest in joining a carshare program were entirely male. The sample population was skewed towards males (62%, while the actual population is evenly split), but the likelihood of all seven individuals who are not at all interested in carsharing randomly being male is only 4%. This suggests that a gender bias may be in effect and fits well with previous research by Cervero et al. (2007) and Loose (2006), who found that women make up the majority of American carshare members. It is possible that men are more attached to their

own private vehicles, as befits the stereotype, or that women tend to have slightly more flexible schedules that lend themselves well to sharing a vehicle.

Those who are unsure of their interest in one carsharing program were very likely to be unsure of their interest in the other. 79% of the respondents who replied “possibly” to the question of joining under scenario one also replied “possibly” under scenario two. These individuals may require more information than was provided before they would be able to make a final decision, as the scenarios provided were somewhat brief. The “possibly” group was evenly split between males and females, and mirrored the entire sample population in terms of education, age, and student status. This subpopulation did have a higher-than-average income of \$71,447, indicating that cost of a carsharing service may not be their primary concern.

Survey respondents were provided with six trip types for which they could possibly use a carshare vehicle (work, school, food shopping, non-food shopping, errands, and social activities) and asked which of these types they personally were likely to take. Under both scenarios, all respondents were most likely to use the vehicle for errands (89% with traditional carshare vehicle and 83% with Smart ForTwo vehicles) and least likely to use the vehicles for school or work. Non-food shopping was the second most popular reason to use a carsharing vehicle, with 55% of respondents opting to use either a traditional vehicle or a Smart ForTwo to accomplish this shopping. Frequencies of errand and non-food shopping trips are likely less and destinations are more varied than work or school trips. It is reasonable to assume that many people run errands alone or possibly with one other person, suggesting that a Smart ForTwo vehicle would be adequate for their needs. Non-food shopping may present challenges for the Smart ForTwo, however, depending on the precise type of shopping. Clothing and many other personal items are small and easily fit on an empty passenger seat or in the moderate cargo hold that the vehicle

provides, but larger household items or furniture will generally not fit in the vehicle. This is a concern that Daimler will need to track as its operation commences to determine how many potential users are avoiding its carshare service because the vehicle will not suit their needs.

The sample population is generally willing to walk slightly further to reach a Smart ForTwo vehicle (0.92 km or 0.57 miles) than to reach a traditional carshare vehicle (0.87 km or 0.54 miles) ($t=1.67$). The student subpopulation shows some differences in average distance they are willing to walk; students will walk 0.89 km (0.55 miles) to reach both a traditional carshare vehicle ($t=2.82$) and a Smart ForTwo vehicle ($t=7.95$). These differences in the student subpopulation from the general population are statistically significant, but of little value practically. Using the rule of thumb that a block is about 150 m (400 ft) long, these differences in walking distances represent only one-quarter of one block.

An interesting point of analysis is the connection between number of vehicles owned and whether or not an individual is a member of a carshare (ACS, in this case). Considering that the mean number of vehicles owned by a non-carshare member is approximately twice that of a carshare member, one might expect that such a correlation will exist. In fact, when the subpopulation of ACS members is compared with the general population, statistical analysis shows that fewer vehicles owned is indeed correlated with the likelihood that an individual was an ACS member ($t=1.40$). Extrapolating this result further, it suggests that car-less individuals and households are likely a strong market for Car2Go. Since students and residents of Austin's CBD have a lower vehicle ownership rate than the overall metropolitan area, the survey indicates that these are likely to be relatively good markets for Car2Go.

The mean educational level for members of ACS is higher than for non-members ($t=4.68$). This fits well with previous research on carshare user demographics, and it can be assumed that

the mean educational level for Car2Go members will also be higher than for non-members. Additionally, this finding suggests that the downtown residents and UT campus population will represent strong markets for Car2Go, as these are some of the highest concentrations of those with high education levels. Recall that 15% of the residents of downtown Austin have at least a master's degree and that the campus population (which includes faculty) is among the most educated group of individuals in the city.

One consideration is that students may have been underrepresented in ACS due to the organization's fee structure. ACS charged an application fee of \$25, a refundable deposit of \$300, and either a monthly or yearly membership fee, depending on the plan chosen (Austin CarShare, 2009). As shown above, the difference in income of students and nonstudents is quite substantial, indicating that students are likely to be much more sensitive to pricing and fees than are non-students. Students may not have been able or willing to pay the upfront fees required to be a member of ACS. Car2Go may be able to overcome this obstacle to student membership as it does not charge security deposits or monthly fees. Instead, the cost is based purely on minutes of vehicle use, with hourly and daily maximum charges. While there is a small fee (around \$30) to cover the cost of the personal identification card that will act as the vehicles' key, the costs of membership of Car2Go are substantially lower than they were for ACS, which may lead to a much greater student membership.

Both the student population and those who live in Austin's CBD are, on average, highly educated. This alone indicates that these groups are likely to be a better market for Car2Go and other carsharing programs than the general Austin population. In comparison, most of those who work in Austin's CBD are not professionally employed but are instead in clerical, service, or support positions. Individuals holding these types of jobs, on average, are not as highly educated

as UT students and those who reside in the CBD. As a result of this lower average level of education and the resultant lower salaries, the general CBD working population is likely to be a less-rich market for carsharing than are students and CBD residents.

The limited capacity of Smart ForTwo vehicles, for both humans and cargo, is a concern, as mentioned when discussing the potential trip types for which members will use the vehicles. Based on previous research (see, for example, Millard-Ball et al., 2005; Loose et al., 2006), most carshare users tend to primarily use public transportation, walking, or biking for their trips, but will occasionally consider a private vehicle to be necessary or particularly convenient. In these situations, the limited capacity of Smart ForTwo vehicles may detract from their appeal as carshare vehicles. However, in San Francisco, whose City CarShare service is among the best-studied of all carshare programs, most members drive alone (Cervero et al., 2002a), which indicates that the Smart ForTwo's two-person capacity may not be a hindrance after all.

CHAPTER 5 – CURRENT OPERATING STATUS

Car2Go was launched on November 17, 2009, as a pilot program. Initially, it was available only to employees of the City of Austin. During its first six months, City employees were able to use the vehicles at no cost to themselves, as the city picked up the cost. As a result, the vast majority of trips occurred between the hours of 8am and 5pm, and the vehicle pickup and dropoff points were nearly exclusively in the downtown area. Usage picked up slightly on days of inclement weather; city employees appeared to be using the one-way convenience of Car2Go to travel between city office buildings without having to walk outdoors in the rain. At the end of the initial six-month pilot project, Car2Go boasted 4,632 members, more than ten times the membership of ACS.

On May 21, 2010, Car2Go opened to the public. In its first public week, the organization gained 1,266 new members. Membership has continued to climb, and at the end of 2010, Car2Go had 15,585 members and had become the fastest-growing carsharing organization in the United States. In July of 2010, ACS announced that it had ceased operations. ACS board member Thomas Butler confirmed that Car2Go's appearance in the Austin market was "definitely a factor" in the non-profit's closure (Gregor, 2010).

According to communications with Car2Go executives, the membership consists of approximately 20% students. Many of the members are residents of a variety of new downtown condominium projects, some of which have developed partnership agreements with Car2Go to provide dedicated parking spaces for the vehicles. Members are also residents of both the older and denser neighborhoods that make up the core of Central Austin and also many of the suburbs that are much further from Central Austin. Several hundred of the nearly 16,000 members claim a home address outside of central Texas, with many of those outside of Texas entirely. These

non-Texas members may be visitors to Austin, either regular or infrequent, who preferred using Car2Go to a traditional rental vehicle. Many of the non-Austinites who are members may also have visited the city for one of its two best-known festivals, Austin City Limits or South by Southwest; Car2Go provided substantial advertising before and during both events.

A complete analysis of the customer and usage data remains to be completed. Initial analysis, however, indicates that the vehicles are very well-used. At any given moment, approximately 25-40 of the 200 vehicles are in use, with usage rates increasing throughout 2010. Between March 18 and March 20, 2011, Car2Go replaced the 200 vehicles with 300 different Smart ForTwo vehicles that have solar roofs and more user-friendly entertainment and navigation systems. Car2Go also increased its operating area to 52 mi², encompassing much more of the Austin metropolitan area. The company also plans to expand into other cities around the country during 2011.

CHAPTER 6 – CONCLUSIONS

Carsharing is increasing in popularity both domestically and internationally. Many individuals and businesses are finding that the option to use a private vehicle without the expenses of purchase, upkeep, fuel, and parking is a very attractive one. Additionally, carsharing has the potential to reduce congestion, as long-term studies have shown that carshare users reduce their driving and purchase fewer cars over time. If carshare users tend to use carsharing largely for non-work trip purposes, as indicated by the survey, they tend to use a mode other than single occupant vehicle for their work trip travel. The industry's growth in the United States, particularly in dense and congested urban areas, has been substantial since the 1990s, and the city of Austin is poised to reap the benefits of this growth. Starting in the fall of 2009, a for-profit carsharing organization will be entering the market. This organization, called Car2Go and operated by Daimler Automotive Group, will consist of a large fleet of Daimler's Smart ForTwo vehicles. Car2Go will be unique in that it allows users to charge their time by the minute, instead of the usual hour, and will allow one-way carshare use. Car2Go will also provide members with use of one of the most uniquely-designed vehicles on American roads today, potentially increasing its appeal.

This paper considered the unique characteristics of Car2Go in combination with the socio-demographics of the two primary foci of Daimler's operation: Austin's CBD and the University of Texas. Using a survey to determine preferences of Austin residents, it was possible to compare the characteristics of this market to those markets which have previously been found to be highly successful, such as members of San Francisco's City CarShare and other popular carsharing services.

The results of the survey confirmed some basic demographic information for Austin: namely, that the general population is younger and more highly-educated than national averages. Previous research has concluded that the young and highly-educated are precisely the groups who are most attracted to carsharing, suggesting that the city as a whole is a prime market for the service.

However, the survey data goes further to show that specific subgroups, particularly those who live in downtown Austin and those who work and study at the University of Texas campus, are an even richer market for a carsharing operation. These groups are among the most highly-educated in the city and either earn or have the potential to earn far more than the average individual. Additionally, these subgroups tend to have high rates of public transit usage and lower rates of vehicle ownership, resulting in fewer difficulties in encouraging the use of a shared vehicle. Daimler's proposed focus on these two subgroups is likely to be their most successful possible focus and will bode well for the future of Car2Go in the Austin area.

In its first year of operation, Car2Go became the fastest-growing carsharing organization in the country, acquiring 15,000 members. The demographics of the users represent a variety of individuals from around Austin; only one in five users is a student, and members reside all over the Austin metropolitan area. Further analysis remains to be done on the users and their vehicle usage patterns, but initial results indicate that Car2Go has been an initial success in Austin.

Certainly, many analysts will be paying close attention to the Car2Go operation. Not only is it unique in its pricing structure and one-way allowance, but it also marks the first major entry of a car manufacturer into the carshare market. If Daimler finds success in carsharing, it is likely that other manufacturers will follow in its footsteps. These ventures, like Daimler, will have the option of attempting to earn a profit from the carsharing side of the business or simply using

carsharing as a way to further market their vehicles. Either way, it is likely that carsharing organizations will continue to develop, expand, and generate new and innovative methods to attract additional users.

APPENDIX: Survey Instrument

1. Introduction

This survey is to determine which groups of people are most likely to be interested in car sharing. The results will be used to help shape the future of car sharing in Austin.

2. Demographics

Please answer all of the questions on this page. Demographic and location data is vital to the success of this survey.

1. What is your age?

- ☐ 0-15 years
- ☐ 16-17 years
- ☐ 18-25 years
- ☐ 26-35 years
- ☐ 36-45 years
- ☐ 46-55 years
- ☐ 56-65 years
- ☐ More than 65 years

2. What is your gender?

- ☐ Male
- ☐ Female

3. What is the highest level of education you have completed?

- ☐ Some high school
- ☐ High school
- ☐ Some college
- ☐ Bachelor's degree
- ☐ Master's degree or higher

4. What was your household's total income in 2008?

- ☐ \$0-5,000
- ☐ \$5,000-\$24,999
- ☐ \$25,000-69,999
- ☐ \$70,000-149,999
- ☐ \$150,000 or more

5. Do you work, either full- or part-time?

- ☐ Yes
- ☐ No

6. Are you a student, either full- or part-time?

- ☐ Yes
- ☐ No

7. What are the nearest cross-streets to your home? (For example, Congress & 6th)
[Open Response]

8. What are the nearest cross-streets to your work or school? (If you have both a work and a school location, please provide the location at which you spend the most time.)
[Open Response]

9. How many vehicles are available for use in your household?

- ☐ 0
- ☐ 1
- ☐ 2
- ☐ 3+

10. How many people live in your household, including yourself?

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5
- ☐ 6+

11. How many people in your household have a valid driver's license, including yourself?

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5
- ☐ 6
- ☐ 7+

12. Are you currently a member of a carsharing organization?

- ☐ Yes
- ☐ No

3. Car Sharing

Car sharing is a type of car rental organization that focuses on very short-term rentals, charging by the hour or even the minute instead of by the day or week. In some organizations, mileage charges also apply. Car share vehicles are strategically located, providing easy vehicle access for as many users as possible. Given a car sharing program with:

- a variety of vehicle types, including sedans, minivans, and pickup trucks
- no membership fees, and
- hourly usage fees,

please consider the following questions.

1. Would you join such a program?

- ☐ Yes
- ☐ No
- ☐ Possibly

2. What type(s) of trips would you use a carsharing vehicle for? (Check all that apply.)

- ☐ Errands
- ☐ Work
- ☐ Non-food shopping
- ☐ Food shopping
- ☐ Social activities
- ☐ School

3. How far would you be willing to walk or bike in order to reach one of these vehicles?

- ☐ 1 block
- ☐ 3 blocks
- ☐ ¼ mile
- ☐ ½ mile
- ☐ 1 mile

4. Would you like to have the option of one-way car share use? In other words, would you like to have the option to not have to bring the car back to the same location where you picked it up?

- ☐ Yes
- ☐ No

4. Car Sharing 2

Now consider a car sharing organization that used only Smart ForTwo vehicles. These vehicles are very compact and easy to park, and they hold two passengers and 3-4 bags of groceries in the trunk. Again assuming no membership fees and hourly usage charges, please consider the following questions again.

1. Would you join such a program?

- ☐ Yes
- ☐ No
- ☐ Possibly

2. What type(s) of trips would you use a carsharing vehicle for? (Check all that apply.)

- ☐ Errands
- ☐ Work
- ☐ Non-food shopping
- ☐ Food shopping
- ☐ Social activities
- ☐ School

3. How far would you be willing to walk or bike in order to reach one of these vehicles?

- ☐ 1 block
- ☐ 3 blocks
- ☐ $\frac{1}{4}$ mile
- ☐ $\frac{1}{2}$ mile
- ☐ 1 mile

4. Would you like to have the option of one-way car share use? In other words, would you like to have the option to not have to bring the car back to the same location where you picked it up?

- ☐ Yes
- ☐ No

REFERENCES

- Abraham, J. (1999) A Survey of Carsharing Preferences, University of Calgary, (<http://www.ucalgary.ca/~jabraham/WTPPCarshare.PDF>). World Transport Policy & Practice.
- American Automobile Association (AAA). (2010) *Your Driving Costs 2010*. Available at <http://www.aaaexchange.com/Assets/Files/201048935480.Driving%20Costs%202010.pdf>.
- Austin CarShare. (2009) Available at <http://www.austincarshare.org/>.
- Austin CBD, University, and Urban Area Commuting Profile. (2006) Urban Transport Fact Book. Available at <http://www.publicpurpose.com/ut-cprof-aus.htm>.
- Austin city, Texas. (2009) U.S. Census Bureau: City and State QuickFacts. Available at http://factfinder.census.gov/servlet/ACSSAFFacts?_event=&ActiveGeoDiv=geoSelect&pctxt=fph&_lang=en&_sse=on&geo_id=16000US4805000&_state=04000US48.
- Austin Population. (2008) The Greater Austin Chamber of Commerce. Available at <http://www.austin-chamber.org/DoBusiness/GreaterAustinProfile/population.html>. Retrieved June 18, 2009.
- Barth, M.J., S.A. Shaheen, T. Fukuda, and A. Fukuda. (2006) Carsharing and Station Cars in Asia: Overview of Japan and Singapore. *Transportation Research Record 1986*: 106–115.
- Bhat, C. (2004, September 22) Austin Commuter Survey: Findings and Recommendations. Available at www.ce.utexas.edu/prof/bhat/REPORTS/Commuter_survey.ppt.
- Brook, D. (2004) Carsharing – Start Up Issues and New Operational Models. Presented at the Transportation Research Board 2004 Annual Meeting, Washington, DC: January 11-15, 2004.
- Burkhardt, J., and A. Millard-Ball. (2006) Who Is Attracted to Carsharing? *Transportation Research Record 1986*: 98-105.
- Car2Go. (2009) Daimler AG. Available at <http://www.car2go.com/portal/page/home.faces>. Retrieved June 11, 2009.
- Celsor, C., and A. Millard-Ball. (2007) Where Does Carsharing Work?: Using Geographic Information Systems to Assess Market Potential. *Transportation Research Record 2007*: 61-69.
- Census Tract 11 Data Profile. (2009) The U.S. Census Bureau. Available at http://factfinder.census.gov/servlet/ADPTable?_bm=y&-geo_id=14000US48453001100&-qr_name=ACS_2009_5YR_G00_DP5YR5&-context=adp&-ds_name=&-tree_id=5309&-lang=en&-redoLog=false&-format=.
- Cervero, R. (2002a) City Carshare: First Year Travel Demand Impacts. *Transportation Research Record 1839*: 159-166.
- Cervero, R., A. Golub, and B. Nee. (2007) City CarShare: Longer-Term Travel Demand and Car Ownership Impacts. *Transportation Research Record 1992*: 70-80.
- Cervero, R., and Y. Tsai. (2004) City CarShare in San Francisco, California: Second-Year Travel Demand and Car Ownership Impacts. *Transportation Research Record 1887*:117-127.
- Cervero, R., N. Creedman, M. Pai, and M. Pohan. (2002b) City CarShare: Assessment of Short-Term Travel-Behavior Impacts. Working Paper 2002-01. Institute of Urban and Regional Development. University of California, Berkeley. Available at <http://repositories.cdlib.org/iurd/wps/WP-2002-01>.

- Cervero, R., N. Creedman, M. Pohan, M. Pai, and Y. Tsai. (2002c) City CarShare: Assessment of Intermediate-Term Travel-Behavior Impacts. Working Paper 2002-03 Institute of Urban and Regional Development. University of California, Berkeley.
- CIA World Factbook. (2008) Central Intelligence Agency. Available at <https://www.cia.gov/library/publications/the-world-factbook/>.
- College Students to Spend Nearly \$15 Billion on Cars in 2004. (2004, May 13) *PRNewswire*. Available at http://www.advn.com/news/College-Students-to-Spend-Nearly-15-Billion-on-Cars-in-2004_7644637.html.
- Comparative Neighborhoods Data Analysis Report. (2005) City of Austin. Available at http://www.ci.austin.tx.us/demographics/downloads/npa_comparative_data.pdf.
- Executive Summary: Downtown Austin Retail Market Strategy. (2005) Economics Research Associates and Downtown Austin Alliance. Available at http://downtownaustin.com/downloads/DTAustin_Retail_ExecSumm.pdf.
- Faculty Salary Analysis Report. (2010) The University of Texas. Available at <http://www.utexas.edu/academic/ima/facsal>.
- Gregor, K. (2010, July 30) So Long, Austin CarShare. *The Austin Chronicle*. Available at <http://www.austinchronicle.com/gyrobase/Issue/story?oid=oid%3A1063448>.
- Heimsath, C. (2008, April 2) Downtown Condominium Study: Report by Capital Market Research. Report prepared for Downtown Austin Alliance Economic Development. Available at http://www.downtownaustin.com/downloads/DTAustin_CondoStudy_20080402.pdf.
- Hope, S. (2001). *Monitoring and Evaluation of the Edinburgh City Car Club*. Scottish Executive Central Research Unit. Available at: <http://www.scotland.gov.uk/Resource/Doc/156493/0042015.pdf>.
- Katzev, R. (2003) Car Sharing: A New Approach to Urban Transportation Problems. *Analyses of Social Issues and Public Policy*, 3(1): 65–86. www.asapspssi.org/pdf/katzev.pdf.
- Kearney, A., and R. De Young. (1996) Changing Commuter Travel Behavior: Employer-Initiated Strategies. *Journal of Environmental Systems*, 24(4): 373-393.
- Lane, C. (2005) PhillyCarShare: First-Year Social and Mobility Impacts of Car Sharing in Philadelphia. Presented at the Transportation Research Board 2005 Annual Meeting, Washington, DC: January 9-13, 2005.
- Loose, W., M. Mohr, and C. Nobis. (2006) Assessment of the Future Development of Car Sharing in Germany and Related Opportunities. *Transport Reviews*. 26(3): 365-382.
- Maynard, M. (29, May 30) Industry Fears Americans May Quit New Car Habit. *The New York Times*. Available at http://www.nytimes.com/2009/05/31/business/31car.html?_r=1.
- Millard-Ball, A., G. Murray, J.T. Schure, C. Fox, and J. Burkhardt. (2005) Car-Sharing: Where and How It Succeeds. *Transit Cooperative Research Program Report 108*: Transportation Research Board, Washington, D.C.
- PTS: Frequently Asked Questions. (2008) University of Texas Parking and Transportation Services. Available at <http://www.utexas.edu/parking/utafaq2.html>.
- PTS: Shuttles. (2008) University of Texas Parking and Transportation Services. Available at <http://www.utexas.edu/parking/transportation/shuttle/>.
- Report Puts Brakes on Slipping Auto Sales. (2009, July 2). *Reuters*. Available at <http://www.reuters.com/article/bigMoney/idUS222534889720090702>.
- Rutledge, I. (2006) *Addicted to Oil: America's Relentless Drive for Energy Security*. New York: I.B. Tauris.

- Schrank, D., and T. Lomax. (2007) *The 2007 Urban Mobility Report*. Texas Transportation Institute, The Texas A&M University System. Available at http://tti.tamu.edu/documents/mobility_report_2007_wappx.pdf.
- Shaheen, S.A. (2008, October 20) *The Look of Carsharing Today Across North America and Abroad*. Presented at The Transportation – Land Use – Environment Connection Conference, Lake Arrowhead, CA. Available at https://www3.uclaextension.edu/arrowhead/ppts_09/A16.ppt.
- Shaheen, S.A. and C.J. Rodier. (2005) Travel Effects of a Suburban Commuter Carsharing Service - CarLink Case Study. *Transportation Research Record* 1927: 182-188.
- Shaheen, S.A., D. Sperling, and C. Wagner. (1998) Carsharing in Europe and North America: Past, Present, and Future. *Transportation Quarterly*, 52(3): 35-52.
- Steininger, K., C. Vogl, and R. Zettl. (1996) Car-Sharing Organizations: The Size of the Market Segment and Revealed Change in Mobility Behavior. *Transport Policy*, 3(4): 177-185.
- Taylor, J. (2003) *Key Lessons Learned from a World Wide Car Club Tour*. Car Plus, San Francisco. <http://www.carclubs.org.uk/carclubs/N-Amer-tour.htm>.
- Texas QuickFacts. (2009) U.S. Census Bureau: City and State QuickFacts. Available at <http://quickfacts.census.gov/qfd/states/48000.html>.
- The University of Texas at Austin. (2008) USA Today Education: College Toolkit. Available at https://www.collegetoolkit.com/co/usatoday/colleges/studentprofile/the_university_of_texas_at_austin/228778.aspx. Retrieved July 2, 2009.
- University of Texas Bicycle Plan: Integrating Bikes into a Pedestrian Campus. (2007, August). Report prepared by Bowman-Melton/Alta Planning + Design. Available at http://www.utexas.edu/parking/transportation/biking/UTBicycle_Plan.pdf.
- Walsh, M. (1993) Highway Vehicle Activity Trends and Their Implications for Global Warming: The United States in an International Context. In *Transportation and Global Climate Change*. Edited by D.L. Greene and D.J. Santini. Washington, DC: American Council for an Energy-Efficient Economy.
- Zhou, B., K. Kockelman, and R. Gao. (2008) Opportunities for and Impacts of Carsharing: A Survey of the Austin, Texas Market. Paper #08-1639. Presented at the Transportation Research Board 2008 Annual Meeting, Washington, DC: January 13-17, 2008.