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BEYOND THE EARLY ADOPTERS: EXAMINING THE POTENTIAL FOR CAR-
SHARING IN RICHMOND, VIRGINIA

A Thesis submitted in partial fulfillment of the requirements for the Master of Urban and
Regional Planning degree at Virginia Commonwealth University.

by

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Abstract

BEYOND THE EARLY ADOPTERS: EXAMINING THE POTENTIAL FOR CAR- SHARING IN RICHMOND, VIRGINIA

By Steven P. Spears, MURP

A Thesis submitted in partial fulfillment of the requirements for the degree of Master of Urban and Regional Planning at Virginia Commonwealth University.

Virginia Commonwealth University, 2008

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Car-sharing is a membership-based mobility service that offers short-term vehicle rentals. Studies have shown that car-sharing can increase transportation sustainability by encouraging the use of public transit and reducing vehicle miles traveled. This thesis examines the potential for car-sharing in Richmond, Virginia through an attitude-based qualitative pilot study. Using the theory of planned behavior as a framework, urban and suburban residents were asked questions that measured car-sharing intention strength, mode choice habit, and life change effects. The study found that even among those with positive attitudes toward car-sharing, existing habits, lack of adequate commuting alternatives and the needs of non-driving dependents were major hindrances to shared-

car use. Better facilities and interventions designed to encourage the use of transit, walking, and bicycling may play an important role in overcoming these obstacles and increasing the viability of car-sharing in Greater Richmond.

Chapter I: Introduction

Car-sharing is a mobility service that makes vehicles available to members on a short-term basis – normally a few hours at a time. Members typically pay a joining fee and are then charged based on time and/or mileage used. By trading car ownership for car access, members may save on their overall transportation costs and gain access to a range of vehicles that have specific capabilities for various journeys. Car-sharing can be utilized by both individuals and employers to increase mobility options and facilitate the use of other transportation modes, such as transit, walking, and cycling.

Car sharing organizations take on a variety of structures, from for-profit corporations to local cooperatives to non-profit organizations. They also use a variety of operational models, including station cars, neighborhood car-sharing, multi-nodal shared-use vehicles, and hybrid approaches (Barth and Shaheen, 2002) . Station cars are located at major public transport stations and are intended to serve users on the final leg of a multi-modal journey. With neighborhood car-sharing, vehicles are placed within neighborhoods to serve the daily needs of local residents. Multi-nodal systems allow users to travel between multiple activity centers, including college campuses, airports, shops, and major employment centers. Cars can be used for round trips or driven one-way between activity centers. Finally, hybrid models have been developed that use combinations of the three other types. For example, the CarLink pilot program in the

San Francisco area used a transit-based commuter car-sharing system. With CarLink, home-based commuters would drive shared cars to stations, where public transportation commuters could use them for the final leg of their work commute. During the day, work-based users could access the cars at their workplace for both business and personal use (Shaheen, 2001).

Although car sharing has been in existence since the late 1940s, its development and relevance to transport planning has only been realized within the past two decades. As part of a sustainable transport system, car sharing offers several potential advantages. Studies worldwide have found that car sharing club members typically reduce their annual vehicle miles traveled (VMT) and may sell or postpone the purchase of a personal vehicle. In addition, members tend to make greater use of public transport, walking, and cycling (Nobis, 2006; Prettenthaler and Steininger, 1999; Shaheen and Cohen, 2006). The changes in travel behavior that are attributed to car-sharing membership can contribute to reductions in traffic congestion, fuel consumption, and vehicle emissions. As a complement to public transportation, car-sharing can encourage ridership growth, reduce parking space requirements, and promote compact urban development (Schuster et al., 2005).

Car-sharing can provide economic benefits to users as well. By joining a car-sharing organization, members can reduce their motoring costs while maintaining the personal mobility that car access provides (Shaheen et al., 2006). While the break-even

point varies based on a number of factors, Schuster et al. (2005) estimated that more than four percent of vehicles in the Baltimore, Maryland metropolitan area could be replaced by shared cars based on cost savings alone. Using a commuter-based model, Schuster estimated nearly fifteen percent of vehicles could be switched based on economic considerations.

Typically, car-sharing organizations have been initiated in core urban areas that offer a variety of transport alternatives and dense housing. In these locations, members have adequate opportunity for travel mode substitution, meaning shared cars are needed only for trips where other modes are unsuitable. (TCRP, 2005) In most American cities, however, public transport options are limited and housing densities are quite low. In addition, the potential for massive public transport expansion is limited by land use, economic, and political constraints.

In the long term, a combination of significant land use, behavioral, and technological changes will likely be required to achieve any measure of transport sustainability in the United States. However, the social and environmental problems associated with car travel are pressing concerns today. Transport is the second largest and fastest growing source of greenhouse gas emissions in the US (EPA, 2006) and congestion costs amount to \$800 per capita annually (FHWA, 2006). Car-based travel reduction strategies, such as car-sharing, may help to reduce VMT in areas where public

transport service is not currently feasible and provide a complementary measure where service does exist.

Chapter II: Thesis Objectives

Previous studies of car-sharing viability have tended to focus on the characteristics of people who are currently using the schemes and the neighborhoods in which they live. This has resulted in a rather narrow definition of the conditions under which car clubs can succeed. According to the Transit Cooperative Research Program (TCRP) publication *Car-Sharing: Where and How it Succeeds* (2005), car-sharing appeals to people who:

- are highly educated
- have middle to high income levels
- live in a dense urban area
- live in households with two or fewer people
- are in their 30s or 40s
- consider themselves to be innovators
- have high environmental and social awareness
- drive less than average annual distances
- are more concerned with car access rather than status
- are cost-conscious

The first six items on this list are likely attributes of the early adopters of any new technology, be it flat-screen televisions or personal transport. Of the final four characteristics, only higher annual distance driven is likely to be solely characteristic of suburban and exurban residents of a metropolitan area.

Because car sharing in the United States has grown from a base of near zero in 1998 to more than 60,000 in 2004 (TCRP, 2005), the concept is certainly in its earliest stages of development. Even in Switzerland, which pioneered car clubs, the number of members grew from 500 in 1990 to 58,000 in 2003. (DfT, 2005) With any new technological development, such as personal computers or the automobile itself, the profile of early adopters does not necessarily determine the profile of users in a mature market. As awareness, affordability and accessibility increase, the market demographics for car-sharing will likely change. Therefore, it is important to look beyond the profile of the early adopters to determine the wider potential for car-sharing organizations. This is the gap this study intends to fill.

The objective of this thesis is to examine the potential for car-sharing in Greater Richmond, Virginia. This is accomplished by extending previous research on member characteristics to identify people within the general population who hold attitudes that indicate they are potential car-sharing members. This includes people living in neighborhoods not typically served by car clubs in the United States, such as those in suburban and rural settings. This thesis consists of a pilot study that makes use of

attitude theory and qualitative methods to gain a deeper understanding of the underlying factors that influence the decision to become a car-sharing member.

Chapter III: Literature Review

While car-sharing organizations are increasingly recognized as an important component of the urban transportation system, relatively little academic literature exists that examines their long-term growth potential and possible impact on travel behavior. Even fewer studies have focused on attitudinal aspects of car-sharing acceptance and membership.

Although car-sharing has grown rapidly in both Europe and the United States over the past decade, members still account for a very small percentage of licensed drivers. In the United States, only 0.03 percent of licensed drivers were car-sharing members as of 2005. (TCRP, 2005) Even in countries where car-sharing has been established for some time, such as Austria, members account for only 1 percent of all drivers.

The overall impact of car-sharing on travel patterns will clearly be dependent on its continued growth and its ultimate market share within the array of options available to travelers. Evaluating this potential and forecasting the future growth of car-sharing is difficult, due to its current position as a small niche in the mobility market. Just as the earliest market for the automobile was vastly different than it is today, the market for

car-sharing may change dramatically as transportation needs change and are affected by external factors such as increased energy costs and environmental regulation.

This literature review focuses on three major areas that are important to understanding the potential for car-sharing in Richmond, Virginia. First, it examines previous research on car-sharing organizations in both North America and Europe. This includes various shared-use vehicle models, market growth and potential, and the characteristics of car-sharing members and the geographic locations where it has been successfully implemented. Second, it looks at the application of various transportation forecasting methods and their application to car-sharing. Special emphasis is placed on forecasting in situations where potential users have little knowledge or experience with the alternative under consideration. This is the case with car-sharing in localities where the service does not currently exist, such as Richmond. Lastly, it examines previous application of attitude theory, and specifically the theory of planned behavior (TPB), to travel behavior research.

3.1 Early car-sharing research in North America - CarLink

One of the earliest studies of car-sharing in North America was carried out by Shaheen (1999). The study was conducted prior to the start of an associated San Francisco Bay area car-sharing pilot program known as CarLink. The purpose of Shaheen's research was to determine the conditions under which potential users would

be most willing to car-share. In addition to demonstrating the car-sharing concept, CarLink incorporated a number of “smart” technologies that have subsequently been adopted by commercial operators.

At the time of the study, no operational car-sharing organizations existed in the United States. Therefore, there was virtually no awareness of car-sharing amongst potential users. Shaheen used a variety of methods to introduce potential users to CarLink and studied their attitudes and beliefs toward the follow-on pilot program. The methods of introduction included a brochure, a video, and a “clinic” where potential users could experience the technology and information systems that would be used in the CarLink demonstration project.

The study utilized a combination of social learning and social marketing theory, combined with travel activity analysis, to determine which methods were most effective in promoting positive attitudes toward car-sharing and inducing travel behavior change. Shaheen found that those who had limited exposure to educational information, such as brochures alone, were much less likely to develop positive attitudes toward CarLink than those who were exposed to the video and clinic. In fact, positive attitudes in Sheehan's control group, who received no additional information on CarLink beyond the initial brochure, actually decreased over time.

Shaheen's research demonstrates the importance of exposure and education in the acceptance and adoption of an unfamiliar transportation technology. In a metropolitan area where car-sharing does not exist, awareness is likely to be very low. While initial introduction to the concept may result in a significant positive response, more information and experience is required to encourage potential users to move toward adoption of a new service.

The CarLink pilot program that followed Sheehan's initial study is also relevant to this thesis. Most car-sharing programs in existence today are neighborhood-based. In neighborhood-based car-sharing, cars are located throughout a neighborhood to form a network of available vehicles. In this model, members are expected to make most of their daily trips by public transport, walking, or cycling. Shared cars are used to fill the gaps that other modes cannot easily accommodate.

In contrast, CarLink used a commuter-based car-sharing model. It was designed to provide links to employment and public transportation at a suburban location. The cars were based at a Bay Area Rapid Transit (BART) station close to major employment centers. This location allowed use of shared cars by three distinct user groups – home-based, work-based commuters, and work-based day users. (Shaheen and Rodier, 2005)

Using CarLink, home-based members would drive to the transit station, where they would leave a car during working hours. At the end of the day, they would return

home with a car, which they had access to in the evening and on weekends. For this service, they paid a flat fee of \$300 per month. Work-based commuter users would arrive at the transit station by train and continue to their work destination using a shared vehicle. This service, which was provided as a benefit by employers, cost approximately \$50 per month. Cars parked at business locations by work-based commuters were then available to work-based day users for both personal and business trips. This service was provided by subscription to employers, who paid \$300 per month. The fees for each of these packages included fuel, insurance, maintenance, roadside assistance, and emergency transportation services.

Although the complexity of commuter-based car-sharing presents challenges to providers, it has the potential to reach a much broader market than neighborhood-based programs alone. In a study of the Baltimore, Maryland metropolitan area, Schuster, et al. (2005) estimated that cost savings could be realized for 14.8 percent of drivers if they switched from ownership to commuter-based car-sharing. This compared to only 4.2 percent for the neighborhood-based model.

3.2 Market Research

Perhaps the most comprehensive North American study of car-sharing potential and market appeal was conducted by the Transit Cooperative Research Program (TCRP) of the US Transportation Research Board. The TCRP report, entitled *Car*

Sharing: How and Where it Works, examined the demographic, geographic and attitudinal characteristics of car sharing members in the USA and Canada. The study included web-based surveys of 1,340 members and six 90-minute focus groups with a total of 56 participants.

Smaller scale studies have been carried out on car-sharing members in North America and abroad, including Austria (Steininger et al. 1996; Prettenthaler and Steininger, 1999), Germany (Nobis, 2006; Loose et al., 2006), Switzerland (Harms and Truffer, 1998), Sweden (Polk, 2000; Vägverket, 2003) and the United Kingdom (Bonsall, 2002; Cairns et al., 2004; Carplus, 2004; Hope, 2001). These studies have produced a variety of findings about the potential for car sharing based on geographic location and availability of alternative modes of transport. Combining the differences and similarities between the findings of these studies gives a more rounded picture of the characteristics of car-sharing members. This diversity of views derived from various contexts can then be used to inform research on the wider car-sharing market.

3.2.1 Total Market Potential

According to the TCRP (2005), car-sharing members account for 0.02 percent of the US population and 0.03 percent of licensed drivers. While this is a very small fraction, US car clubs are growing rapidly. From a base of essentially zero in 1998, there were more than 60,000 members in 2004. A similar growth pattern appears to be

occurring in the UK, Germany, Austria, and Switzerland (Cairns et al., 2004; Loose et al., 2005).

Several attempts have been made to estimate the total market potential for car-sharing. Various methods used in these studies have resulted in widely varying theoretical limits ranging from 3% to 25% of the total number of households (TCRP, 2005). For instance, Schuster et al. (2005) estimated that neighborhood-based car-sharing had the potential to replace 4 percent of private cars in Baltimore, based solely on drivers switching due to cost savings.

More sophisticated studies have attempted to determine the number of people who possess demographic characteristics similar to existing members and extend these characteristics to the larger population (Steininger et al., 1996; Vägverket, 2003; Muheim, 1998; Loose et al., 2005). Using these methods, the maximum theoretical market for car-sharing was 13.5% of drivers in two Austrian neighborhoods, 25% in Sweden, and 23% in Switzerland. Estimates for Germany have concluded that car sharing organizations could potentially attract 3 percent of the population (Loose et al., 2005; Baum and Pesch, 1994). In the United States, Shaheen et al. (2006) estimate the potential in metropolitan areas at 12.5 percent.

However, Steininger et al. (1996) acknowledge the calculated potential in their study is based only on the profile of early adopters. The overall market potential may be

greater as car-sharing becomes more commonplace and is better integrated with public transport. Steininger et al. also attempted to determine the immediately available market in the vicinity of existing shared-car vehicle stands. A mailed description of the scheme to 1,200 households resulted in a 1.5% positive response rate to a trial membership period.

The previously mentioned studies of market potential focused on urban areas where most car-sharing organizations have begun. The UK car club organization Carplus has conducted a study of rural car-share members. The results of their study indicate that rural car-sharing organizations draw members with very different demographic profiles, including older people and those with lower incomes. (Carplus, 2004) The demographics of rural members are discussed in the following section, but this finding could indicate a larger potential market than was previously identified.

3.2.2 Demographic Characteristics

Several studies have attempted to identify the demographic characteristics of car-sharing members. TCRP (2005) conducted a web-based survey of more than 1,300 existing members in North America. The study found that members were typically in their mid to late 30s and had a higher than average income and educational attainment

level. These findings are in general agreement with other studies from North America and Europe (Brook, 2004; Harms and Truffer, 1998, Steininger et al., 1996).

However, differences have been noted in demographic composition of some member groups. According to Polk (2000), members of car-sharing organizations in Oslo and Göteborg had a significant number of older members. Loose et al. (2006) found that German 26 to 35 year-olds were particularly disinterested in car-sharing, and exhibited strong positive attitudes toward car ownership and negative attitudes toward public transport. Carplus (2004) found a wider range of age, income, and educational attainment amongst rural members. Their average age was 47, compared to 42 for urban members, 63 percent were female, and the percentage of those in professional occupations was half that of urban clubs. This likely reflects the difference in the demographic make up between rural and urban communities, but may also indicate that car-sharing has a wider appeal than previously thought.

Differences have also been noted in household characteristics across various studies. TCRP (2005) found that car-share members in the United States typically belong to small households without children. Thirty-six percent of survey respondents lived alone, and their average household size was 2.02, compared to the national average of 2.60. Only 24% of car-sharing households included at least one child under the age of 18. Conversely, studies in the UK and Austria found a greater than average number of

households with children participated in car-sharing. (Carplus, 2004; Hope, 2001; Steininger et al, 1996)

Considerable differences have also been noted in the car ownership rates of those who belong to car-sharing organizations. Steininger et al. (1996) found that approximately half of members in Austria owned a car prior to joining. Three-quarters of rural club members in the UK owned at least one car. (Carplus, 2004) TCRP (2005) found that a very high percentage of North American members (72%) did not own a car. This included 87% of Canadian and 67% of US members. This percentage is surprisingly high considering car ownership rates in North America compared to Europe. It may be an indication that North American members currently come from a very narrow demographic profile or that the geographical location of clubs is limited to the most dense urban core neighborhoods.

3.2.3 Attitudes and Reasons for Joining

A number of studies have examined the common attitudes of car-sharing members and their reasons for joining. Their motivations can generally be grouped into two categories – practical and ideological. Practical reasons for joining include cost savings, convenience, and elimination of the hassles of car ownership and maintenance. Ideological reasons include environmental and social concerns and positive views toward cooperative ownership. (Harms and Truffer, 1998; Carplus, 2004; TCRP, 2005)

The TCRP study found that while car-sharing members in North America tended to hold strong social and environmental views, their reasons for joining were more pragmatic. Nearly 90% of respondents in a web-based survey agreed with the statement “It's my responsibility to help create a better world.” (TCRP, 2005, p 3-16) Likewise, 88% agreed that they were “very concerned about environmental issues.” (TCRP, 2005, p 3-16) However, the reasons most cited when respondents were asked their reasons for joining were more practical. They included the desire to eliminate car ownership hassles, lower transportation costs, and increased mobility options. Interestingly, one of the highest rated reasons for joining was “the overall philosophy of car sharing”. While the exact meaning of this statement is a bit ambiguous, it seems to indicate that North American members have some attraction toward the cooperative ownership model of car sharing clubs.

Studies in other countries indicate varying attitudes. Polk (2004) found a pattern similar to the TCRP amongst members of a Swedish car sharing club. Cost savings and lack of a maintenance obligation were highly rated, as was the notion of collective ownership and the cooperative ideology. Environmental considerations rated considerably lower. A study of rural car-share members in the UK found that environmental concerns were foremost, followed by cost and less hassle than car ownership. (Carplus, 2004) Similarly, the primary motivations for members of Austrian car sharing clubs were environmental protection, congestion reduction, and cost-

effective car access. (Steininger et al, 1996) In Germany, 70% of members gave environmental reasons as their primary motivation for joining. (Harms and Truffer, 1998) Interestingly, Harms and Truffer found changing attitudes amongst Swiss car sharing club members over time. The social dimension of the clubs tended to decrease as organizations became larger and more anonymous. Newer members showed a more practical view toward car sharing arrangements. Their main purpose in joining was increased mobility.

Several studies identify life changes as an important determinant of the willingness to join a car sharing club. Carplus (2004) found that 77 percent of rural car club joiners had experienced a recent life change such as moving house, changing jobs, or selling a car. Harms and Truffer (1998) found a similar situation for Swiss and German members, but accumulated events such as parking, congestion, or continued major repair costs also played a role. In any case, the presence of a trigger event appears to play an important role in changing the habitual behavior of personal car use.

3.2.4 Geographic Characteristics

In the United States, car-sharing organizations are almost exclusively located in the largest urban areas. As of 2003, 94% of all members were located in eight large metropolitan areas – three in the Northeast and five on the West Coast. (Shaheen et al.,

2004) These large urban areas have characteristics that make them most favorable for success. They include high density, mixed use neighborhoods, high parking pressures, and adequate choice of alternate transport modes. (TCRP, 2005; Bonsall, 2002; Meaton, 2003)

Other locations where car sharing clubs have proven viable include university campuses and apartment complexes (TCRP, 2005). In the UK, Bonsall (2002) identified new mixed use development and middle class neighborhoods with strong sense of community as having good potential. In the United States, this would seem to indicate that new urbanist and transit oriented developments could be favorable locations.

Studies have shown that car-sharing can work in smaller communities as well. Examples include Cooperative Auto Network's small town service in British Columbia, Canada (TCRP, 2005) and the Countryside Agency's rural pilot projects in the UK. (Carplus, 2004) In Austria and Sweden, clubs successfully serve towns with as few as 1,000 residents. (Koch, 2002)

A study by Meaton and Low (2003) found that “local champions” of car-sharing may have more influence over success than geographic or socio-economic factors. They maintain that the main barriers to car clubs are low public awareness and the lack of support for those who wish to establish one in their area. The fact that the vast majority of car sharing clubs in the United States are currently located in large urban areas does

not necessarily mean that they cannot survive and grow in other areas. Examples from Canada and Europe indicate that there are other potential markets and these markets may expand as public awareness and acceptance increase.

3.3 Transportation Forecasting Methods and the Car-Sharing Market

This study, like many others in the transportation planning field, is concerned with determining the demand for a new service. Many advances have been made over the past half-century regarding the prediction and forecasting of travel demand. However, the goal of the various methods that have been developed over the years remains the same: to predict the actual behavior of travelers based on their responses to hypothetical research questions.

One of the most widely used methods of soliciting user preferences and forecasting demand is the stated preference (SP) method. In SP surveys, participants are asked to evaluate a hypothetical situation and choose or rank alternatives based on their economic utility. The microeconomic theory upon which the SP method is based states that the preferences derived from the SP survey reflect the core preferences of individuals. These core preferences are theorized to correspond to actual behavior when a situation is presented in a real environment. (Fujii and Gärling, 2003)

Although the SP method is well-established in the field of transportation research, its limitations are also well-recognized. The basic assumption that underlies the predictive capabilities of SP methods is that the utility function derived from an SP survey is invariant. Studies have shown, however, that this may not be the case. Context appears to play an important factor in the choices made by respondents in SP surveys, despite the best efforts to design out biases. (Fujii and Gärling, 2003)

Examples of biases introduced by context include the way alternatives are framed (improvements or degradations), completeness of information or understanding, and the mode of response to the question (discrete choices that limit the number of options).

Although researchers strive to develop SP surveys that capture “core preferences”, while eliminating those that are dependent on context, there are some cases where core preferences may not even exist prior to respondents being asked to make a choice. (Fujii and Gärling, 2003) In situations where core preferences do not exist, respondents tend to make decisions “on the fly” and form ad hoc preferences. This form of decision making is dependent on a number of contingencies, including frame of reference, time constraints, task complexity, question framing, and response mode. (Slovic, 1995) This has been found to be especially true for surveys that ask people to evaluate unfamiliar services or those that do not currently exist. (Ajzen et al., 1996, Schkade and Payne, 1994) As a result, respondents often tend to overstate their intention to use a new

service, especially when its use is seen as socially or environmentally responsible. (Slovic, 1995; Bonnel, 1995)

Car-sharing still has a very low level of public awareness in the United States. Only 0.03 percent of American drivers are car-sharing members and the service is currently offered almost exclusively in the urban core of large cities. (TCRP, 2005) Therefore, knowledge and experience with car-sharing is likely to be very low in smaller metropolitan areas where car-sharing does not exist. Awareness is likely to be lower still in suburban and exurban neighborhoods away from the urban core. For this reason, SP methods may not be well-suited to studies of car-sharing potential in these areas.

3.4 Attitude Theory in Transportation Studies

In order to address the limitations of the SP method, several researchers have suggested the use of attitude theory in transportation planning studies – either alone or in conjunction with SP questionnaires. (Fujii and Gärling, 2003; Heath and Gifford, 2002) According to Gärling et al. (1998), “Attitude refers to an evaluative response to some object which disposes a person to behave a certain way toward it.” (p. 130) Social psychologists have found that attitude is relatively stable regardless of context. Therefore, the use of attitude theory may reduce the errors introduced in the SP method and better capture an individual’s core preferences. (Fujii and Gärling, 2003)

However, while attitude may dispose a person to act a certain way, attitude alone has been shown to be a relatively poor predictor of actual behavior. (Ajzen, 1991; Gärling et al., 1998) The shortcomings of using attitude alone to predict behavior have been attributed to the fact that other factors tend to intervene and prevent action. These factors include social pressure, the control that the actor has over performing the behavior, and whether or not the behavior is volitional. (Ajzen, 1991)

Several previous studies of car-sharing market potential have attempted to use member attitudes and demographic data to predict the percentage of the population who might be attracted to car sharing. (for example, Harms and Truffer, 1998; Carplus, 2004; TCRP, 2005) These studies hypothesize that those within the general population who hold positive attitudes toward car-sharing and its beneficial outcomes (such as environmental benefits and cost savings) are likely to use the service. However, because attitude alone has proved to be a relatively poor predictor of behavior, these studies may not provide an accurate forecast of car-sharing market potential. This is especially true when respondents are asked about their attitudes toward very general concepts such as environmental protection or social responsibility. (Ajzen, 1991)

One of the key insights gained from studies of the attitude-behavior relationship is that behavioral intention is a much better predictor of actual behavior than other measures. Behavioral intention signifies not only a desire but also a commitment to act. (Ajzen, 1991; Fujii and Gärling, 2003) One of the most successful frameworks for

understanding the attitude-intention relationship and ultimately predicting behavior is the Theory of Planned Behavior (TPB). (Ajzen, 1985) TPB has strong empirical support, and has been used to explain a wide variety of behaviors, including eating disorders, smoking cessation, voting choice, and leisure activity participation. (Armitage and Connor, 2001)

Within the transportation field, TPB has been used in a variety of studies. For example, De Groot and Steg (2007) found that the TPB accounted for 47 percent of the variance in shoppers' intention to use a park and ride facility outside of Groningen, Netherlands. Haustein and Hunecke (2007) used an extended version of the TPB to examine the affect of perceived mobility need on mode choice in three German cities. They found that TPB explained 85 percent of the variance in intention to use environmentally friendly transportation modes and 38 percent of the variance in actual use. Bamberg et al. (2003) used the TPB to examine the impact of an intervention designed to increase bus use by university students traveling to class. The TPB was found to accurately predict both intention to use the bus and actual behavior both before and after the intervention.

In the TPB, behavioral intention is considered the direct antecedent of behavior. Intention strength is a measure of how much effort an individual is willing to put forth to perform a behavior. Three factors predict an individual's behavioral intention in the TPB (Francis et al., 2004):

- Whether the person has a positive or negative feeling about the behavior and its possible outcomes (attitude)
- Whether the person feels social pressure to perform the behavior (social norm)
- Whether the person feels he or she has control over performing the behavior (perceived behavioral control)

Figure 1 shows a schematic representation of the TPB.

In addition to perceived behavioral control, actual control plays an obvious part in the performance of the target behavior. If an individual has no opportunity to perform an action, it is unlikely to be performed, regardless of the strength of the intention.

(Ajzen, 1991) For instance, if car-sharing does not exist in a particular area, there is no opportunity for even those with the strongest intentions to become members. However, the purpose of this study is to examine the overall market for car-sharing, assuming it becomes widely available as it matures. In the situation where the service is available, it should be expected that those with strong intentions to use it would do so.

From a psychological standpoint, the TPB considers perceived behavioral control to be more important in the prediction of behavior than actual control. This is because an individual's unrealistically optimistic or pessimistic perception of control has a direct impact on how much effort he or she will be willing to put into performing the behavior.

(Ajzen, 1991) However, unrealistic evaluations of control are an important factor to consider in studies of transportation mode choice.

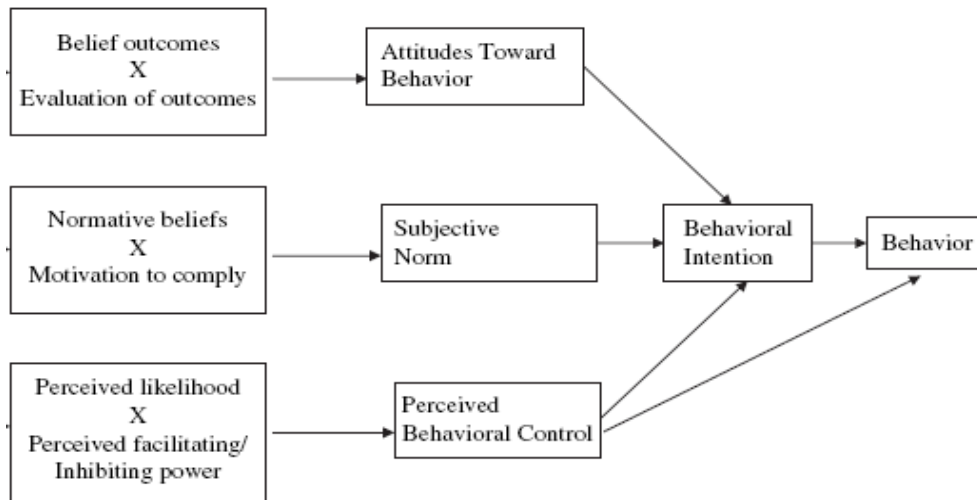


Figure 1: Schematic Representation of the Theory of Planned Behavior (Deskins et al. 2006)

In the course of daily travel, individuals often make the same trips over and over by the same route and mode of transport. When an action such as this is repeated enough times, its performance can become semi-automatic, with little conscious thought given to alternatives. In the case of habitual behaviors such as these, studies have found that the addition of a habit measure to the TPB significantly improves the prediction of future behavior. (Verplanken et al., 1994; Bamberg, 2000; Bamberg, 2003) The study of car-sharing in an area where it does not exist necessarily means that even those with a strong intention to car-share will have developed habitual travel behaviors that do not

include car-sharing. Therefore, it is important that current travel behavior be documented and considered when predicting a future switch to car-sharing.

3.5 Summary

Although car-sharing is increasingly recognized as an important component of a sustainable and flexible urban mobility system, relatively little research exists that examines its market potential. The majority of studies that do exist have focused either on economic utility or on the demographic and attitudinal profiles of existing members. Because car-sharing is still not well known by the public and the urban neighborhood operational model predominates, these types of studies may be too narrowly focused to gauge the potential for car-sharing. It may be necessary to look beyond the profile of existing members to understand the future role of car-sharing – especially in metropolitan areas where the service does not currently exist.

While stated preference survey techniques are widely used in transportation research, studies have shown they have potential limitations in situations where respondents have little experience with the issue or service being presented. This may lead to respondents being led by the context of survey questions or making evaluations “on the fly” that do not reflect their true preferences.

Alternative methodologies, such as those incorporating social psychology, have been used in transport studies in an attempt to improve behavior prediction, either alone or in conjunction with stated preference methods. One example is the theory of planned behavior (TPB), an attitude-based theory that has shown the ability to predict a wide variety of behaviors through the measurement of intention. TPB has been adapted by transport researchers by using measures specifically tailored to the problem of transportation mode choice and travel behavior.

Chapter IV: Methodology and Research Design

The purpose of this study is to assess the potential for car-sharing in the Greater Richmond Area. Because car-sharing is not available in Richmond and awareness of the concept is likely to be very low, much attention was given to applying an appropriate theoretical framework for this study. The main goal was to gain an understanding of the issues affecting car-sharing membership while limiting the biases that often influence participant responses.

Based on empirical studies conducted on a wide range of behaviors, the theory of planned behavior (Ajzen, 1985) provided an appropriate framework for examining the salient beliefs associated with car-sharing in the Richmond area. The following sections describe the methodology and research design used in this thesis. They include a brief description of the theory of planned behavior and the additional parameters that were added to improve the understanding of the barriers to car-sharing in Richmond.

4.1 Theoretical Background

According to the theory of planned behavior, the likelihood of an individual performing a behavior, such as becoming a car-sharing member, depends on the strength of his or her intention to perform that behavior. Intention strength is influenced by three

sets of beliefs. These are the individual's attitude toward the behavior (behavioral beliefs), subjective norms about the behavior (normative beliefs), and perceived control of the ability to perform the behavior (control beliefs). Generally, the more positive the beliefs are toward the behavior, the stronger the intention and therefore, the greater the likelihood the individual will perform the behavior if an opportunity arises (Ajzen, 1991). The theory of planned behavior has proved its value in diverse fields, including various transportation studies (Bamberg et al., 2003; Heath and Gifford, 2002; Anable, 2005; Erickson, Garvill, and Nordlund, 2007).

While the TPB provides a framework for determining strength of the intention to perform a behavior, studies have found that habit often interferes with intention when behaviors are not entirely volitional. This can be especially problematic in transport studies that deal with mode choice. In cases where the same trips are made by the same mode and route on a regular basis, little or no consideration is given to alternatives. This is particularly true where substitute modes of transport are lacking. (Fujii and Gärling, 2003)

Verplanken et al. (1994) have suggested that habit strength can be measured by asking respondents to rapidly choose their most likely travel mode for a variety of trip types. The number of times a mode is chosen indicates the habitual inclination toward its use. This measure was subsequently adapted by Bamberg et al. (2003) to improve the

predictive capabilities of the TPB with respect to travel behavior. The framework adopted by Bamberg is used in this study as well.

4.2 TPB and Prediction of Shared-Car Use

By dividing individuals into groups based on intention strength and habit, predictions can be made about the likelihood of car-sharing use. While conclusions about market size cannot be drawn from this pilot study, future larger-scale studies could use classifications to quantify the number of potential users. Such groupings may also yield information on which types of encouragement or incentive may assist potential users in changing behavior. Table 1 lists the four possible categories that participants could fall under, including a brief description of their car-sharing potential.

Intention	Personal Car Habit	Potential
Strong	Weak	Likely car-sharing member if service becomes available.
Strong	Strong	Potential member with intervention to break habitual personal car use.
Weak	Weak	Potential member if targeted with information about car-sharing benefits.
Weak	Strong	Unlikely to join a car-sharing organization.

Table 1: Car-sharing membership potential based on intention and habit

As Table 1 shows, those with strong intentions and weak personal car habits would be expected to adopt car-sharing as one of their mobility options if it becomes available. These are the “early-adopters” who account for most of the current car-sharing membership. On the other end of the spectrum, those who have very weak intention to car-share and a strong habitual use of private cars are very unlikely to become users.

The real area of interest is the “gray” area between these two positions. These are people who may be persuaded to use car sharing if the proper conditions exist or they are made aware of its benefits. Appropriate persuasion may include information about the economic or environmental benefits of car-sharing. Interventions, such as trial memberships and incentives to use alternate commuting modes could be used to encourage change as well. Those who fall into these categories are of special interest, since they may represent the currently untapped market for car sharing.

4.3 Life Change

The final area of interest in this study was whether respondents had recently experienced a major life change. Several previous studies of car-sharing members have indicated that life changes, such as change of job or residence, birth of a child, or retirement, are often triggers that cause a change in travel behavior. (Carplus, 2004; Harms and Truffer, 1998) Identifying the intentions of those who have experienced a

recent change may also be useful in better understanding their beliefs and designing interventions to encourage membership.

4.4 Study Area Background Information

The Greater Richmond Area of Virginia was chosen as the study area for this thesis. Greater Richmond lies at the heart of the Richmond-Petersburg (Virginia) Metropolitan Statistical Area (Richmond MSA). It is comprised of the City of Richmond, the counties of Henrico, Hanover, and Chesterfield, and the Town of Ashland. According to the Greater Richmond Partnership (2008), the region's population was 881,378 in 2007. By 2010, the population is expected to reach 915,000, a 13.4 percent increase from the year 2000.

Richmond continues to experience rapid suburban growth, especially in western Henrico, Hanover, and Chesterfield counties. This growth, aided by the recent completion of Virginia Route 288, has facilitated increased cross-commuting, especially between western Henrico and Chesterfield. Richmond's bus-only transit system consists of a hub and spoke route system centered on downtown, with extremely limited service to suburban areas. The most rapidly developing suburban areas, such as Short Pump in Henrico and Midlothian in Chesterfield, currently have no public transportation system.

Richmond was ranked 51st of 85 metropolitan areas in the United States in traffic congestion costs in 2005, up from 61st in 2000. (TTI, 2006) The Greater Richmond Transit Company provides bus service in Richmond and the surrounding counties. Amtrak regional rail service is accessible through two stations in Richmond and one in the town of Ashland. There is no local commuter rail service.

Richmond is the capital of Virginia and has a relatively diverse economy. Thirteen Fortune 1000 companies are headquartered in the area. It also has a strong public sector presence. In addition to being the seat of state government, Richmond is the home of the Fifth District Federal Reserve Bank, and the Fourth U.S. Circuit Court of Appeals. The area's unemployment rate was 3.7 percent as of December, 2007. (GRP, 2008)

4.5 Neighborhood Study Areas

For this study, participants were recruited from three different areas in Greater Richmond. The first area was a historic neighborhood in the urban core, the second a rapidly developing suburban center, and the third a small independent town in a semi-rural area. The three areas were chosen in an attempt to examine beliefs of people who live in neighborhoods that vary in their density, access to transit, and level of traffic congestion. Figure 2 shows the locations of the study areas within Greater Richmond.



Figure 2: Study Area Location Map

The Fan District was chosen as the urban area for this study. The Fan, which is comprised of more than 100 city blocks, is the largest intact Victorian community in the United States. It developed in conjunction with Richmond's trolley system between 1880 and 1920. (HRF, 2008) It lies immediately west of the central business district and adjacent to Virginia Commonwealth University. Neighborhood access to public transportation through Greater Richmond Transit System buses is among the best in the Richmond area. The area is highly walkable and offers a variety of shops and restaurants both within and on the fringes of the neighborhood. Housing in the Fan District consists of a variety of single-family homes and converted apartments. Because the neighborhood

has a mix of students and professionals, renters and homeowners, income levels vary widely. Among the census block groups that comprise the Fan, median household incomes ranged from \$11,650 to \$60,529 in 1999. The 1999 median household income for the Richmond-Petersburg Metropolitan Statistical Area was \$46,800. (US Census Bureau, 2000).

The suburban area chosen for this study was Short Pump and Innsbrook in Western Henrico County. Short Pump is located approximately twelve miles northwest of downtown Richmond. The area has experienced extremely rapid residential and retail growth over the past two decades, and adjoins two of the largest suburban employment centers in Greater Richmond – Innsbrook in Henrico County and West Creek in Goochland County. Its proximity to Interstates 64 and 295 and State Route 288 facilitates commuting both to and from the area and has led to increasing traffic congestion along Broad Street, which is a major arterial route through Western Henrico and the City of Richmond. Median household income in the census block groups of the study area ranged from \$62,610 to \$75,199 in 1999 (US Census Bureau, 2000).

The third area chosen for this study was the Town of Ashland. It is a small independent town in Hanover County that lies approximately fifteen miles north of downtown Richmond. The town had an estimated population of 7,052 in 2006. Originally developed by the Richmond, Fredericksburg and Potomac Railroad as a resort in the 1840's, the town has always been closely tied to Richmond through its

transportation links. This included streetcars at the turn of the 20th Century and US Route 1 and Interstate 95 today. The town is also home to Randolph-Macon College, which relocated to Ashland in 1868. (PBS, 2008) Housing in Ashland consists mainly of single-family units, although there are a number of apartment complexes in town in addition to dormitories on the Randolph-Macon campus. The 1999 median household income in the block groups that comprise the Town of Ashland ranged from \$34,231 to \$44,821 (US Census Bureau, 2000)

4.6 Participant Recruitment

A variety of methods were used to recruit potential participants. Recruitment initially focused on homeowner and neighborhood organizations in the three study areas. Organization members were identified through neighborhood websites and contact was made by both telephone and e-mail.

Within the urban study area, approximately thirty-five members of the Fan District Association (FDA) and West Grace Street Association were contacted by e-mail and telephone. This resulted in approximately ten people expressing interest in participating in a focus group discussion. Of these, eight committed to attend the focus group discussion and six ultimately participated.

Recruitment for the suburban focus group again relied on homeowner association contacts. Approximately ten associations in the Innsbrook and Short Pump areas of western Henrico County were contacted in an effort to recruit participants. At least two of these groups passed mass e-mails along to association members with information about the study. This effort resulted in four potential participants committing to attend the focus group session. For various reasons, none showed for the focus group at the scheduled date and time. All were subsequently offered an opportunity for a short individual interview at a time that was convenient for them. Two of the four accepted, and individual interviews were conducted with the same semi-structured questioning route that was used for the focus group.

Recruitment for the Ashland focus group was even more problematic. The town lacks distinct neighborhoods and subdivisions, and therefore other types of organizations were used to contact volunteers. These included local parent-teacher organizations, Friends of the Ashland Library, and local media. Announcements were made on the local public access television station, and information about the study was placed on the homepage of a local news website. Ashland is home to Randolph-Macon College, and efforts were made to recruit students and faculty as well. All student Resident Assistants at the college were contacted about the study, as was the Environmental Studies department. From these efforts, only three participants volunteered to take part in a focus group. As was the case with the suburban

participants, none showed for the scheduled focus group discussion. All were offered the opportunity for individual interviews, but none accepted.

In all, the data collected for this study included one six-person focus group of urban residents from the Fan neighborhood and two individual interviews with residents in suburban Short Pump and Innsbrook in western Henrico County. The difficulty in recruiting volunteer participants for this study is likely indicative of an overall lack of interest and understanding of car-sharing in the Greater Richmond area. This is not surprising, considering the fact that less than 0.03% of licensed drivers in the US are car-sharing members and they are almost exclusively located in the urban cores of the largest cities. The fact that volunteers were relatively easy to attract in the urban study area is probably due to a higher level of awareness and more positive attitude toward private car alternatives.

Chapter V: Research Methods

The most common method used to carry out a TPB-based behavioral investigation is a survey questionnaire. The three constructs of the TPB are ordinarily assessed directly, through a series of questions that use standard attitude scaling procedures such as Likert or Thurstone scaling. However, before a TPB questionnaire can be developed, pilot work is usually required to elicit the salient behavioral, normative, and control beliefs that exist among the study population. The pilot work can be used to elicit personal beliefs, or to examine the beliefs that are most frequently expressed by respondents (modal beliefs). (Ajzen, 2006)

Pilot work is carried out using open-ended questions that are presented to participants in individual interviews or focus groups. Their general format is as follows:

Behavioral beliefs (attitudes):

What do you believe the advantages are [of performing the target behavior]?

What do you believe the disadvantages are [of performing the target behavior]?

Is there anything else you associate with [performing the target behavior]?

Normative beliefs:

Are there any individuals or groups who would approve [of you performing the target behavior]?

Are there any individuals or groups who would disapprove [of you performing the target behavior]?

Are there any other individuals or groups who come to mind when you think about [the target behavior]?

Perceived Behavioral Control:

What factors or circumstances would enable you to [perform the target behavior]?

What factors or circumstances would make it difficult or impossible to [perform the target behavior]?

Are there any other factors or circumstances that come to mind when you think about the difficulty of [performing the target behavior]?

Design, implementation, and analysis of a TPB survey are explained in detail in Francis et al. (2004).

While a full TPB investigation generally consists of both a qualitative pilot study and a quantitative questionnaire, several recent studies have used qualitative methods alone to elicit the salient beliefs about a behavior and examine factors that facilitate or hinder its performance. Topics for these studies have included participation in cholesterol screenings (Deskins et al., 2006), use of problem solving therapy for depression (Pierce and Gunn, 2007), prostate cancer information seeking among African-

American men (Ross et al., 2007) and the intention to commit violations while driving (Forward, 2006).

The purpose of this thesis is to examine the market for car-sharing in Greater Richmond. This study represents a first step in the process of determining who might use the service, where they live, and what barriers need to be overcome to make car-sharing viable. In order to perform a large-scale investigation that quantifies the size of the market in Richmond, we must first identify the beliefs people have about car-sharing. This includes whether or not potential users consider the concept to be useful, whether they feel it will have a positive impact on their mobility, whether it fits into their travel patterns and lifestyle, and how friends and family would react to their trading car ownership for shared-car access.

The qualitative pilot work specified by Ajzen (2006) provides an appropriate means of eliciting the beliefs needed for this study and can help lay the groundwork for more extensive studies of the Richmond area. It served as the basis for the experimental design of this thesis. The following sections describe the methods used in the study and the questioning route used in the focus group and interviews.

One focus group and two individual interviews were conducted as part of this study. In each case, the same basic questioning route was followed. The focus group and interviews followed a semi-structured format that allowed flexibility in tailoring the

discussion to the background of the individual or group. The questions were designed to elicit information from the respondents about the three major constructs of the TPB (attitude, social norms, and perceived behavioral control) as well as travel mode habits and life changes.

At the beginning of the discussion, each participant was asked whether they had any previous knowledge of car-sharing. This was done to give the interviewer / moderator some idea of the knowledge level of each person and tailor the discussion appropriately. Participants were given a brief description of car-sharing during the recruitment process, and were directed to two non-commercial car-sharing resources on the internet. Print information was also offered, although none of the participants requested print materials.

Next, participants were asked to perform an exercise designed to get them to think about how they travel and to measure their habitual use of certain travel modes. Each participant was given a grid with the numbers one through ten across the top and nine travel modes down the side. They were then read a series of ten trip scenarios and asked to choose, without much contemplation, which mode they would use to make that trip. The trip scenarios were as follows:

Visiting a friend

Engaging in exercise/sports

Going to a restaurant/bar in the evening

Visiting relatives
Showing visitors around town
Shopping for groceries
Taking an excursion to the lake, river, or beach
Going to a movie
Going to work
Shopping after work

After all participants had finished marking their grids, the results were discussed. This involved asking about which trips, if any, participants would use a mode other than their personal car. For those who did indicate they used other modes, they were asked about the availability and convenience of those modes. The purpose of this question was to get some idea of the ease of using substitute modes. Studies have found that the availability of substitutes facilitates the use of car-sharing (TCRB, 2005).

Next, the discussion turned toward the constructs of the TPB. The first area of discussion was the attitude of the participants toward the concept of car-sharing. They were asked the following questions:

“Let's assume car sharing were to become available in your neighborhood. Based on what you now know, what do you think the advantages would be of using this service?”

“What do you think the disadvantages would be?”

“Are there any other thoughts or feelings you associate with the car sharing concept?”

The second area that was explored in the focus groups and interviews was perceived behavioral control. This followed logically after the attitude and habit discussions because participants had been given an opportunity to reflect both on how they currently travel and what they might gain or lose from using a car-sharing service. Questions in this portion of the discussion asked participants to consider the factors that would make it easier for them to car-share and what factors would make it difficult or impossible. They included:

“What factors or circumstances would make it easier for you to use a shared car?”

“What factors or circumstances would make it difficult or impossible to use a shared car?”

Next, questions were asked about the social norms associated with car-sharing. Participants were asked how the people who are important to them would feel if they were to begin using car-sharing instead of their own car. They were especially asked to consider how those people would feel if they decided to give up one or more of the cars they now own. The questions designed to elicit beliefs about social norms included:

“How do you feel that important people in your life, such as family, friends, or co-workers, would feel about you using a shared car instead of one you own?”

“Who would approve? Who would disapprove?”

As part of this discussion, participants were also asked about their attachment to the specific make or model of car they now own. This was asked to gauge how strongly they attach status or identity to car ownership.

Next, participants were asked about how life changes, such as a family birth, job change, or move has or might affect their interest in car-sharing. The first part of this discussion centered on whether recent life changes had caused more interest in car-sharing. The second part dealt with any anticipated changes and their potential impact.

Finally, participants were asked if they had any thoughts about car-sharing that were not covered in other parts of the discussion.

Chapter VI: Results

The audio recordings from the focus group and individual interviews were summarized and abridged transcripts were created to capture statements that were particularly relevant to the study. These summary statements and transcripts were then analyzed and grouped together based on the categories included in the theoretical framework of the study. Groups included statements that pertained to the theory of planned behavior (attitude, subjective norm, and perceived behavioral control), as well as habit and life changes. In addition to statements made during the interview, travel scenario worksheets, which included mode choices for ten travel scenarios, were analyzed to examine participant travel behavior.

The following sections discuss the results of the focus group and individual interviews. Results are categorized by the theoretical constructs of this study, beginning with habit, followed by the constructs of the theory of planned behavior, and life changes. In some cases, participant comments were directed at how car sharing fit within the community, rather than his or her individual situation. These comments were summarized and analyzed to extract information that may be useful in understanding neighborhood and regional issues that affect the viability of car-sharing.

6.1 Mode Choice Habit

Each interview or focus group began by asking participants to indicate the transportation mode they would most likely choose for a variety of trips. Trip types included those of a variety of distances and frequencies, including daily (commuting to work), several times per week (grocery shopping, getting exercise), weekly (going to a restaurant, visiting friends) and less than weekly (leisure day trips, showing visitors around town). The various travel scenarios were read to the respondents, who were asked to choose a travel mode without contemplation. This exercise, first proposed by Verplanken et al. (1994), was designed to measure mode choice habit strength.

The results of the habit measure indicated a high degree of dependence on personal cars among all but one of the study participants. Suburban interviewees were entirely car-dependent, with one indicating that she used her car for every trip type. The second suburban respondent indicated that she would use the train for visiting friends in the Washington D.C. area, but would rely on a car for all other trips. When asked about their travel habits, suburban respondents indicated that a lack of public transportation and sidewalks were major barriers to using alternative modes. Comments about the lack of alternatives included the following:

“The Short Pump area...I moved here three years ago and my concern is it's not set up for any kind of metro[politan] transportation hub.” [Suburban Participant 2]

“We don't have sidewalks. There's a lot of issues, you see, and the sidewalks...we don't have them in the neighborhood...Just to walk is dangerous.” [SP2]

While neither of the suburban interviewees indicated that they used public transportation in Richmond, both had previously used buses and one regularly used commuter trains while living in and visiting the Washington D.C. area. Both stated they would be interested in using buses if they were available. However, they also indicated that any transit service would need to be convenient and frequent for them to consider its use.

Among the urban group, private car use was also dominant for nearly all of the trip types that were presented. Two exceptions were trips to restaurants and for exercise. Four of the six urban focus group participants indicated that they would walk or bicycle when engaging in exercise or sports and five indicated that they would prefer to walk to a restaurant or bar. Only one indicated he would primarily use the bus for any of the journeys, which was a trip to the movies.

All of the trips for which the urban group used a mode other than private car were leisure trips where travel time was relatively flexible and items did not need to be carried. When asked about using alternatives for other trips, such as grocery shopping, participants stated the following:

“I could probably [walk to the supermarket], and I should. But then I have cold stuff and...it gets unwieldy [to carry everything].” [Urban Participant 5]

Respondents often indicated that space was a problem when using the bus for shopping:

“Even on the bus, you've got to presuppose that you have one extra [seat].” [UP3]

There were also concerns about the frequency and reliability of local buses:

“They're not too bad about schedules, but they are just bad enough that if I *have* to be somewhere...I'll find the bus I need to take and take the one 20 minutes before it – just in case.” [UP6]

“Especially on a Sunday or a holiday, you've got forever between buses coming.” [UP3]

Several participants in the urban group also made statements which indicated a negative image of bus use:

“Even growing up as a kid, we always had the impression that you only used the bus system because you couldn't afford to have a car.” [UP1]

“My grandparents were appalled when I used to take the bus to work.” [UP3]

In contrast to the urban group, both suburban participants expressed positive attitudes toward bus use, although their experience with public transportation was in cities other than Richmond.

“I think the bus system's great. If we had it here I'd just take it to work. I used to take it when I was in college.” [SP1]

“I spent several years on Okinawa. They have a bus system to die for. Every 15 minutes you can go anywhere on that island by bus.” [SP2]

Only one of the urban participants used a means other than private car to travel to work. This person had previously taken the bus, but had switched to a scooter because it was more convenient. Currently, he uses the bus as an alternative during bad weather. Another participant commuted by bus until his job required car travel during the day. All others commuted by private car. The reasons for this varied. Two participants used their car in their work and one worked in the Innsbrook area where public transportation was not available.

6.2 Attitudes toward car-sharing

An individual's attitude toward a behavior is an indication of his or her positive or negative feelings toward the behavior and its possible outcomes. (Francis et al., 2004)

All participants in this study had a favorable attitude toward the concept of car-sharing. This is not surprising, since those who took part in the discussion did so voluntarily and were therefore more likely to have some interest in how car-sharing could benefit them or their community.

However, even though participants expressed a positive attitude toward the car-sharing concept, their attitudes toward using the service varied. The following statements were typical of both the urban and suburban groups:

“I would definitely use it in Washington (D.C.) if I lived there...but living here...I have a one car garage and a car and I drive it every single day all the time.” [UP4]

“I put my support behind it because I think it is a great thing, but I can't say personally I would use it...because I have a car and I have a parking space and I can't see any reason that I would ever give up having a [personal] car.” [UP5]

Some felt that only those who do not have access to a car would be likely to use car-sharing:

“If you had a group of students who lived in a dorm...every one of them would say yes. They walk to class every day. They don't have issues for day to day. They do have parking problems. They don't need to get to work with their car.” [UP4]

“To share...it's good if you don't have a car to begin with.” [SP2]

“I work with a lot of immigrants. As you listen to them, as to what their needs are, transportation is a huge one, and they all end up buying a car. Without cars they can't have the jobs.” [SP2]

In the Fan, streets near Virginia Commonwealth University have one-hour parking restrictions for those without resident parking permits. Several comments were made about the potential of car-sharing to mitigate the parking problem in this area, especially among students. However, those who participated in the study indicated that parking did not have a personal impact on their travel behavior.

“It's a great idea...especially in an area like the Fan, specifically when you have a lot of students. Personally, I use my car pretty often and I have, you know, off street parking, so it wouldn't really help the neighborhood like that.” [UP5]

Of the people who took part in the discussions, only one exhibited a strong positive attitude toward car-sharing. This person had previously identified a need for informal car-sharing through discussions with like-minded neighbors:

“A group of us in my neighborhood know a couple of other people who have just one car...We all got together and thought, well what if we all got together and just bought one car to share. And somebody said...you know, there are programs out there that already do that...I would, without a question, use it tomorrow if we had it.” [UP6]

This person was one of only two who had investigated car-sharing prior to being recruited for this study. In addition, this participant’s household was the only one that had taken steps to reduce the number of cars it owned. Three years previously, the family had eliminated one of its cars and the husband used the bus to travel to work. After one year, he bought a motor scooter for his commute due to the added flexibility and convenience it provided.

Although only one participant expressed a strong positive attitude toward car-sharing in the Richmond area, others thought it would be useful to them in certain circumstances. These included times when access to larger vehicles was needed:

“I went from a Honda Odyssey [minivan]. I thought I needed a smaller car but I couldn’t go too small. I can think of maybe one day a month where I might need a [big] car. The

rest of the time I could get along with a really small energy efficient, gas efficient car. That's the kind of use for which a shared vehicle would be very tempting." [SP2]

Many stated they would car-share if they lived in or visited large cities where the service existed. In these cases, participants pointed out important differences between Greater Richmond and large metropolitan areas such as Washington D.C., New York, and San Francisco. Comments included the following:

"In San Francisco, I had to pay \$125 per month to park...and you had the number going over and over in your head. [And you think] I only use the car once or twice a week, so what am I paying for?" [UP4]

"You can even be very rich and not want a car in New York." [UP2]

Among suburban participants, attitudes toward car-sharing were mixed as well. One interviewee felt she might use it if commuting alternatives were available.

"I drive to work...I really only drive it the four minutes there and the four minutes back, but I do have to spend [money on] the insurance and all of that." [SP1]

"We do things on the weekends, but it's not as though we use [our second car] that much. So [eliminating one car] would help reduce the cost." [SP1]

6.3 Perceived Behavioral Control

In the Theory of Planned Behavior, perceived behavioral control (PBC) is a measure of how confident a person is that he or she is capable of performing a behavior. (Ajzen, 1996) In this study, it is a measure of the ease or difficulty someone would have in using a shared-car instead of one they owned and what factors would help or hinder that ability. Four major themes emerged from the interviews and focus group concerning TPB. These included the difficulty of accessing destinations by modes other than private car, the need to use a car for commuting or work, vehicle mix of shared-vehicles, and the presence of dependent non-drivers in the household. Some of these themes overlapped with those expressed during the habit discussions. This was expected, since the habit measure was added to account for travel behavior that is related to PBC but not entirely volitional. (Verplanken et al., 1994; Bamberg et al., 2003)

Much of the discussion about barriers to car-sharing involved the lack of alternatives for commuting. Participants were concerned about public transportation frequency and reliability in the urban group and the lack of service in the suburban group. Because car-sharing is intended to be a complementary mobility option, a lack of alternatives limits its usefulness. (TCRP, 2005) Six of the eight participants in this study commuted to work by car and/or used their car for work during the day. One of the remaining two was retired, and the other used a motor scooter or the bus depending

on weather. Those who commuted by car felt that private cars were essential for their work trip and could see no way they could give them up in their current situation.

However, several comments were made about the advantage of being able to own a small, efficient car for commuting while having access to larger shared vehicles.

“I believe that the flexibility issue for me would almost prohibit me from using [car-sharing] on a regular basis. However, I do see it as an advantage...if I needed a vehicle that could carry more things.” [UP5]

I think a huge consideration is the vehicle mix. It might not get some people to get rid of a car, but [they may] get a much smaller car. I don't need to buy that SUV for that one time a week I use it if I can get one from car share.” [UP6]

“I can think of maybe one day a month where I might need a [big] car. The rest of the time I could get along with a really small energy efficient, gas efficient car. That's the kind of use for which a shared vehicle would be very tempting.” [SP2]

“If we have two to three [kids] could we live this [single car] lifestyle? Maybe, maybe not. But if we absolutely decided we had to have two [cars] we'd be very likely to buy something like a Smart car – knowing that if we both had to take kids somewhere we had availability of another [shared] car.” [UP6]

While most thought larger vehicles would be more useful for them, some felt car-sharing would be more attractive if the vehicles were very small and/or futuristic:

“I think if it’s really something that’s...very green, electric, or hybrid or something you’re going to feel good about doing it and it’s going to attract more people.” [UP5]

This dichotomy of opinions points out the importance of providing an appropriate mix of vehicles to accommodate the needs of the target market. Within the group that was assembled for this study, those who had stronger intentions to use a shared car were also those who were attracted to larger shared vehicles.

The presence of non-driving dependents in the household was a hindrance for some of the respondents. Two households had young children and one an elderly parent. In each of these cases, using a shared rather than owned car presented challenges.

“If we had to walk five minutes with two kids and car seats, that would become difficult...I certainly wouldn’t want to do that.” [SP1]

“They go to two different schools...We have to pick them both up separately, so...I don’t know if it would work...and then if there was an emergency.” [SP1]

“I think for families it would be a very difficult thing with children.” [UP2]

“At this point, even though I would like to do with [fewer] vehicles, the fact that we need the truck for the work we do and that I have my 91-year old mother who lives with me and I have to be able to get her to the doctor...Even though I'd be willing to not have a car, I'm not in a position to do that right now.” [UP2]

6.4 Social Norms

In the TPB, the social norm construct is a measure of the social pressure an individual feels to perform or not perform a behavior. Among those who participated in this study, social norms appeared to play a minor role in their decision to car-share. Most felt their closest friends and relatives would support their choice and would feel it was a positive step. Several felt it would be viewed as “creative” or “cool” and that others would understand that it fit their personality and lifestyle. This seemed especially true of those who placed a high value on the environmental aspects of car-sharing but had weak intentions to use it.

However, those who had previously commuted by bus or intentionally reduced the number of cars they owned felt there might be some skepticism or concern from friends and family.

“I think all of my friends who live in the suburbs, and I’m positive my folks would just roll their eyes, shake their heads and say, ‘you’ll have a car again in less than a year’.”

[UP3]

“That’s what they all said to us. I can remember when we first [got rid of one car] my parents constantly said: ‘Do you want a car? Do you need a car this weekend?’ But once they realized we never did it finally went away.” [UP6]

Although those who felt there would be some concern from friends and relatives stated it would not influence their decision, they anticipated negative reactions due to past experience.

6.5 Life Changes

Several studies have examined the effect that life changes, such as moving house, the birth of a child, change of job, or retirement have on travel behavior (Carplus, 2004). As part of this study, participants were asked whether recent life changes had made them more likely to consider car-sharing. They were also asked whether they could foresee a change that would encourage them to reconsider their decision.

One of the suburban interviewees was a retiree and widow who had recently moved to the Short Pump area because of the close proximity and high concentration of retail shops and services. In her previous location, the family was more car dependent:

“I used to live 20 miles from anyplace, so I had to have a car. And all the kids eventually got cars...So, at one time we had five cars parked in the driveway.” [SP2]

After retirement, time had become less of a concern and she stated she was more willing to consider alternatives such as public transportation, car-sharing, and delivery services. When asked what type of life change would enable them to car-share, many in the Fan focus group felt retirement would encourage them to use other alternatives, including car-sharing.

“If I were to retire tomorrow, I would be more likely to give up a car and do car-sharing.” [UP5]

“If I were retired, I would have more time to [use alternatives]. Time is too critical when you're working. You need the convenience [of owning a car].” [UP4]

Others had experienced job changes that affected their ability to car-share. Those who used their cars in their work indicated that car-sharing could be difficult or impossible in

their current employment situation. However, one respondent stated that a change in job duties would completely change his interest in alternatives.

“All that would have to happen for me to change my mind [about car-sharing] is for me to have a desk job instead of a job where I’m on the road during the day.” [UP3]

These statements indicate the importance of life changes in altering travel behavior. Making potential users aware of car-sharing at the times when they are forming new travel habits may play an important role in increasing its viability. In a study of rural car-sharing clubs in Britain, Carplus (2004) found that 77 percent of new members had experienced a recent life change that had influenced their decision to join.

Chapter VII: Discussion

The number of participants in this study was small, and two interviews and one focus group are unlikely to capture all of the salient beliefs that are important for understanding the car-sharing market in Greater Richmond. Although those who took part in the study represented a range of ages, annual miles driven, and number of dependents, they were not especially representative of the socio-demographic profile of the region. All had household incomes at or above the regional average, were highly educated, and were homeowners. None of the participants were ethnic minorities. In addition, recruitment of subjects was not random and participation was voluntary. The result of this self-selection process was that those who took part were probably more likely to have an interest in car-sharing than the general population. A summary of participant characteristics can be found in Appendix A.

Although participant characteristics limit the generalizations that can be made from this study, it is a starting point that can be used to inform future research. The interviews and focus group proved especially useful in identifying recurring themes that provide insight into some fundamental barriers to car-sharing in the region. These included a lack of alternatives to the private car, urban form that necessitates car use for most journeys, and an abundance of convenient free parking. Combined, these factors play an important role in the formation of individual travel behavior and influence

attitudes toward car-sharing and other sustainable transportation modes such as transit, walking, and bicycling.

7.1 TPB, Habit and Intentions

In terms of the framework of this study, which included the TPB and a habit measure, only one participant exhibited a strong intention to car-share. This person had a positive attitude toward car-sharing, felt a high degree of control over his ability to use the service, felt little social pressure not to join, and was not a habitual car user. He closely fit the profile of American car-sharing members identified in previous studies: highly educated, middle to high income, urban dweller, 30 to 49 years old, environmentally and socially aware, who drives less than average annual distances.

Although several of the other participants also fit the demographic profile of car-sharing members, they had varying intention strengths and car habits. Four of the remaining seven participants exhibited generally negative attitudes toward car-sharing. This was most often expressed as a belief that personal mobility would be reduced by using a shared-car - especially in terms of freedom and flexibility of scheduling trips. With a personal car, trips can be made at any time, without pre-planning. Efficient route planning is not important, and there is no set return time that limits duration of use. Even though shared cars provide the same accessibility to destinations as a private car,

the fact that they must be reserved in advance and accessed some distance from home was perceived to be a significant barrier for some.

Only two of the eight people who took part in this study seemed to feel they had enough control over their daily travel requirements to allow them to take up car-sharing. For suburban dwellers, this lack of control stemmed from the absence of alternatives to the private car. The Short Pump and Innsbrook areas currently lack public transportation. Walking and bicycling were perceived to be difficult due to traffic levels and lack of facilities, especially in older subdivisions.

Among the urban dwellers, three used their vehicles for work. One commuted to Western Henrico, where no transit service currently exists. Each of these people felt that car ownership was essential for his or her daily activities and that a shared-car would offer no advantages. The only possible benefit they perceived was access to vehicles that fit specific purposes – especially vehicles that could carry more cargo or people than their own car.

One of the car commuters who had a negative attitude toward car-sharing did express the belief that he could give up one of his household's two cars by altering his travel behavior. However, he stated that taking the bus or bicycling to work and having to schedule previously spontaneous activities would result in an unacceptable decrease in quality of life. Although this person had little intention to use car-sharing, his beliefs

indicated that he may be persuaded by incentives that encourage the use of alternative commuting modes. This could be achieved by offering, for example, a one-month bus pass in conjunction with a trial car-sharing membership. Employer incentives for commuting by means other than car might also prove effective at changing habitual commuting behavior and encouraging experimentation with new transportation options.

All but two of the participants in this study exhibited strong habitual use of their private cars. Both of those with weak car habits fit the ‘early adopter’ profile and one stated that he would definitely use the service. The other felt owning a car was a necessity for his work travel, which required visiting clients throughout the area. However, he indicated that he would be very willing to give up a private car and car-share if his work requirements changed. This is a good example of where employer-based car sharing could provide a benefit in the Richmond area. Such a service could prove useful in both promoting transit and mitigating the need for employer subsidized parking in downtown Richmond.

7.2 Other Factors

Participants in this study seemed to be relatively unconcerned with the potential cost savings offered by car-sharing, and several commented that they were willing to trade the higher cost of ownership for the convenience. This is what Prettenthaler and Steininger (1999) refer to as the “waiting obedience” of the private car. Waiting

obedience allows owners the privilege of traveling when they want, where they want, in a vehicle of their own choosing. It is a benefit of the private car that is present even when it is not being driven, and may be one of the most difficult obstacles for car-sharing to overcome, especially among households with a car for each licensed driver.

Only one of the participants in this study lived in a household that had access to less than one vehicle per licensed driver. Those participants with individual access to a car showed strong habitual use of their cars and less tendency to consider alternative modes for anything other than short leisure trips. The one household that had fewer than one car per driver had made a conscious effort to reduce its car use, and was the most willing to experiment with other travel options – including car-sharing.

All but one of the participants in this study indicated that their main interest in car-sharing was its potential environmental benefit. However, many also seemed to feel that buying an energy-efficient car was sufficient to reduce their travel-related environmental impact. While more study is needed to quantify the prevalence of this attitude in the region, it points out the importance of matching fleet composition to user needs. For those who own small fuel-efficient cars, the attraction of a car-sharing fleet comprised of hybrid or other “green” technology vehicles may be low. For these people, access to a large car or SUV a few times a month may be a more compelling reason to join a car-sharing organization. Although offering vehicles that complement rather than replace personal cars may not reduce vehicle miles traveled, it could provide some overall

environmental benefit by matching vehicles to trip purpose, thereby decreasing overall fuel consumption.

7.3 Intention Prediction

One of the objectives of this thesis is to examine the usefulness of an extended version of the TPB in determining the viability of car-sharing in Richmond. Although the small sample size of this pilot study limits the conclusions that can be drawn, an analysis was conducted to determine car-sharing intention strength among participants.

In order to qualitatively determine intention strength, an assessment was made of each participant's beliefs with respect to the theoretical framework of the study. This included attitude, social norm, perceived behavioral control, habit, and life changes. Attitude was further divided into attitude toward the car-sharing concept and outcome beliefs. Only positive beliefs about both the concept and its outcomes indicate a positive attitude toward car-sharing membership. Social norms were also broken into two components. These included normative beliefs (social pressure) and motivation to comply with that pressure. Participants with negative normative beliefs but weak motivation to comply would be expected to consider car-sharing, as would those with positive norms and weak motivation to comply.

Table 2 shows a summary of this assessment. The table contains the participant's identification (UP1, SP2, etc.) and an indication of whether his or her statements indicated a positive (+) or negative (-) affect on the intention to car-share. The table shows that only one of the study participants (UP6) exhibited a strong intention to car-share. All of the other participants held beliefs in at least one area that indicated weak intention.

Participant	Attitude		Social Norms		PBC	Habit	Life Changes	Car-sharing Intention
	Car-Sharing Concept	Personal Outcome	Normative Beliefs	Motivation to Comply				
UP1	+	-	+	+	-	-	+	-
UP2	+	+	+	+	-	-	+	-
UP3	+	+	-	+	-	+	+	-
UP4	+	-	+	+	-	-	+	-
UP5	+	-	+	+	+	-	+	-
UP6	+	+	+	+	+	+	+	+
SP1	+	-	+	+	-	-	+	-
SP2	+	-	+	+	-	-	+	-

Table 2: Summary of Results and Intention Assessment

7.4 Implications for Greater Richmond

The findings from this study indicate that it may be difficult for car-sharing to advance beyond a small niche market under current conditions in Greater Richmond. Participant recruitment for this study was difficult outside of the urban study area, and even the majority of urban participants expressed relatively weak intentions to use car-

sharing. However, the discussions held in the course of this research indicated several scenarios where offering car-sharing could potentially be viable.

The first scenario that could be considered is the establishment of a car-sharing program at Virginia Commonwealth University (VCU). This was mentioned as a positive first step on several occasions in the Fan focus group. VCU's urban location, parking issues, and growing student population make it a seemingly ideal location. Commercial provider Zipcar has recently established programs at several universities in the region, including Old Dominion University, the University of North Carolina, and Elon University. In addition to providing greater mobility for students, car-sharing at VCU has the potential to allow residents in surrounding neighborhoods, such as the Fan, an opportunity to become familiar with car-sharing. Simply having a program available would help to raise awareness of the concept, complement existing options, and promote transportation sustainability in the VCU area. Car-sharing may also provide some parking relief for neighborhoods in the immediate vicinity of campus, and could be viewed as a positive step by adjoining neighborhood associations. However, actual impact would likely depend on program size and parking policies.

The second scenario in which car-sharing seems to have potential is as a complement to public transportation in downtown Richmond. One participant in the urban focus group and one suburban interviewee indicated that they or members of their household would be more likely to use transit to commute downtown if shared cars were

available for use during working hours. Car-sharing was also mentioned as a way to attract car-sharing members from other cities to downtown hotels during trips to Richmond.

In addition to encouraging greater use of transit, downtown car-sharing could have other potentially positive effects. These include the reduction of parking space requirements and lower traffic levels during peak periods, allowing for the development of a more pedestrian-friendly environment.

A third opportunity for car-sharing in the Richmond area is within several New Urbanist developments that are planned in the Richmond area. Examples include West Broad Village, Tree Hill, and Wilton Farms in Henrico County and Roseland in Chesterfield County. Figure 3 shows the location of these developments. New Urbanist communities are designed to allow residents to live, work, and shop within their neighborhoods. They emphasize pedestrian scale and walkability and aim to reduce car use. However, their suburban locations, lack of public transportation links and proximity to major highways do little to discourage private car use.

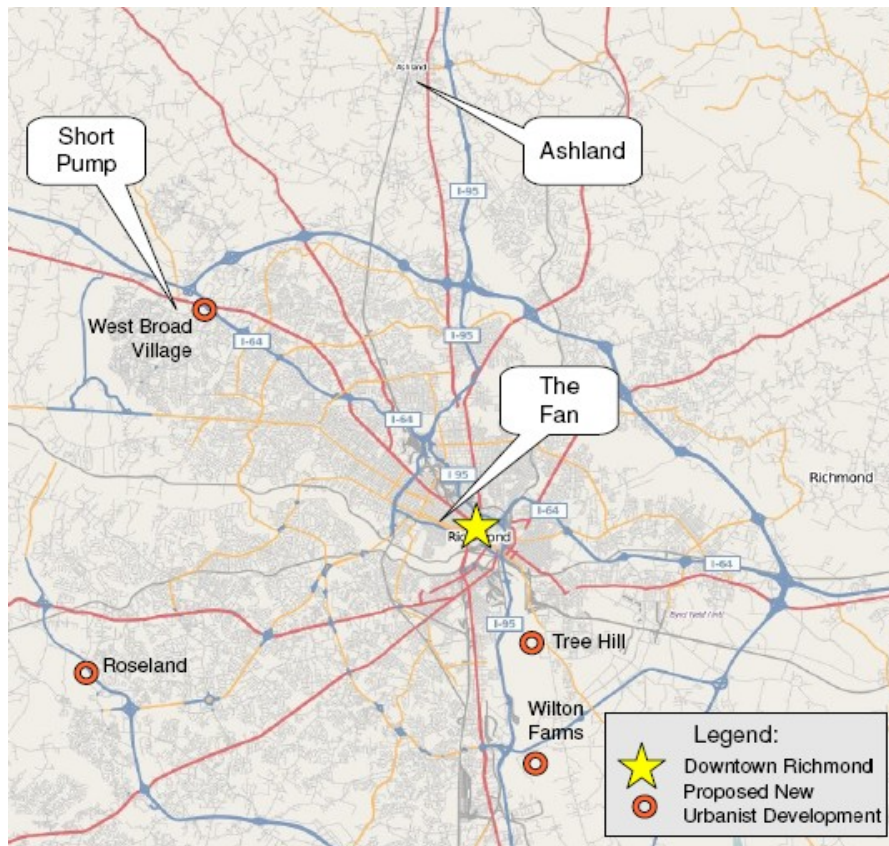


Figure 3: Location of Proposed New Urbanist Developments

Although residents may choose to locate in these areas with the intention of using their cars less, opportunities must exist for them to use alternatives as soon as they arrive. Otherwise private car use will likely become habitual, just as it was for the majority of participants in this study. Partnerships between local government, transit providers, developers, and car-sharing organizations could help to ensure these developments live up to their goal of reducing car dependence by offering transportation choice to residents.

Chapter VIII: Questions for Further Study

The findings from this study lead to several potential questions for future research. The first question deals with the size of the potential market in Richmond. Because the framework used for this research consisted of the qualitative pilot phase of a full TPB investigation, the salient beliefs elicited here could be used to construct a full TPB questionnaire. This questionnaire could then be used to investigate the car-sharing potential over a much wider range of neighborhoods in Greater Richmond.

This study also raises questions about the need for research into the mobility requirements of groups who lack car access. This includes university students, lower income families, and immigrant populations. These groups are likely to be currently utilizing informal arrangements and making use of public transportation to meet their mobility needs. They are also likely to have unmet needs that car-sharing may help to satisfy. Although commercial car-sharing organizations may not be willing to serve these populations, community groups and non-profit organizations may be able to facilitate the establishment of local informal or non-commercial services. While car-sharing's role in a sustainable transportation system is generally associated with the reduction of vehicle miles traveled, there may be a role for car-sharing to play in the economic sustainability of disadvantaged communities. To some extent, this has been the purpose of rural car-sharing pilot programs in Britain. (Carplus, 2004)

Another important aspect of car-sharing in the Richmond area that needs to be investigated is the role that businesses and government agencies can play in promoting more sustainable employee commuting practices. This could be especially important in downtown Richmond, where parking availability and cost is problematic for employers and commuters. Having shared-cars available to carry out work trips and daytime errands may encourage greater use of public transportation, bicycling, walking, and car pooling. A car-sharing's ability to increase commute mode substitution could be carried out through a pilot program that made several shared cars available to employees of a government agency in downtown Richmond. Techniques such as travel diaries could be used to track changes in behavior among those who use the service.

Chapter IX: Conclusions

Previous studies of car-sharing have focused on cost savings, environmental attitudes, and/or socio-demographic characteristics as a means of determining market potential (TRCP, 2005; Bonsall, 2002; Loose et al., 2006; Harms and Truffer, 1998, Steininger et al., 1996). While these studies have estimated that between 3 and 25 percent of licensed drivers are potential car-sharing members (Prettenthaler and Steininger, 1999; Vägverket, 2003; Muheim, 1998, Loose et al., 2006; Shaheen et al., 2006), penetration of the mobility market has been far less than expected – even in countries where car-sharing is well-established. For example, only 0.17 percent of German drivers are registered car-sharing members, despite a predicted maximum market share of 5 percent. (Nobis, 2006)

The pilot study that was conducted for this thesis explored a different approach to evaluating the car-sharing market potential in Greater Richmond. Using the theory of planned behavior as a framework, it qualitatively examined the psychological factors that are important in an individual's decision to join a car-sharing organization. Specifically, this study examined mode choice habit and the beliefs that affect behavioral intention. Although the results of this research are limited by the small number of participants and conditions specific to the study areas, they appear to offer some useful

insights for further study into car-sharing and other sustainable transportation initiatives in the Richmond area.

The first of these insights is that lack of alternative mode choices and abundance of low-cost or free parking in Greater Richmond encourage commuting by private car. Those participants who depended on private cars for their commute also showed strong car dependence for other trips and weak intention to car-share. In contrast, those who used alternate commuting modes or had used them in the past were more attracted to car-sharing. This was true of both urban and suburban respondents. Nobis (2006) noted similar characteristics among German drivers.

This finding demonstrates the importance of making alternative commuting modes such as bus, bicycle, and walking more attractive. However, major changes in regional transportation policy would likely be required to encourage any significant number of drivers to switch to alternate commuting modes. Such changes could include higher motoring costs (especially in the form of parking fee increases, parking restrictions or road pricing), education and intervention programs to reduce car dependence, and improvements to transit, bicycle, and pedestrian infrastructure. Accomplishing this would require regional cooperation and a significant shift in the region's emphasis on car-centered transportation investment and land-use. Such changes could potentially require a lengthy and politically contentious transition period.

The second insight is that work and family obligations appear to have a significant influence on an individual's perceived control over his or her ability to car-sharing. While personal circumstances may be difficult to overcome, efforts to increase mobility options for non-drivers could help the situation. Just as transit, bicycle and pedestrian improvements could encourage non-car commuting, they could also help reduce the number of car trips required to meet the needs of non-drivers in a household. Programs such as Safe Routes to School, which funds improvements that make it easier and safer for children to walk and bicycle, could help to reduce the need for parents and students to drive to school. Improved medical transport services, handicapped accessible crossings and sidewalks, and delivery services for basic needs such as groceries could help satisfy the needs of elderly and disabled residents. The availability of these services could also provide greater independence for non-drivers and allow greater mode flexibility for drivers, thus increasing the viability of car-sharing and transit. For those who use cars in the course of their work, opportunities may exist for employers, car-sharing organizations, and local government to work together to meet the needs of employees. Commuter-based car-sharing models, such as CarLink (Shaheen, 1999) may provide a way forward in this area.

While car-sharing appears on the surface to offer a viable and acceptable means of increasing transportation sustainability in Richmond, its viability appears to rely heavily on the attractiveness of non-car modes. The responses from participants in this study indicate that both urban and suburban residents are highly dependent on their cars.

Public transportation was not viewed favorably by urban residents – even those who had used it in the past. Suburban residents expressed interest in bus service, but it was not available in their area. None of the participants in this study used non-motorized modes for utilitarian trips. Walking and cycling were viewed as dangerous by suburban participants due to lack of sidewalks and bike lanes. Even among urban residents, walking was used only for leisure trips where nothing needed to be carried, such as visiting a restaurant or showing visitors around the neighborhood.

While more study is needed into the needs of other Richmond residents, including students and disadvantaged groups, the results of this pilot study indicate the need to focus more attention and investment on improving all non-car transportation modes. Until car owners have viable alternatives for their most critical journeys, such as commuting and transporting non-driving dependents, they will continue to rely on their cars. As long as mobility options are lacking, they cannot really be faulted for doing so. Therefore, further research into increasing car-sharing viability in Richmond may need to focus as much on the car-dependence reduction as on car-sharing itself.

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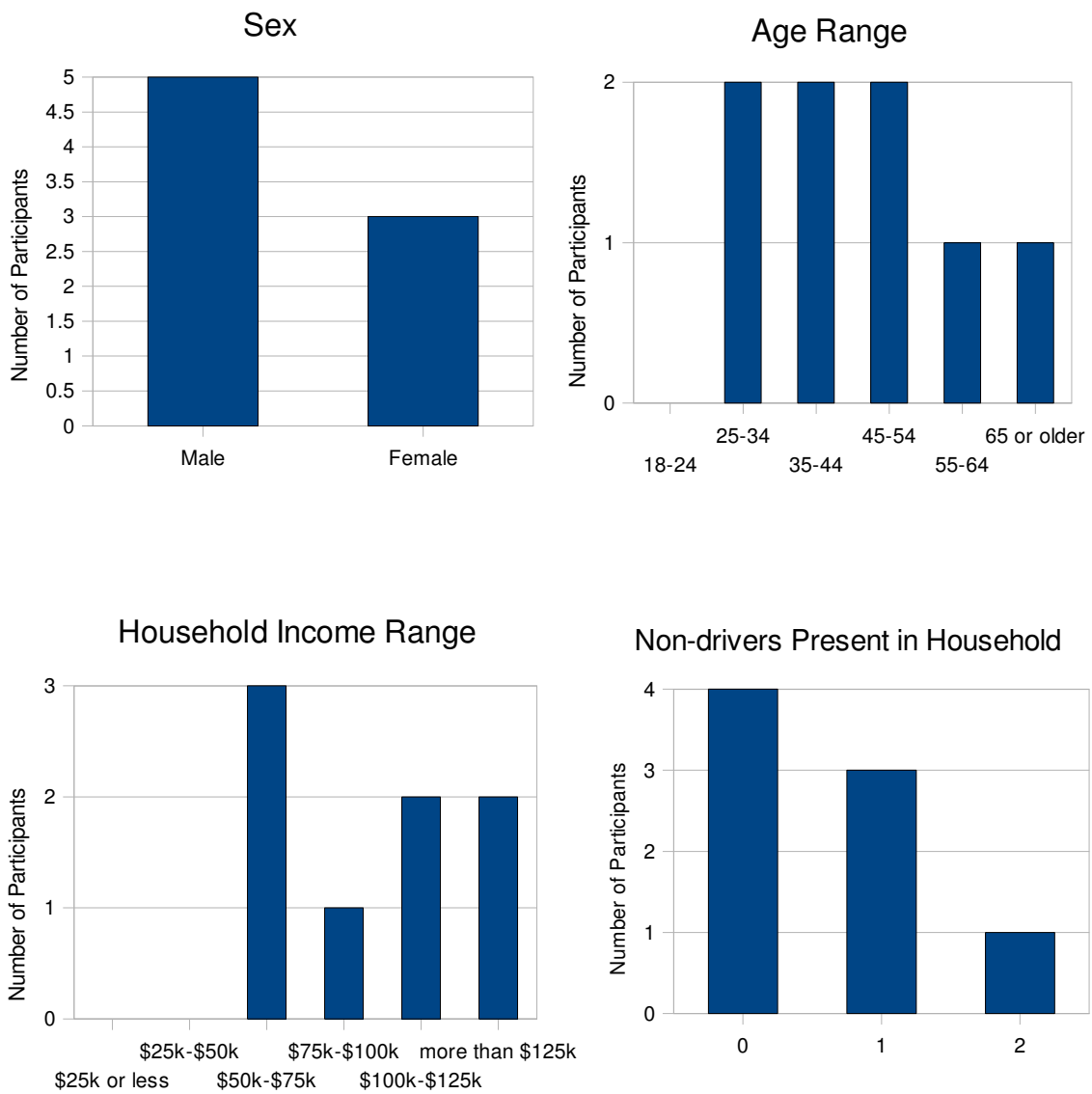
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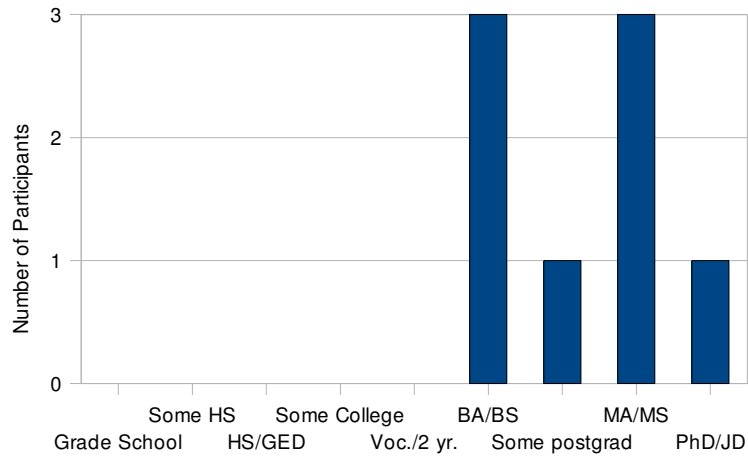
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APPENDIX A

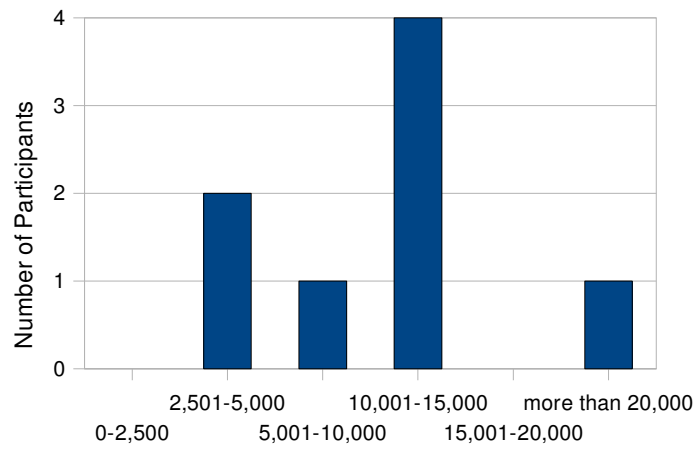
Participant Demographic Survey Summary



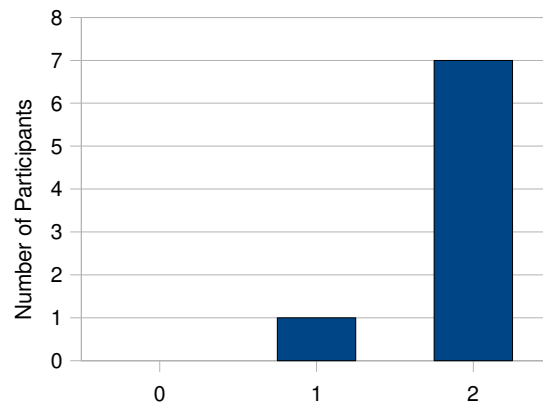
Educational Attainment



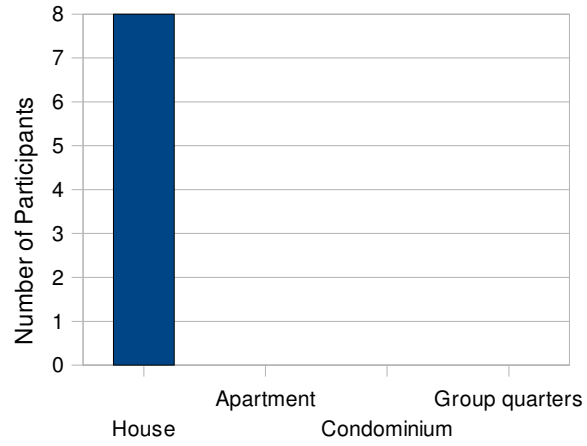
Annual Miles Driven



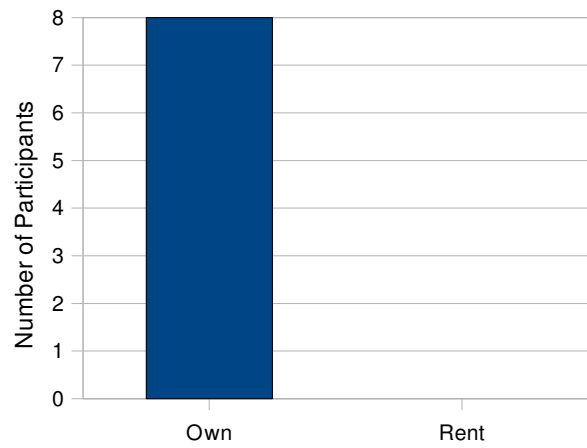
Vehicles Available in Household



Dwelling Type



Ownership Status



VITA

Steven P. Spears was born 15 July, 1969 in Harrogate, England. He is a citizen of both the United Kingdom and the United States. Mr. Spears holds a Bachelor of Science Degree in Mechanical Engineering from Clemson University and a Postgraduate Diploma in Transport and Planning from Cardiff University. He has public and private sector work experience in the fields of aviation, atmospheric science, and transportation planning.