Understanding How Individuals Make Travel and Location Decisions: Implications for Public Transportation

DETAILS

137 pages | | PAPERBACK
ISBN 978-0-309-42084-6 | DOI 10.17226/23124

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TRANSIT COOPERATIVE RESEARCH PROGRAM

TCRP REPORT 123

Understanding How Individuals Make Travel and Location Decisions: Implications for Public Transportation

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Subject Areas
Public Transit

Research sponsored by the Federal Transit Administration in cooperation with the Transit Development Corporation

TRANSPORTATION RESEARCH BOARD

WASHINGTON, D.C.
2008
www.TRB.org

TRANSIT COOPERATIVE RESEARCH PROGRAM

The nation's growth and the need to meet mobility, environmental, and energy objectives place demands on public transit systems. Current systems, some of which are old and in need of upgrading, must expand service area, increase service frequency, and improve efficiency to serve these demands. Research is necessary to solve operating problems, to adapt appropriate new technologies from other industries, and to introduce innovations into the transit industry. The Transit Cooperative Research Program (TCRP) serves as one of the principal means by which the transit industry can develop innovative near-term solutions to meet demands placed on it.

The need for TCRP was originally identified in *TRB Special Report 213—Research for Public Transit: New Directions,* published in 1987 and based on a study sponsored by the Urban Mass Transportation Administration—now the Federal Transit Administration (FTA). A report by the American Public Transportation Association (APTA), Transportation 2000, also recognized the need for local, problem-solving research. TCRP, modeled after the longstanding and successful National Cooperative Highway Research Program, undertakes research and other technical activities in response to the needs of transit service providers. The scope of TCRP includes a variety of transit research fields including planning, service configuration, equipment, facilities, operations, human resources, maintenance, policy, and administrative practices.

TCRP was established under FTA sponsorship in July 1992. Proposed by the U.S. Department of Transportation, TCRP was authorized as part of the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA). On May 13, 1992, a memorandum agreement outlining TCRP operating procedures was executed by the three cooperating organizations: FTA, the National Academies, acting through the Transportation Research Board (TRB); and the Transit Development Corporation, Inc. (TDC), a nonprofit educational and research organization established by APTA. TDC is responsible for forming the independent governing board, designated as the TCRP Oversight and Project Selection (TOPS) Committee.

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Once selected, each project is assigned to an expert panel, appointed by the Transportation Research Board. The panels prepare project statements (requests for proposals), select contractors, and provide technical guidance and counsel throughout the life of the project. The process for developing research problem statements and selecting research agencies has been used by TRB in managing cooperative research programs since 1962. As in other TRB activities, TCRP project panels serve voluntarily without compensation.

Because research cannot have the desired impact if products fail to reach the intended audience, special emphasis is placed on disseminating TCRP results to the intended end users of the research: transit agencies, service providers, and suppliers. TRB provides a series of research reports, syntheses of transit practice, and other supporting material developed by TCRP research. APTA will arrange for workshops, training aids, field visits, and other activities to ensure that results are implemented by urban and rural transit industry practitioners.

The TCRP provides a forum where transit agencies can cooperatively address common operational problems. The TCRP results support and complement other ongoing transit research and training programs.

TCRP REPORT 123

Project H-31
ISSN 1073-4872
ISBN: 978-0-309-09925-7
Library of Congress Control Number 2008922408

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TRANSIT COOPERATIVE RESEARCH PROGRAM

are available from:

Transportation Research Board
Business Office
500 Fifth Street, NW
Washington, DC 20001

and can be ordered through the Internet at

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Printed in the United States of America

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AUTHOR ACKNOWLEDGMENTS

The research described in this report was performed under TCRP Project H-31 by TranSystems Corporation, with assistance from Matthew Coogan, Resource Systems Group, Simon & Simon Research and Associates Inc., Susan A. Shaheen, Battelle, and Icek Aizen.

Karla Karash of TranSystems is the Principal Investigator for the project, in close partnership with Matthew Coogan and with Thomas Adler of Resource Systems Group. Karla Karash and Matthew Coogan were the primary authors of this final report. Thomas Adler and Resource Systems Group personnel (Nelson Whipple, Karyn Dossinger, and Margaret Campbell) provided the resources and expertise for conducting the Internet panel survey, as well as much of the analysis. Matthew Coogan provided a continuing series of quality insights into the data. Monica and Rosalyn Simon of Simon and Simon Research and Associates were responsible for conducting the focus groups. Dr. Icek Aizen provided invaluable advice on how to structure a survey for the theory of planned behavior. Susan Shaheen and her associates from the University of California at Berkeley assisted in the literature review and expert interviews. Chris Cluett of Battelle contributed to the research approach and assessed the practical implications from the research.

We would like to thank Janice Pepper at NJ Transit for providing access to a portion of their e-panel for the research.

The guidance of Dianne Schwager, the TCRP Program Officer for the project, and the Project Panel has been appreciated.

FOREWORD

By Dianne S. Schwager
Staff Officer
Transportation Research Board

TCRP Report 123: Understanding How Individuals Make Travel and Location Decisions: Implications for Public Transportation explores a broader social context for individual decision making related to residential location and travel behavior and consequently will be of interest to planners, researchers, transit managers, and decision makers. The findings from this research contribute to efforts to predict mode choice and how to influence it through better policies and design, education, and communication.

Because residential location and travel behavior have a large effect on society's consumption of energy, on levels of pollution, and on health, there is great value in increasing our understanding of the mechanism of mode choice. While the transportation community has considerable experience in using rational economic models of decision making in exploring residential and travel choice, there is less research into decision-making models from other fields such as sociology, psychology, and marketing research. This research project explored an approach from the field of psychology that adds valuable perspective to understanding behavior.

An underlying assumption of this research is that growing urban congestion and impaired mobility can be mitigated by encouraging people to substitute public transportation and walking for individual automobile use. A related assumption is that if people live in communities that are transit oriented (called *compact neighborhoods* in this research), they will walk and take public transportation more. A practical challenge, of course, is how to promote this kind of behavior in enough instances to have a measurable, beneficial effect on travel conditions. The premise of this research is that by gaining a better understanding of the links between individuals' attitudes, intentions, and behaviors with regard to c*ompact neighborhoods* and travel alternatives to the automobile, strategies can be better configured and targeted to help achieve the desired outcomes.

Thus, the goals of this research are two-fold: namely, to improve understanding of how people make travel and location decisions, and to derive practical implications and policy guidance for encouraging more use of public transportation and walking.

Appendixes to the contractor's final report are available on the TRB website at http://trb.org/news/blurb_detail.asp?id=8661. The appendixes are the following: Appendix A: Interviews with Experts; Appendix B: The Interview Questionnaires; and Appendix C: SPSS and Excel files of Survey Results. The SPSS and Excel files contain the responses of respondents from an internet survey panel that provided information on memories, perceptions, preferences, and behavior related to mode and residential choice. The data will be of great interest to researchers exploring the relationships among these factors.

CONTENTS

SUMMARY

Understanding How Individuals Make Travel and Location Decisions: Implications for Public Transportation

The purpose of this project (TCRP H-31) is to explore a broader social context for individual decision making related to residential location and travel behavior. Because residential location and travel behavior have a large effect on society's consumption of energy, on levels of pollution, and on health, there is great value in increasing our understanding of the mechanism of choice. Better understanding could lead to better insights on the part of planners and decision makers as to how to predict choice and how to influence it through better policies and design, education, and communication. While the transportation community has considerable experience in using rational economic models of decision making in exploring residential and travel choice, there is less research into decision-making models from other fields, such as sociology, psychology, and marketing research. This project provides a look at an approach from the field of psychology that adds valuable perspective to understanding behavior.

Although the work done for this project used a different methodology for analysis, the project also had a goal of deriving practical implications and policy guidance for encouraging more use of public transportation and walking. An underlying assumption is that growing urban congestion and impaired mobility can be mitigated by encouraging people to substitute public transportation and walking for individual automobile use. A related assumption is that if people live in communities that are transit oriented (called *compact neighborhoods* in this research), they will walk and take public transportation more. A practical challenge is, of course, how to promote this kind of behavior in enough instances to have a measurable, beneficial effect on travel conditions. The premise of this research is that by gaining a better understanding of the links between individuals' attitudes, intentions, and behaviors with regard to compact neighborhoods and travel alternatives to the automobile, strategies can be better configured and targeted to help achieve the desired outcomes.

Thus, the goals of this research are twofold: namely, to improve understanding of how people make travel and location decisions, and to derive practical implications and policy guidance for encouraging more use of public transportation and walking. Given the goals of the research, a number of overall objectives have been set, as follows:

- Explore the characteristics of market sectors that are more likely to be favorable to an urban residential environment, particularly an environment characterized as a transit oriented development (TOD) or, as used in this research, a compact neighborhood.
- Explore the characteristics of market sectors that are more likely to be favorable to increased transit use and walking.
- Explore the impact of neighborhood type on the use of transit and walking.
- Explore methods for encouraging more walking and transit use.

- Explore the theory of planned behavior (TPB) as an approach to understanding how individuals make travel and location decisions. In particular, explore TPB in the context of a decision to move to a compact neighborhood and to take environmentally friendly modes, such as walking and transit.
- Examine the power of the TPB to distinguish these market sectors and provide insight into motivating factors.

This project follows on the successful "New Paradigms" TCRP research program, which examined new structures and approaches for transit agencies (*1*). One motivation for this follow-on work was to look at new approaches from other fields, such as psychology and social marketing, for motivating individuals to choose transit and transit-friendly communities.

This research included an extensive review of the literature and interviews with experts in a variety of related fields. A conclusion from the literature and interviews was the value of applying the TPB in an examination of individual decision making for residential and mode choice. Using the TPB, the project team has conducted an extensive amount of original research over a 3-year period using focus groups and Internet panels. The research has yielded some interesting findings, provided new data for existing research issues, and left plenty of questions to be explored with further research.

Practical Implications from the Research

This project included the use of Internet panels derived from large metropolitan areas in the United States where there is good transit service. Separate surveys were used to query respondents' attitudes and intentions about using transit and walking and to query their attitudes and intentions about moving to a compact neighborhood. Although the research was focused on testing new methodological approaches, there are some findings that provide practical advice to practitioners in the transit field. Most of the following findings are based on analysis of the Internet panel surveys.

Implications from the Research on Mode Choice

Findings from the research on mode choice that have practical implications include the following:

- Although respondents indicated that transit service was within walking distance for most of them (70%), normative support for increased walking and use of public transit was low. These individuals said they wanted reliable transportation at low cost, and they didn't want to spend any additional time commuting, nor did they want to be dependent on someone else for their transportation. They believed that transit would take them more time and they would have less ability to control the timeliness of their arrival. They also expressed a need to use a car for short or spur-of-the-moment trips or to carry heavy things. *These attitudes present a challenge for policymakers seeking to encourage more transit ridership. Replacing the car will take a suite of services to meet requirements for both speed and flexibility.*
- When respondents were asked to consider traditional marketing messages and a suite of transit supportive services (including good downtown transit service, regional transit service, smart card, shuttle service, smart phone, and car sharing), their beliefs about transit changed. However the changes were apparently due to the suite of services and not to the marketing messages. *The practical implication is that it will be difficult to significantly change beliefs toward transit riding with public policy messages alone. More emphasis will*

need to be placed on supplementing messages with a suite of services that enhance the overall transit riding experience.

- Being able to depend on transit to "get me to my destination in a timely way" was a key driver of attitude. Providing information to customers on transit schedules and improving the reliability of the service would appear to be key strategies based on this research.
- Although those respondents that were concerned about reducing pollution and improving health had a more positive attitude toward walking and taking transit, respondents were not convinced that the suite of transit supportive services would reduce pollution and improve health. A message about the positive health and environmental impacts of transit use also was not convincing. *There is a need to more convincingly communicate the positive health and environmental impacts of walking and transit.*
- Respondents' attitudes toward transit riding and walking are the most critical drivers of intentions to increase use of these modes, but respondents' self-confidence in using transit and walking and their perception of others' opinions also affected their intentions. In this research, respondents' attitudes did not change even with the messages and transit-supportive services. Although attitudes did not change, respondents' self-confidence that they could take transit increased when additional transit-supportive services were considered. Also, they believed that their families would be more supportive of their taking transit and walking. *This would suggest that a practical policy approach would be to seek to provide and market a set of ancillary services intended to make transit riding more simple and attractive (a higher status activity) for those who otherwise are inherently reluctant to use transit.*
- Respondents' concerns about being stranded when using transit appeared to be the most critical driver of their self-confidence in being able to take transit as well as in the approval of friends and family. This was especially true of the environmentally oriented market segment, which was willing to change modes if the conditions associated with transit riding were improved. *The practical policy implication is to focus on providing this group, in particular, with ancillary services that can help them overcome these kinds of concerns. By making the transit system safer and more attractive, family and friends are likely to feel more positively about transit and further motivate the members of this group to translate their expressed intent into actual transit riding behavior.*
- Prior research has shown that an impediment to using public transportation is that the behavior is unfamiliar to many people and hence is not actively considered as an option. This research verified the importance of respondents' self-confidence in using public transportation. *Many communities and employers are offering incentives for people to try out transit, including free passes, employee discounts, or charges for parking personal cars at work, especially for single-occupant vehicles. These actions will help transit to become more familiar and increase users' self-confidence in taking transit.*

Implications from the Research on Compact Neighborhoods

Findings from the research on compact neighborhoods that have practical implications include the following:

- Some features of a compact neighborhood were of greater importance to this sample of respondents than other features. The most important belief was that it would be easier to get to stores, restaurants, libraries, and other activities if one were living in a compact neighborhood. *Developers of compact neighborhoods should ensure that they are near interesting destinations such as stores, restaurants, and other activity centers.*

- Making new friends with close neighbors in a compact neighborhood emerged as an important influencing factor, along with needing fewer cars and liking having public transportation readily available for the places you want to go. *Marketing campaigns intended to promote the values of living in compact neighborhoods should emphasize these kinds of attributes and benefits.*
- Individuals who believed that such a residential move would result in more street noise or less living space had a more negative attitude toward the move. *Practical efforts to promote living in compact neighborhoods should be aimed at countering these perceived negative attributes and emphasizing the positive attributes.*
- Individuals are more likely to feel they could move to a compact neighborhood if they could find affordable housing. This was the most important perceived barrier to such a move, over others that included having to get by with fewer cars, having less living space, or losing touch with current friends. *Public policy that seeks to ensure the availability of affordable housing in compact neighborhoods would be indicated by this finding.*
- Respondents who expressed a more positive attitude toward living in a compact neighborhood are the best initial candidates for promotional efforts. *It would make most sense to approach those with the highest probability of receptiveness to campaigns that encourage transit use and walking, as well as living in compact neighborhoods. For example, those who say that owning fewer cars is a good thing would fall into this positive group, as would those who value a clean environment.*
- If family and friends are supportive or encouraging of a move to a compact neighborhood and communicate that riding transit and walking reflect appropriate values, then an individual is more likely to be motivated to do those things. *Promotional efforts could be directed toward families, rather than just toward individuals, to help build a foundation of support for the value of living in compact neighborhoods and using public transportation. In the longer term, seeking to influence community normative values with respect to these behaviors could have positive effects on an even larger segment of the population.*
- From a practical policy standpoint, perhaps the biggest impediment to marketing compact neighborhood living and use of transit is the pervasive reluctance to give up personal automobiles. This research showed that the average number of automobiles per person in a household is more predictive of the propensity to walk and use transit than the type of residential neighborhood or set of urban/environmental values held by the individual. *Policies such as reducing the zoning requirement for parking in compact neighborhoods, providing mortgages that recognize savings from reduced car use or ownership, and employer incentive programs for transit use and ridesharing could help in this regard. However, such measures need to be accompanied by substantial improvements in transit and walking services and amenities, such as those described in the findings presented here. At the same time, policy to create new infrastructure to facilitate walking and transit will be more successful if it is coupled with efforts to support and encourage reduced auto ownership.*
- Prior research on the propensity to change modes suggests that people are creatures of habit. Individuals who have never used public transportation or who use it rarely tend not to consider public transportation as a viable alternative to meeting their transportation needs. The times when these individuals are most likely to consider such a change in transportation mode is when they are making life-cycle changes, such as a change in residence or a change in employment. *Thus, practical strategies that seek to induce a mode change should recognize that individuals may be more receptive during these periods of change in their lives.*

Summary of Implications for Transit Managers

Figure S-1 highlights some of the practical strategies that may be undertaken in an effort to promote living in compact neighborhoods and encourage more transit use and walking, as suggested by the research findings from this study. Practical implications of this research all derive from three component strategies for accomplishing the goals of the research, which include encouraging individuals to move to a compact neighborhood and encouraging them to increase their use of transit and walking in place of automobile use. These component strategies are as follows:

- Encourage policies that lead to the creation of urban form that is highly conducive to transit use and walking. Attributes of compact neighborhoods include ease of walking to stores, restaurants, and other activities; easy access to public transportation; ability to live with fewer automobiles in the household; and opportunity to interact with neighbors. Work through employers and community policymakers to provide incentives for transit use.
- Provide a set of services that complement and support using public transportation, particularly for the market segments with the most potential to increase transit use. These include providing real-time information about transit arrival/departure times, as well as other services that make people feel safer and more confident about using transit.
- Educate and market the use of public transportation to the public, focusing first on segments of the population that are known to be more receptive. Focus marketing and policies on increasing the status of transit and making it simpler to use.

As pointed out in this research report, there are many challenges to accomplishing the desirable practical outcomes discussed in this summary. It is also clear that additional research will be needed to more fully understand the factors that link attitudes and values with the outcome behaviors. The positive market sectors identified in this research represented 30% to 45% of the sample, and practical strategies noted above should target those segments

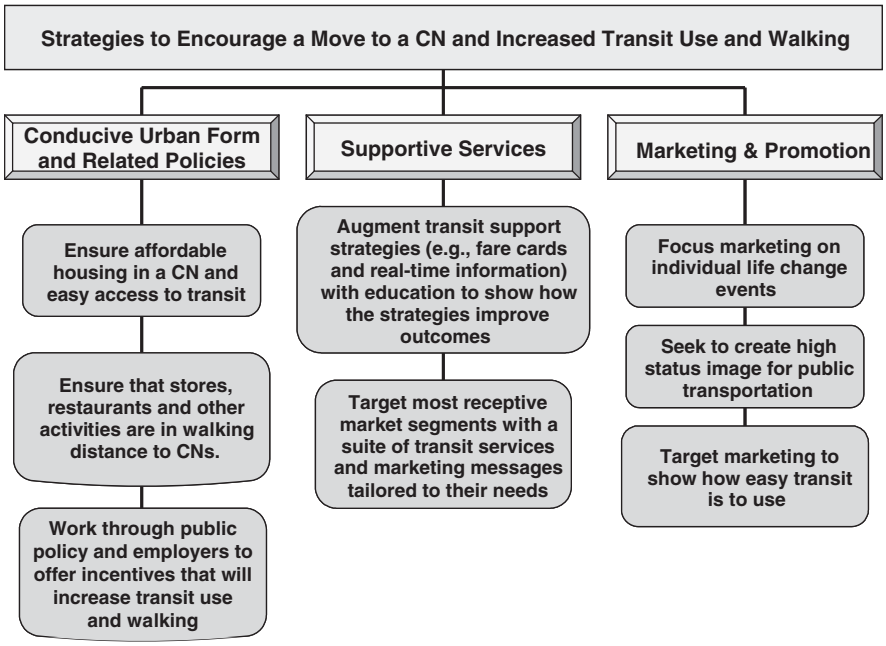


Figure S-1. Practical policy approaches. (CN = compact neighborhood)

first. The promotional messages directed to these individuals will need to be tailored to their needs and matched with their attitudes and values, as identified herein. However, no one approach is likely to be highly successful on its own; rather; a variety of approaches must be applied simultaneously, including creating conducive urban form, providing supportive public services, and coordinating these with targeted marketing and promotion. In addition, a suite of incentives and disincentives should be added, resulting in structural, social, and economic forces that may be expected to have a reasonable chance of changing human behavior in ways favorable to usage of public transportation and walking.

The Theory Behind the Research: The Theory of Planned Behavior

The model of human behavior used in this research is the TPB, as illustrated in Figure S-2. This model, which comes from the field of psychology, holds that human action is guided by three types of considerations:

- *Attitude toward the Behavior*—An individual's own evaluation of an action, such as riding transit. It will be referred to as *attitude*.
- *Subjective Norm*—An individual's perception of what others will think if he/she takes an action (e.g., what friends and parents will think if he/she rides transit).
- *Perceived Behavioral Control or Self-Confidence*—An individual's assessment of his/her ability to take an action, such as taking transit.

For each individual, these three types of considerations will have different importance or weighting, depending upon the behavior or action. For example, young teens, as compared with older adults, may be more influenced by the opinions of their peers in a decision to take transit. Attitude, subjective norm, and self-confidence all contribute to an individual's *intent* to carry out a behavior. Whether an individual actually carries out the intent depends also on his/her self-confidence in doing so.

Selection of the TPB as the model for this research followed a literature review that identified extensive use of the TPB in the health field. The literature review also found that the TPB has been applied in several European studies of mode choice.

Research Approach

The research approach for the above findings involved the use of focus groups and a consumer panel to investigate how individuals regarded (*a*) moving to a compact neighborhood

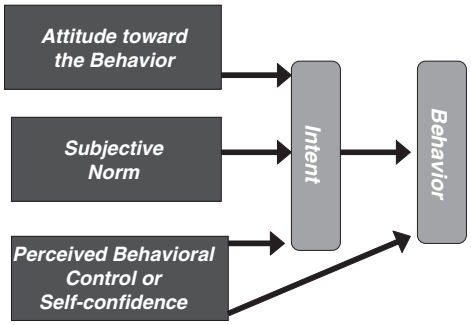


Figure S-2. The theory of planned behavior.

and (*b*) increasing their use of public transportation and walking. In Phase 1, the purpose was to investigate the decision to move to a compact neighborhood, whereas in Phase 2 the purpose was to investigate the decision to increase use of public transportation and walking. The consumer panel was recruited by email and surveyed on the Internet.

The sample for the Phase 1 Internet panel was drawn from 11 major metropolitan areas, distributed across the United States, that offered public transportation services. Specifically designed for the transit industry, the sample is drawn from highly urbanized areas, such as New York, Chicago, Los Angeles, and Boston. Of the total sample, 639 were selected from a panel conducted by a commercially owned business, while 226 were drawn from a research panel maintained by New Jersey Transit.

The Phase 2 Internet panel was made up of 501 respondents drawn from the Phase 1 panel, with additional individuals added from the 11 major metropolitan areas. The surveys were specifically designed to oversample groups with proximity to good public transportation, and they were not intended to be representative of the national population.

Research Results

The Positive Market Segments

Market segments were created for each project phase by grouping respondents based on their values and their attitudes toward moving to a compact neighborhood and making more trips by walking and using public transportation. In each phase, two positive segments were found—a transit-oriented market segment and an environmentally oriented market segment (see Chapters 7 and 11 for more detail). The characteristics of the positive segments follow.

Transit-Oriented Market Segments

The transit-oriented market segments currently exhibit travel behaviors that are environmentally friendly. They walk more and take transit much more than any of the other market segments. More than 60% of the respondents say that transit is their primary mode to work. They report the lowest need for a car to get where they need to go, and they do not think they are wasting too much time driving in congestion. They enjoy driving less than any other group. They are more likely to think they could live with fewer cars than any other group.

The transit-oriented market segments are characterized by their present use and understanding of public transportation services. More than any other segment, they are traveling to downtown, the traditional destination for transit services. They have less of a need for a car to get where they need to go than any other segment. For them, issues such as the safety of transit services or difficulty in paying the fare are not considered to be deterrents to using transit and therefore are not important to be solved with new products and services. This group tends to have a strong idea of what transit is, as well as how it can improve on doing what it presently does. Having frequent bus or train service is considered very important, and they want transit to serve their most frequent destinations. They have the highest intent to increase their use of public transportation and walking, but not because of additional supportive technologies and services. They are already intensive transit users.

The transit-oriented segments have a higher percentage of young people than the other segments. Consistent with this, they have lived in their present home for less time than any other group. As urbanites, they have the highest reported access to frequent transit and the best access to reliable taxis. More than any other group, they have a commercial district

within walking distance. Their houses do not have significant amounts of parking or a large lot. Emotional commitment from these young people to their neighborhood is, however, somewhat low, as they have the lowest propensity to believe that others think their home and neighborhood is nice. Fifty-five percent of this group currently live in a compact neighborhood or are contemplating moving to one in the next 2 years. Although they are the market segment with the most potential to choose a compact neighborhood when they move, they are not necessarily loyal to continuing to live in an urbanized neighborhood.

Environmentally Oriented Market Segments

The environmentally oriented market segments are the oldest of the market segments. In terms of present modal behavior, the environmentally oriented would seem to have a long way to go before making a residential move *and* following that up with a transit-oriented travel pattern: this group chooses transit less for the work trip (20%) than any other group. More predictably, the group has the second highest walking trip rate, although with a walking rate far behind that of the transit-oriented group. Its trip lengths are the longest of any group.

Consistent with their name, this group is very concerned about the environment. In terms of values, the group has the highest propensity of any to place a positive value on reducing pollution by driving less, improving their health, meeting more neighbors, and reducing the time spent driving.

The environmentally oriented segments have the highest ratings of any group for concerns about global warming and climate change, for protection of the environment with more taxes, and for being more active in helping the environment. They are most likely to disagree with the statement that environmental concerns are overblown. They remember their environmental leanings from childhood.

After the transit-oriented market segment, the environmentally oriented segment has the highest intent to change modes to include more transit and walking. That intent to change modes increased more than for any other market segment when the group was presented with transit- supportive services and technologies. This increase was not due to a change in their attitude, as the group did not significantly change their opinion that using transit and walking would be more desirable, pleasant, or interesting. Rather, the change in intent appears related to an improvement in self-confidence and the subjective norm. The environmentally oriented segment emerged as the most optimistic about nearly every question asked that assumed all the new services and strategies were available for use. Among the positive responses, they thought they would save money, improve their health, reduce pollution, reduce the time spent driving, and find the new services dependable. With the new products and services, the environmentally oriented segment had the highest propensity to say that it would be easier to pay the fare, it would be easier to know when the train would arrive, and they would have less fear of crime or of being left stranded. They believed that with new services available it would be easier to use transit and walk more, and they believed that their family and others would approve.

The environmentally oriented group is suburban and quite satisfied with their neighborhoods. More of this group lives in single-family homes than any other group. Their lots are bigger, and they are more satisfied with the size of their lot than any other group. Their homes have the most parking and the most trees and bushes. They are happiest with their access to work/school and with the quality of biking. They have the highest belief that other people think their home and neighborhood are nice. This group tends to show the highest ratings for the attributes associated with urban life; they have the highest belief they should be spending more time walking, just to be healthier.

In spite of the level of contentment experienced, the environmentally oriented group seems open-minded about a change of lifestyle. The group is the oldest, and they have been living in their present home longer than any other group. They, more than any other group, think that they are wasting too much time driving in congestion. The group tends to have a positive expectation of the results of a move to a compact neighborhood; more than any other group, they think they would exercise more, make more friends, and find it easy to get to local destinations. With such a move, they could own fewer cars and get by with less living space. In short, they are optimistic that they could make the changes associated with life in a neighborhood supportive of transit and walking. This group has a high potential for moving to a compact neighborhood and making an environmentally friendly mode change.

The Negative Market Segments

There were three negative market segments based on values and on attitudes toward moving to a compact neighborhood. There were two negative market segments based on values and on attitudes toward walking and using public transportation more. With regard to moving to a compact neighborhood, the negative market segments were the Conflicted/Contented group, the Low Expectations group, and the Anti-Environmental group. With regard to increasing use of public transportation and walking, the negative market segments were the Happy Drivers group and the Angry Negative group.

Conflicted/Contented Group

The Conflicted/Contented group has an intent to move to a compact neighborhood that ranks in the middle of the pack. This group is the most complex of the five market segments for moving. They rank their concern with environmental issues (e.g., global warming/climate change) among the highest of any group, while at the same time reporting a level of auto dependence that is among the highest of any group. While they express their commitment to environmental change, altering their neighborhood to attain that change is not a desired option for this group.

Low Expectations Group

The Low Expectations group does not value the attributes of a compact neighborhood that are desired by those who value urban attributes. In general, this group expresses less hostility to environmental issues than does the Anti-Environmental group, but does not place a positive value on the things that might be expected to occur in a compact neighborhood, such as getting more exercise or even making more new friends.

Anti-Environmental Group

The Anti-Environmental group has the lowest level of intent to move to a compact neighborhood. This group expresses its displeasure most specifically to the concept of environmental causes, thinking they are "overblown" and unnecessarily costing them money. They report the highest propensity to love the freedom and independence of owning several cars, and the highest propensity to need a car to get where they need to go.

Happy Drivers Group

The Happy Drivers group provided a middle ranking for concepts associated with a change in mode. For example, the group has a slightly higher than average ranking on the

statement, "For me to walk and take public transportation more would be desirable." However, this pattern of near-average support of statements related to mode change never translates into a top ranking on any key variable. The members of this group had the highest propensity to say that they liked to drive, with high scorings on the freedom and independence that comes from owning several cars.

Angry Negative Group

The Angry Negative group is characterized its low evaluation of just about every aspect of altering modal behavior and by the radically low intent of its members to alter their own transportation behavior. This is the most negative group towards mode change. This group emphasizes its auto dependency, with the highest propensity of any group to need a car to get where they need to go. In the scenario in which there is more reliance on transit and walking, this group has the lowest propensity to say they would reduce the time spent in driving. Two of the few exceptions to the most negative role come in two questions concerning worry about crime. This group reports less worry than some other groups about crime while using transit or while walking; perhaps they do not worry about it because they do not think about it, having no intention to use it. In addition, the group has the second highest belief that lowering the cost of transportation would be desirable.

Learning from the Theory of Planned Behavior

In Phase 1 of the research the respondents' thoughts and opinions about moving to a compact neighborhood were investigated. The survey participants were told the following:

> We are interested in your thoughts and opinions about moving to a particular type of neighborhood. The neighborhood has good sidewalks, a mix of housing types, shopping or restaurants within walking distance, and nearby public transit. You would be able to walk, bike, or drive to nearby shops, restaurants, pubs, and a library, but parking would be limited. You would be close to cultural events and entertainment. The neighborhood would be as safe as where you live today. Parking near your home would be limited to one car per household or street parking or you could rent a garage space. In this survey, we will call this a compact neighborhood.

The TPB says that intent to move to a compact neighborhood will be driven by attitude, subjective norm, and self-confidence in being able to move. The data from the Phase 1 research confirmed that there was a significant association between each of those variables and intent to move, with attitude being the most important.

Attitude toward moving was measured by respondents indicating how pleasant, desirable, and interesting such a move would be. Subjective norm was nearly as important as attitude. Subjective norm was measured by respondents' indications whether family and friends would approve of such a move. The research confirmed that people care strongly about what others think of their neighborhood.

A more interesting question is, what characteristics of compact neighborhoods drive respondents' attitude, subjective norm, and self-confidence? The key findings are as follows:

- The strongest association with a positive attitude toward moving to a compact neighborhood was the belief that it would be easier to get to stores, restaurants, libraries, and other activities.
- The belief that one would make more friends in a compact neighborhood emerged in this research as another influencing factor, along with a belief in being able to take public transit and being able to own fewer cars.

- Being able to "exercise by walking and biking" was rated as by respondents as the most important outcome of moving to a compact neighborhood.
- Individuals who believed that moving to a compact neighborhood would expose them to more street noise or less living space had a more negative attitude toward the move.
- Being able to find an affordable home in a compact neighborhood was a key concern that affected self-confidence.

In Phase 2 of the research, respondents' thoughts and opinions about using a set of transportation options that could allow a reduction in the number of private automobile trips and increase the number of trips by walking and public transportation were investigated. At the start of the questionnaire, respondents were asked to rate a number of statements that expressed opinions about walking and taking transit. Following a set of messages and presentation of alternative transportation options, respondents were asked to rate a similar set of statements. The objective was to determine if exposure to messages and alternative transportation options would change respondents' attitudes and intentions regarding walking and using transit.

The transportation options were presented to the survey respondents as follows:

> We want to know your thoughts and opinions about using a set of transportation options that could allow you to reduce the number of trips you take by private automobile and increase the number of trips you take by walking and using public transportation. Assume that you have all of the following alternative transportation options available to you:
> - There is fast transit service (rail or express bus) to the downtown. This service is available every 15 minutes or better, and a station is located less than a mile away.
> - There are good connections by transit to the rest of the region (other than the downtown). This service may involve a transfer from one transit vehicle to another. Service is available every 15 minutes or better throughout the day.
> - There is a shuttle bus that connects your street with the local community center and other activities within your neighborhood. Service is available every 15 minutes throughout the day.
> - A community door-to-door service that you can take at about half the price of taxi service, that you share with others traveling at the same time. This service can be obtained by calling a special number and is immediately available.
> - Cars are available on your block or near your workplace to be rented by the hour (car sharing) when you need to make a trip that is difficult to make on transit. Cars should be reserved a day in advance, but also may be available immediately.
> - You have a "smart card," which you can use to purchase service on any of the buses, shuttles, trains, or taxis. Just wave the card near the fare reader or meter, and your card will be debited the fare.
> - You have a new kind of cell phone which will tell you exactly when the bus or train will arrive, show you where you are, and provide instructions on getting to your destination by public transportation. It would also have a "911" button that would instantly send your location to police or emergency services. This cell phone can serve as your normal cell phone, or your own phone can be programmed to have this capability.

The data from the Phase 2 research confirmed that there was a significant association between an individual's intent to walk more and take more public transportation and his or her attitude. There was also an association between an individual's intent and his or her subjective norm and self-confidence, but attitude was most influential.

Respondents' beliefs about transit and walking showed why attitude is difficult to change. Respondents thought that walking more and using more public transportation would take more time and make them dependent on others. They rated these outcomes as undesirable.

The most positive impact on attitude came from the belief that "I would rely on alternative transportation and walking to get me to my destination in a timely way." Also contributing to a positive attitude were the ideas that "I would improve my health and reduce pollution" and "I'd save money." On the other hand, the belief that "I would be dependent on someone else" contributed negatively to attitude.

With the new services available, respondents significantly increased their rating of "I would rely on alternative transportation and walking to get me to my destination in a timely way." However, they decreased their rating of "I would improve my health and reduce pollution." Overall, their attitude towards taking transit and walking did not change. However, respondents significantly increased their belief that their families would approve of their taking transit and walking with the new services available, and, as would be predicted by the TPB, they increased their rating for the subjective norm.

The most significant relationship with self-confidence was the respondents' concerns about being stranded. The more respondents agreed with the statement, "With the new services available, I would have less concern about being lost or stranded by missing the bus or train," the higher their self-confidence. Additional analyses found that concerns about crime and being stranded were also highly correlated with the respondents' normative beliefs about the approval of their family and others.

In summary, the overall message of these findings seems to be that to increase transit use and walking will require the following be accomplished:

- The perceived reliability of the system must be improved.
- The positive health and environmental effects of walking more and taking public transportation more must be more convincing.
- Customers must be convinced that they will not be left stranded.
- Families must approve of increased transit use and walking.

Overall, the TPB proved useful for understanding the motivations of the respondents. A major contribution of the theory was to show the importance of the opinions of others and of respondents' self-confidence in the decision to walk and use transit.

The Relationship of Values, Urban Form, and Auto Ownership on Choice of Mode

The two market segments with more positive views on a move to a compact neighborhood made quite different modal choices. The TPB provides a structure for further investigation of how characteristics of respondents are associated with mode choice.

The literature review for this research revealed a debate about the relative influence of values and urban form on travel behavior. This research provides additional evidence for the debate and suggests that another factor—automobile availability and orientation—may play a larger role than either values or urban design.

To structure an investigation into the influence of values on mode choice, a simple method was used to partition all of the 865 respondents into two groups. A compound rating was developed by summing responses to a set of 15 questions on urban and environmental values. The questions included respondents' ratings of (*a*) the importance of community characteristics hypothesized to be characteristics of compact neighborhoods and (*b*) other values related to mode choice and the environment.

First, the respondents were split into two values groups (*high urban/environmental values* and *low urban/environmental values*) using the mean of the compound rating as the dividing value. Second, to examine the influence of urban form, the respondents were broken into two groups: (*a*) those living in a compact neighborhood (CN) and (*b*) those not living in a CN. Finally, a third grouping was created by breaking respondents into (*a*) those respondents whose households have less than one car per adult and (*b*) those having one or more cars per adult. Urban form and automobile ownership levels affect the respondents' self-confidence for selecting travel modes.

Table S-1. Relationship between factors and travel behavior.

Personal Values			*Neighborhood Type*			*Auto Availability*		
	Transit Share, All Purposes	**Walk Share, All Purposes**		**Transit Share, All Purposes**	**Walk Share, All Purposes**		**Transit Share, All Purposes**	**Walk Share, All Purposes**
High Urban/ Envir. Values Group	17%	16%	Lives in a CN	24%	20%	Low Auto Availability	24%	19%
Low Urban/ Envir. Values Group	8%	6%	Does Not Live in a CN	9%	9%	High Auto Availability	8%	8%

Table S-1 shows how selected travel characteristics vary by the different groups. For the two urban/environmental values groups, there is a significant difference in the percentage choosing transit and walking. Similarly, there are significant differences in this choice for the neighborhood-type groups and the auto-availability groups.

Statistical analyses of all of the variables together provided evidence that living in a compact neighborhood and having high urban/environmental values were independently and significantly associated with the choice of green modes (either walking or taking transit, or both). However, auto availability levels had greater association with green-mode choice than either living in a compact neighborhood or having high urban/environmental values.

Research Limitations and the Need for Additional Research

When considering the practical or policy implications from this research, it is important to keep in mind some inherent limitations of the research design. The use of an Internet panel brings some bias to the sample, as respondents are those with access to the Internet who are willing to respond to such surveys. While the sample did include respondents from around the country, it was limited to larger metropolitan areas with good transit. Age-groups of interest were oversampled, and respondents were limited to those who had recently moved or were contemplating moving. Indeed, this research was not intended to give results that could be projected quantitatively to a larger population. Its purpose was to increase understanding of the motivations of certain individuals who are of major interest to policymakers trying to promote smart growth and environmentally friendly modes. Future research will be needed to determine the overall incidence rate of market segments described in this study.

Another limitation relates to the specification of the models of relationships tested in the study. Using the TPB, prior research, and findings from focus group discussions as a guide, this study identified a set of independent variables that are used to explain differences or variations in attitude, subjective norm, and self-confidence, as well as intent. Although the regressions show significant results, as is often the case with individual attitudinal data sets, they typically explain relatively small percentages of the total variation in the attitude, sub-

jective norm, and self-confidence. This means that it is possible that other important factors have been left out of these models. Hence, the practical implications that can be derived are somewhat limited or tentative. The study acknowledges the need for additional research to help further our understanding of these effects.

The Data

One of the important products from this research are the data sets that are available to researchers to explore and draw additional conclusions. These data sets will be available either on CD or on the TRB website. There are two SPSS data sets, each corresponding with the two phases of the study. In addition, there are two Excel files that hold the results of trade-off exercises. In Phase 1 of the study, there was an exercise where respondents chose their favorite residential location based on a set of features for that location. In Phase 2 of the study, there was an exercise where respondents ranked the alternative transportation services. While an extensive amount of analysis was done for this project, there is still much left to discover.

Summary

This research used the model of TPB to structure research into complex issues such as choice of residence and mode choice. Examination of the three components of the model—attitude, subjective norm, and self-confidence—provided insights into motivations that point to reinforcing policies that can be pursued by policymakers and practitioners.

From this research, the most potential for increasing transit usage appeared to come through improving subjective norm and self-confidence. Both of these components were correlated with respondents' concerns about being left stranded by transit. The key to improving attitude was to improve transit reliability and convince respondents that transit use would reduce pollution and increase health.

The characteristic of a compact neighborhood that was most connected with a positive attitude was to be within walking distance of shops, restaurants, and other interesting destinations. The limitation that was key to self-confidence about moving to a compact neighborhood was the concern about finding an affordable home.

Market segmentation based on a set of statements correlated with intent to change modes and intent to move to a compact neighborhood also provided helpful insights. Two positive market segments were found in each case: a transit-oriented segment and an environmentally oriented segment. The transit-oriented segments already choose a compact neighborhood at a high rate and use transit at a high rate. However, the transit-oriented segments cannot be taken for granted: they want frequent transit to downtown and other destinations, and they are not necessarily loyal to living in a compact neighborhood. The environmentally oriented segments currently have a low rate of transit use and are very suburban in their current choice of neighborhood. However, they have potential and interest in increasing their use of transit and moving to a compact neighborhood. They believed that with new transit services available, it would be easier to use transit and walk more, and they believed that their family and others would approve. They also felt that with the new services, there would be less danger of being stranded.

The data collected for this research will be available to other researchers to explore. Although the sample was not representative of the national population, it is representative of the most positive markets for transit in large metropolitan areas. The research team for this project looks forward to learning of additional insights that others may discover in this data set.

CHAPTER 1

Introduction and Research Approach

Introduction

The purpose of this project was to explore a broader social context for individual decision making related to residential location and travel behavior. Because residential location and travel behavior have a large effect on society's consumption of energy, on levels of pollution, and on health, there is great value in increasing our understanding of the mechanism of choice. Better understanding could lead to better insights on the part of planners and decision makers as to how to predict choice and how to influence it through better policies and design, as well as education and communication. While the transportation community has considerable experience in using rational economic models of decision making in exploring residential and travel choice, there is less research on decision-making models from other fields, such as sociology, psychology, and marketing. This project provides a look at an alternative approach from the field of psychology—the theory of planned behavior (TPB).

Although the work done for this project used a different methodology for analysis, the project also had a goal of deriving practical implications and policy guidance for encouraging more use of public transportation and walking. An underlying assumption is that urban congestion and impaired mobility can be mitigated by encouraging people to substitute public transportation and walking for individual automobile use. A related assumption is that if people live in communities that are transit oriented [called *compact neighborhoods* (CNs) in this research], they will walk and take public transportation more. A practical challenge is, of course, how to promote this kind of behavior in enough instances to have a measurable, beneficial effect on travel conditions. The premise of this research is that by gaining a better understanding of the links between individuals' attitudes, intentions, and behaviors with regard to CNs and alternatives to the automobile, strategies can be better configured and targeted to help achieve the desired outcomes.

The goals of this research are thus twofold—to improve understanding of how people make travel and location decisions, and to derive practical implications and policy guidance for encouraging more use of public transportation and walking. Given the goals of the research, the following overall objectives were set:

- Explore the characteristics of market sectors that are more likely to be favorable to an urban residential environment, particularly an environment characterized as a transit-oriented development (TOD), or as used in this research, a CN.
- Explore the characteristics of market sectors that are more likely to be favorable to increased transit use and walking.
- Explore the impact of neighborhood type on the use of transit and on walking.
- Explore methods for encouraging more walking and transit use.
- Explore the TPB as an approach to understanding how individuals make travel and location decisions. In particular, explore the TPB in the context of a decision to move to a CN and to use environmentally friendly travel modes, such as walking and transit.
- Examine the power of the TPB to distinguish those market sectors and provide insight into motivating factors.

This project follows on the successful "New Paradigms" research program, which examined new structures and approaches for transit agencies (*1*). One motivation for this follow-on work was to look at new approaches from other fields, such as psychology and social marketing, for motivating individuals to choose transit and transit-friendly communities.

This research included an extensive review of the literature and interviews with experts in a variety of related fields. A conclusion from the literature and interviews was the value of applying the TPB in an examination of individual decision

making for residential and mode choice. Using the TPB, the project team has conducted an extensive amount of original research over a 3-year period. The research has yielded some interesting findings, provided new data for existing research issues, and left plenty of questions to be explored with further research.

Overview of the Report

This report is divided into 13 chapters.

Chapter 1 provides an overview of the report and some definitions.

Chapter 2 describes some of the background research on the relationship between land use and transportation. The chapter covers current trends in population and employment locations and in the choice of travel mode in the United States. It examines the effect of land use and development on travel. It also covers the impact of transportation and other factors, such as attitudes and lifestyle, on neighborhood choice.

Chapter 3 describes some of the background literature on the TPB, which is the underlying theory behind this research project. The literature covers the application of the TPB in a number of fields. It also covers several applications in transportation.

Chapter 4 describes the model for the TPB as presented by Icek Aizen [also spelled as *Ajzen*], the originator of the theory.

Chapter 5 discusses the research plan for this TCRP project. In addition to the literature review and interviews with experts, the plan included two phases of original research. Phase 1 focused on neighborhood choice, and Phase 2 focused on mode choice. Each phase included a set of focus groups and an Internet panel survey.

Chapter 6 provides some selected results from the Phase 1 survey. The results are provided by age-group and survey panel.

Chapter 7 presents a market segmentation of the Internet survey respondents. The market segmentation divides the population into five groups with different levels of interest in moving to a CN. Two of the groups are characterized as more positive, and three as more negative. Chapter 7 explores the characteristics and the attitudes of these market segments.

Chapter 8 presents an analysis of the relationship between Internet survey respondents' values and beliefs, neighborhood choice, auto ownership, and choice of transit and walking modes. Values and beliefs, neighborhood choice, and auto ownership are all associated with mode choice. Simple contingency tables and structural equation modeling is used to sort out the different effects.

Chapter 9 presents an analysis using the TPB for a move to a CN. It examines the relationship between *intent* to move and respondents' *attitudes* toward moving. It also examines the factors that may underlie those attitudes.

Chapter 10 presents the results of the Phase 2 Internet panel survey that focused on mode choice. The panelists were randomly divided into three groups that each received a different message. Results for two TPB exercises are contrasted.

Chapter 11 presents a market segmentation based on respondents' attitudes toward using transit more and walking more. Four segments are distinguished—two more positive and two more negative. Characteristics of the groups are presented, along with a discussion of what transit service improvements are likely to motivate the groups to increase their use of transit and walking.

Chapter 12 presents an analysis following the TPB for increasing transit use and walking. It explores the relationship between respondents' intent to change mode and their attitude. It also examines factors that may underlie those attitudes and potential transit services that may encourage more use of transit and walking.

Chapter 13 presents a summary of the practical implications of the research.

Definitions

This report uses terms that refer to concepts from the field of psychology. This report also refers to terms that have been specifically defined as part of this research. Because many readers may not be familiar with these and several other terms used throughout the report, some definitions are provided here.

Attitude: A state of mind or feeling.

Attitude Toward the Behavior (ATT): The degree to which performance of the behavior is positively or negatively valued by an individual. For example, an individual may regard riding transit as very undesirable or as very desirable. The degree of desirability is that individual's attitude toward the behavior. *Attitude toward the behavior*, as defined by the TPB, is shortened in this report to *attitude*.

Auto Availability Level: The term *low auto availability* refers to a household in which there are fewer cars than adults. The term *high auto availability* refers to a household in which the number of cars is equal to or greater than the number of adults.

Behavior: The observable response in a given situation. In the TPB, behavior is a function of intentions and perceptions of behavioral control or self-confidence, which moderates the effect of intention.

Behavioral Beliefs: Beliefs about the likely outcome of a behavior. The behavioral belief is the subjective probability that, for an individual, the behavior will produce a given outcome. For example, a man may believe that if he rides transit, it is highly likely that he will save money.

Compact Neighborhood (CN): The concept of a transit-oriented development is represented in this study as a

compact neighborhood. In a survey conducted as part of this research, the following definition was given for a compact neighborhood:

> The neighborhood has good sidewalks, a mix of housing types (including a mix of townhouses, apartments, condos, and single-family dwellings on quarter-acre lots), shopping or restaurants within walking distance, and nearby public transit. You would be able to take public transit to work or to shop, and you would be able to walk, bike, or drive to nearby shops, restaurants, pubs, and a library, but parking would be limited. You would be close to cultural events and entertainment. The neighborhood would be as safe as where you live today. Parking near your home would be limited to one car per household for street parking or you could rent a garage space. In this survey, we will call this a *compact neighborhood*.

Respondents to the survey are defined as living in a compact neighborhood when *(a)* there is some form of housing other than a single-family home within one-third mile of the residence; *(b)* there is a commercial district within one-third mile of the residence; and *(c)* there is transit service to the neighborhood. If any of the preconditions are lacking, the location is categorized as "not in CN."

Control Beliefs: Our beliefs about the presence of factors that may facilitate or impede performance of the behavior. For example, a woman may be concerned that if she rides transit, she could become stranded if she were to miss the bus.

Cronbach's Alpha: A measure of the reliability of a set of variables for measuring a single construct. Cronbach's alpha is a statistic computed from all combinations of pairwise correlations for a set of variables. It indicates if the variables are successfully measuring a single construct, albeit one containing different substantive concepts. Generally, a measure of alpha should be 0.7 or greater.

Green Modes: The term *green modes* is used to describe the sum of the use of transit and of walking from the survey data. The number of bike trips reported in the data set is extremely small. Therefore, for simplicity, bike trips are not included under the broader definition of green modes.

Intention or Intent: Immediate antecedent of a particular behavior. This is the cognitive representation of a person's readiness to perform a given behavior. Intention is based on *attitude toward the behavior (attitude)*, *subjective norm (subjective norm)*, and *perceived behavioral control (self-confidence)*, with each predictor weighted for its importance in relation to the behavior and population of interest. For example, a man may intend to take transit to work tomorrow.

MaxDiff: An analytical technique (maximum difference) for determining the relative preference that a respondent has for a set of alternatives. The result of a MaxDiff exercise is a set of values that indicate the respondent's first choice and last choice and where the middle choices lie along an interval scale. Thus, MaxDiff gives more information than simply asking respondents to assign order to a list of alternatives as a means of indicating their preference. MaxDiff requires respondents to pick the alternative they prefer most and the alternative they prefer least from a short subset of alternatives (usually three to six). By exposing the respondents to different subsets of alternatives and repeating the exercise, it is possible to infer the relative values or "utilities" that the respondents place on all the alternatives.

Mean: The mean is simply the average of all the items in a sample. To compute a sample mean, add up all the sample values and divide by the size of the sample.

Motivation to Comply: The importance placed on complying with others' expectations. For example, a woman may care about what her parents want her to do.

Normative Beliefs: Beliefs about the perceived behavioral expectations of others who are important to an individual. For example, a man may believe that his parents expect that he will take transit and avoid the expense of a car.

Outcome Evaluations: Evaluation of a particular outcome. Outcomes can be good or bad, or they can be important or unimportant. For example, a man may believe he can save money using transit, but he may feel that saving money is not very important.

Perceived Behavioral Control (PBC): Self-efficacy or self-confidence for performing a particular behavior. For example, a young person may have more self-confidence about using transit than an older person. In this report, perceived behavioral control is referred to as *self-confidence (*SCF).

Power of Control: Perceived power of factors that may facilitate or impede performance of the behavior. For example, although a man may feel that he could become stranded if he takes transit, this problem does not really concern him because he has other ways of getting home.

Regression: An analysis technique for estimating the relationship between a response or dependent variable and one or more independent variables. Simple linear regression and multiple linear regression are related statistical methods for estimating the relationship between two or more random variables assuming a linear relationship. Simple linear regression refers to a regression with one independent variable, while multiple regression refers to a regression with more than one independent variable.

Self-Confidence (SCF): Used in this report to mean the same as perceived behavioral control or self-efficacy.

Significance: As used in this report, significance is a statistical concept that indicates a probability. For example, a coefficient is considered significant if there is only a 5% chance it could be zero. Another use of the concept is to indicate differences between values. If a difference between two values is significant at the $p < .05$ level, there is at most a 5% chance that two values are the same. Tables in the text indicate significance of at least 5% with $p < .05$.

Standard Deviation: A statistical measure of the variation or spread in a set of data.

Structural Equation Modeling (SEM): Structural equation modeling (SEM) is a statistical technique that is similar to regression analysis, but is not as restrictive in terms of assumptions about the variables involved. SEM is able to handle measurement error, correlated independent variables, and many other situations that violate the statistical assumptions for a multiple linear regression.

Subjective Norm (SN): Perceived social pressure to engage or not to engage in a behavior. For example, a woman may believe that there is general social pressure not to ride transit.

Theory of Planned Behavior (TPB): A theory of human action developed by Dr. Icek Aizen of the University of Massachusetts, Amherst. This is the theory explored in this report, and it is described in Chapter 4.

Transit-Oriented Development (TOD): A form of development that is conducive to increased use of transit by residents. A mixed-use community within walking distance of a transit stop that makes it convenient to travel on foot or by public transportation instead of by car. This usually implies dense development around mass transit stations that provides a range of destinations within walking distance, including multifamily homes, shops, and workplaces.

Utilitarian Walking: In this report, the term *walking*, or *walk trips*, refers to trips to a destination, such as the workplace, a restaurant, or a church, for a purpose other than for exercise or pleasure. The former trips are referred to as "utilitarian" walk trips; the latter are referred to as "nonutilitarian" walk trips. Thus, references to "trips" or "total trips" exclude all walking trips taken solely for exercise or pleasure. References to utilitarian walk trips do *not* include any trips by bicycle.

CHAPTER 2

The Relationship Between Residential Choice, Transportation, and Life-Cycle Stage

This chapter discusses the literature, theories, and data concerning the factors that influence where people choose to live, work, and travel. The first section presents major trends in population, employment, and mode choice in the United States. It also includes a look at how age and life-cycle stage affect residential density of households.

The second section presents research on the effect of land use on travel behavior. After a presentation of several comprehensive reviews of the research, additional research is presented that focuses on the question of whether living in higher density neighborhoods affects travel behavior.

A third section looks at the question of whether transportation accessibility affects residential choice. Evidence from surveys of homebuyers and from residential choice models is included.

Overall Trends

Before discussing the variety of research on the association between land use and travel behavior, it is instructive to review trends in the United States over the past several decades. The common perception is that residences and jobs have been migrating to the suburbs from the central city, and that automobile travel has grown so that it dwarfs travel by transit. This perception is found in extensive literature on sprawl and on the consequences of automobile dominance (*2, 3, 4*). The statistics on trends in the United States confirm this general perception, with the caveat that recent decades are showing more stability in residences and jobs in the central city and that transit use appears to have stabilized.

A well-known trend is the suburbanization of residences, which has been occurring since the time of the streetcar and which has accelerated beyond the growth of the overall population. Another trend has been the decline in the population living outside metropolitan areas. The percentage of the population living in metropolitan areas has increased from 28.4% in 1910 to 80.3% in 2000. The percentage of the population living in the suburbs went from 7.1% in 1910 to 50% in 2000 (*5*). While the population of the United States tripled between 1910 and 2000, the population in center cities quadrupled, and the population in suburban areas increased by a factor of more than 21. Center city population has been approximately 30% of the total since around 1920. Figure 2-1 shows the number of people in the United States living outside metropolitan areas and in suburban and center city areas.

Jobs have also moved to the suburbs, although not at the same rate as residences. For example, manufacturing jobs have declined from almost 70% in central cities around the time of World War II to 50% in 2000 (*6*). Total employment in the central city appears to have stabilized during the past decade, however. Journey-to-work data from the Census Bureau shows that between 1990 and 2000 the percentage of jobs in the center city actually increased slightly, from 40.8% to 41.6%. Jobs in the remainder of the metropolitan statistical area increased from 37.0% to 39.2%, whereas jobs outside the metropolitan statistical area declined from 22.1% to 19.1%.

Figure 2-2 shows the number of workers by place of work for the United States.

Public transportation declined in absolute terms during the last half of the 20th century, going from a high of 23.4 billion unlinked trips in 1946 to a low of 6.5 billion unlinked trips in 1972 (*7*). Transit use as a percentage of overall travel declined during the last half of the 20th century and remains only slightly more than 1% of all passenger miles. While there are many reasons for this trend, the suburbanization of housing and jobs is one key reason. Figure 2-3 shows the percentage of public transit passenger miles out of the universe of auto passenger miles and transit passenger miles since 1980 (*8*).

Transit mode split is more significant for the journey to work. Figure 2-4 shows the percentage of trips by alternative modes for the work purpose. Alternative modes represent a little more than 10% of trips, and transit increased from 5.4% to 6.7% between 1985 and 2001 (*9*).

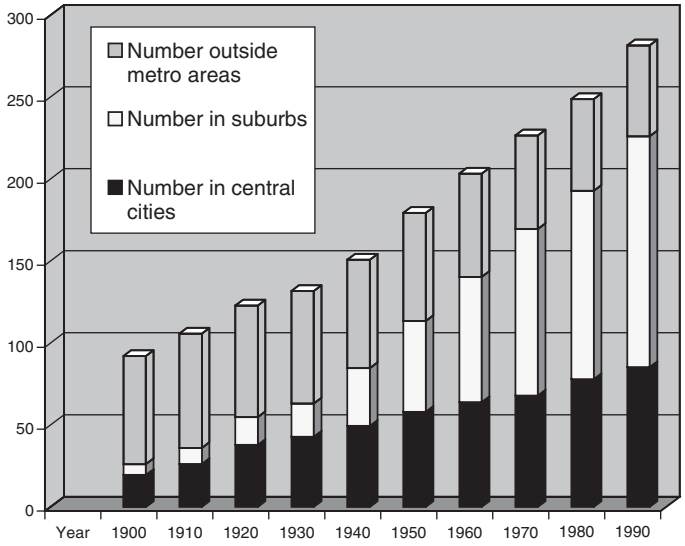


Figure 2-1. United States population, in millions, by residential location (5).

While these trends are not in dispute, there are alternative perceptions of what might happen in the future—whether better land use and transportation policies could promote better outcomes. There is also vast interest in the potential for land use development programs called nontraditional, transit-oriented design (TOD), which are referred to in this research as *compact neighborhoods* (CNs). The hope is that if more communities are formed that are higher density, with a fine-grain mix of land uses, there will be less use of automobile trips and higher use of walking, biking, and transit trips. Such developments will, it is believed, promote more use of alternative modes (walking and transit), cause a decrease in vehicle miles traveled, and provide a high quality of life.

Census data can be used to examine basic lifestyle characteristics of those who might be more inclined to choose CNs. Because CNs are associated with higher than normal densities, and the detached single-family home plays a smaller

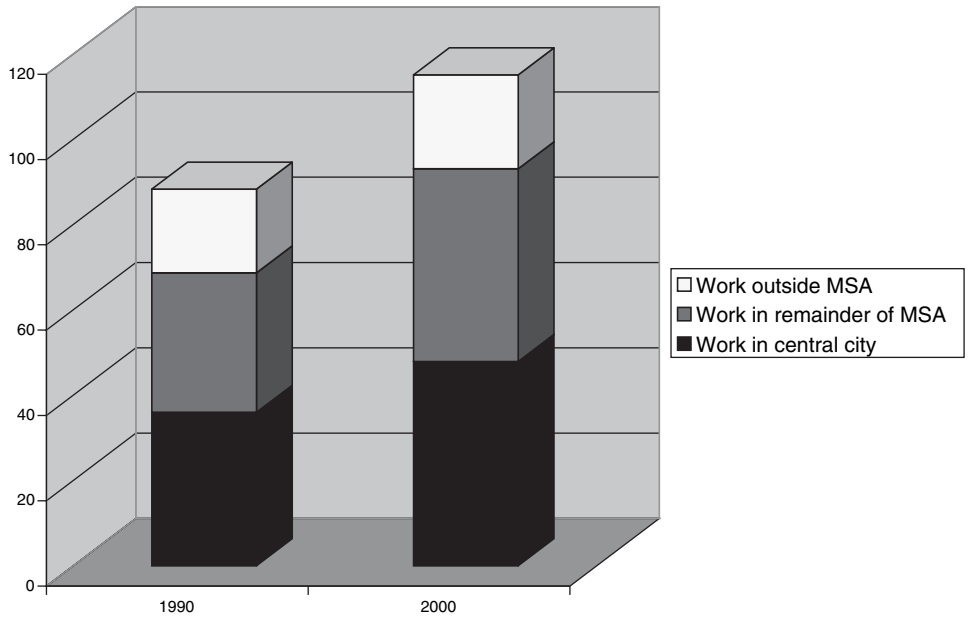


Figure 2-2. Place of work in the United States (millions of workers).

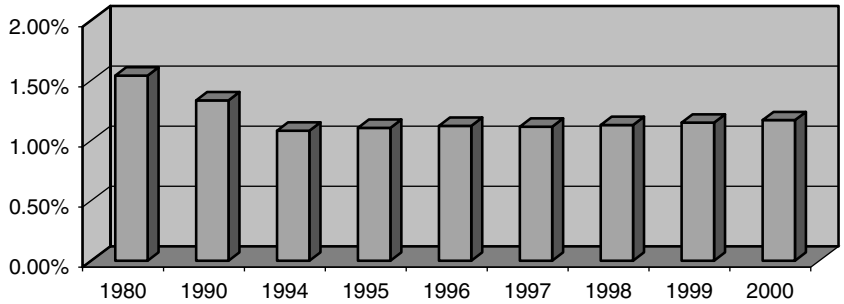


Figure 2-3. Transit passenger miles (percentage of total).

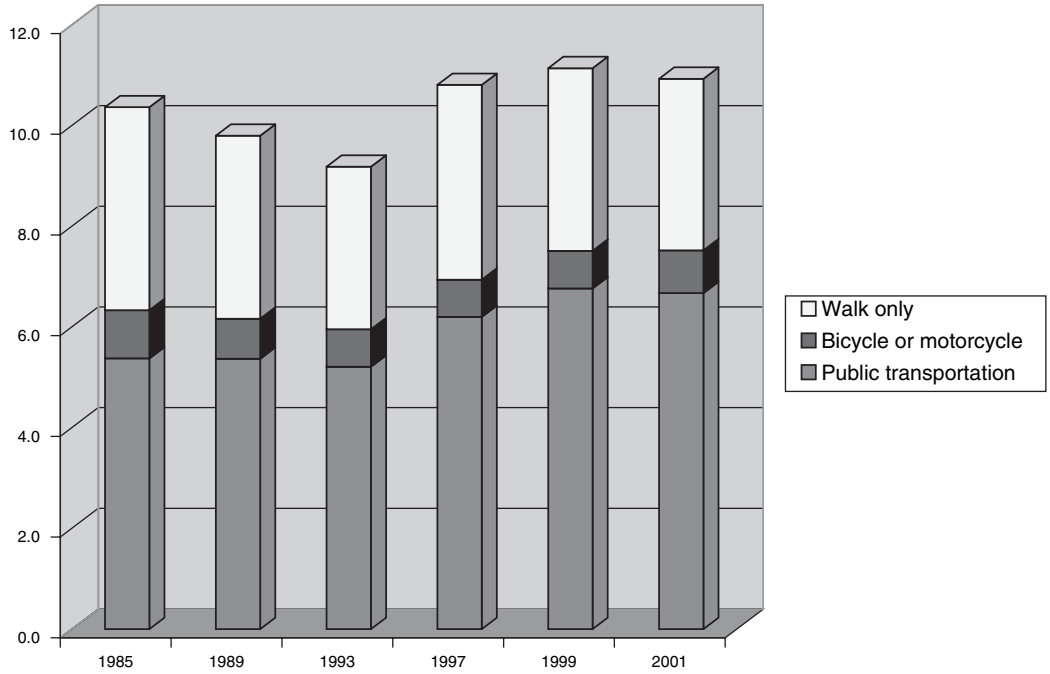


Figure 2-4. Alternative modes for the journey to work (percentage of trips).

than normal role in these settlements, it can be observed that the selection of housing other than the single-family home varies over a family's life cycle. Figures 2-5 and 2-6 document the choice of higher density housing as a function of age and as a function of stage in the life cycle of one particular group in the population—namely, family units of two parents with children. (A similar graph could be created, for example, for single-parent households.) Because of the similarity of patterns, the two graphs can be observed together. The graphs are based on the analysis of the results of the National Household Travel Survey (2001) undertaken by the Federal Highway Administration and the Bureau of Transportation Statistics (*10*); the graphs are based on a sample of the U.S. population living in urbanized areas.

Figure 2-5 shows that more than 60% of single Americans with no children in urban areas live in multiple-unit housing. Figure 2-6 reflects this by showing that more than 50% of Americans between the ages of 21 and 25 in urban areas similarly live in multiple-unit housing. By the time the youngest child is over 5 years of age, the percentage of households living in multiple-unit housing declines to about 20%, as shown in Figure 2-5. The same phenomenon is shown in Fig-

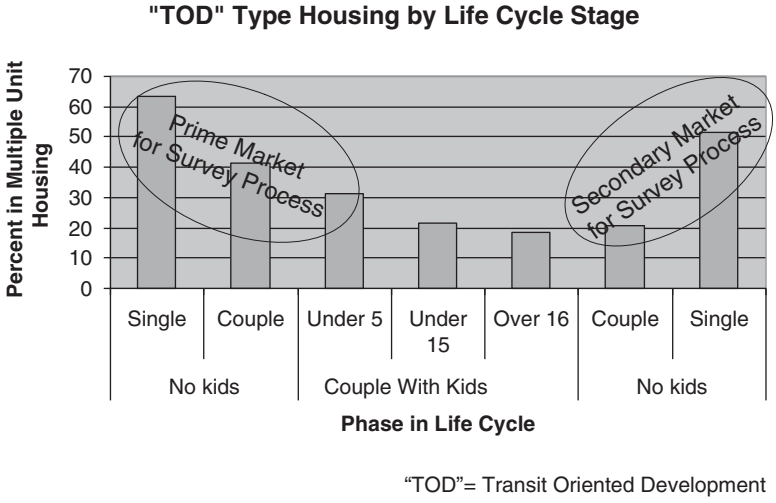


Figure 2-5. Life-cycle stages and use of multiple-unit dwellings.

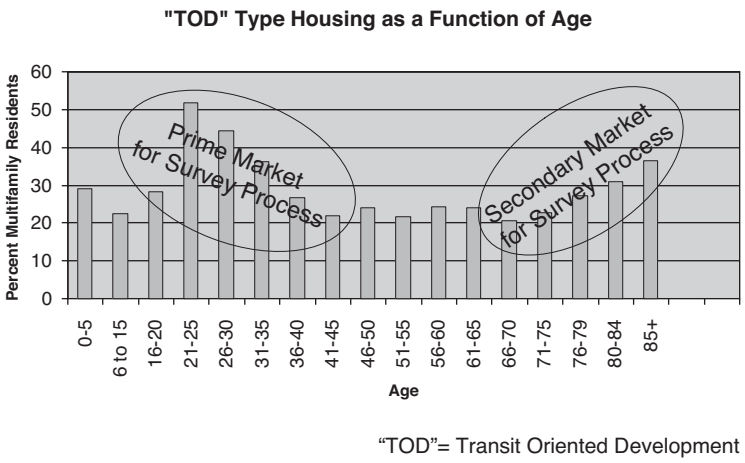


Figure 2-6. Age versus multifamily residence.

ure 2-6 as a function of age of the individual, with slightly more than 20% choosing higher density housing between ages 41 and 55.

This rather basic tabulation from the National Household Travel Survey provides support for the concept that different stages of the life cycle (or age) involve different forces on the residential decision-making process. For young individuals who have not started the child rearing process, higher density living patterns are the accepted norm. By the time their children are old enough to be in school, however, the use of higher density residential patterns has fallen by about half. At some point in the aging process, there is a return to the use of multiple-unit housing patterns.

Given these overall demographic trends and the perception that better policies could produce better outcomes, what does the research tell us that will help policymakers understand how and why people are making these choices and that will also provide some policy levers for influencing choice? The following section includes a discussion of the relevant research on the relationship between land use and transportation.

Literature on the Effect of Land Use on Travel Behavior

The evidence for the effect of land use on travel behavior is the subject of an extensive body of literature, and thus a number of authoritative critical reviews of this literature are available. In this chapter, the key results of reviews by Crane (*11*), Ewing and Cervero (*12*), Cervero et al. (*13*), Handy (*14*), and Kuzmyak et al. (*15*) are presented. Each of those reviews has a unique emphasis, but all share common themes specific to the subject, including methodological challenges, relevant theoretical frameworks, and range of travel behavior effects.

Following the summary review papers, this chapter includes a discussion of several additional studies that provide a background for this project. These papers provide information on the relationship between urban design, walking, and other transportation uses, as well as on the relationship between attitudes or lifestyle and urban design.

Summary Review Papers

***The Influence of Urban Form on Travel: An Interpretive Review*—**Randall Crane's review is focused largely on the methodology limitations of past research and thus the collective validity of findings (*11*). His review specifies three types of past research: hypothetical or simulation studies, descriptive studies, and multivariate statistical studies. Crane finds that hypothetical or simulation models provide little insight into the study of the effect of land use on travel behavior. These models can relate different scenarios "given certain behavioral assumptions," but these assumptions are "too simplistic," are "not intended to explain behavior," and thus "cannot test hypotheses with regard to the effect of land use on travel behavior" (*pp. 5–6*). With respect to descriptive studies, Crane concludes that these studies have made some contribution to our understanding of the effect of land use on travel behavior (e.g., by providing "hard data on real behaviors," *p. 5*), but that these studies have limited utility because they lack a theoretical basis and cannot isolate the effect of land use variables from other competing explanatory variables (e.g., it is impossible to use such studies to identify "how much of the observed behavior is influenced by the street configuration or any specific design feature alone" (*p. 8*). Crane identifies two categories of multivariate statistical studies—ad hoc models and demand models. He finds that ad hoc models are of limited value because they lack a behavioral or theoretical foundation even though they "consider many measures of urban form

while attempting to control for differences among communities, neighborhoods, and travelers" (*p. 11*). Demand models based on a microeconomic theoretical framework are deemed most promising, but unfortunately relatively few studies in the past decade have used this approach. Crane recommends that future "empirical work with strong behavioral foundations may be a useful and rigorous way to systematically link urban form to travel choices" (*p. 4*).

Crane concludes that the group of relationships encompassing urban form and travel behavior is "complex" and our knowledge regarding them is "tentative" (*p. 3*). He writes that "little verifiable evidence supports the contention that changes in urban form will affect travel as intended at the scale proposed" (*p. 3*). This, he continues, has been polarized into a black and white issue for many ("believers or skeptics"), and as a result, many civil decision makers have been left to make their own conclusions on often limited and complicated results (*p. 3*).

***Travel and the Built Environment: Synthesis*—**In their review, Ewing and Cervero acknowledge the methodological limitation of available studies, but seek to summarize the collective weight of the evidence of the land use effects on a range of travel behaviors (*12*). They state that their synthesis focuses on "[examining] research designs without getting bogged down in details, and [generalizing] across studies without glossing over real differences" (*p. 1*). The empirical studies reviewed, most of which controlled for competing explanatory variables, explain the following four types of travel effects: "trip frequencies (rates of trip making), trip lengths (either in distance or time), mode choices or modal splits, and cumulative person miles traveled (PMT), vehicle miles traveled (VMT), or vehicle hours traveled (VHT)" (*p. 2*).

Ewing and Cervero find that mode choice, of all the types of travel effects, has "received the most intensive study" (*p. 13*) and is "most affected by local land-use patterns" (*p. 7*). However, mode choice depends on both the built environment and socioeconomic factors, "though probably more on socioeconomics" (*p. 13*). They also find differing influences of land use variables on transit and walking mode choice: transit use tends to depend primarily on "local densities, and secondarily on the degree of land-use mixing," while walking tends to depend on both equally (*p. 7*). In addition, composite measures of the quality of the transit and walking environment can also influence the choice to use transit or walk.

Ewing and Cervero note that research on the effect of land use on trip lengths is less abundant than on mode choice. The results of these studies generally find that trips are shorter as accessibility or density increases, or when mixed uses are applied. This, they say, "holds for both the home end (i.e., residential neighborhoods) and non-home end (i.e., activity centers) of trips" (*p. 6*). Unlike mode choice, trip lengths appear to be a function of the built environment first and of socioeconomic characteristics second.

Trip frequencies, Ewing and Cervero contend, are like mode choice in that they depend on socioeconomic characteristics first. In fact, trip frequencies are mostly dependent on socioeconomic characteristics, and "differ little, if at all, between built environments" (p. 4) and "appear largely independent of land-use variables, depending instead on household socioeconomic characteristics" (*p. 6*). Similarly, they consider the issues of whether *substitution* or *supplementation* accounts for "the disproportionate numbers of walking and transit trips in traditional urban settings . . . [with regards to] longer automobile trips that otherwise would have been made out of the neighborhood or activity center" and find that the weight of the current evidence supports the substitution effect (*p. 4*).

With respect to the effect of land use on total travel (PMT, VMT, and/or VHT), the authors find that when the effects of regional accessibility are isolated, studies they review "differ on the effects of local density and mix on total vehicular travel" (*p. 5*). Thus, regional accessibility plays a greater role, and "total household vehicular travel, whether VMT or VHT, is primarily a function of regional accessibility" (*p. 5*).

Ewing and Cervero suggest that future research should study "how much of [an] impact density on travel patterns is due to density itself as opposed to other variables with which density co-varies" (p. 8). Consideration should also be given to the standardization of such terms as "transit friendliness" and "walking quality," because in current studies their definitions across the board are "unclear" (*p. 12*). Such issues warrant "much more empirical testing and replication of results" (*p. 12*). Another interesting area of research that has received relatively little attention is the influence of land use on trip chaining.

***Transit-Oriented Development and Joint Development in the United States: A Literature Review*—**In their literature review, Cervero, Ferrell, and Murphy address the more specific relationship between TOD and/or transit joint development (TJD) on transit ridership (*13*). The literature review included "secondary sources—comprising reports, articles, and books assembled from libraries, personal collections, and various public agencies" of a relatively recent date (*p. 9*). In general, the authors find a positive relationship between TODs or TJDs and transit ridership. However, they identify self-selection as an important control variable in these studies; for example, one study found the following:

> TOD residents patronized transit as their predominant commute mode more than five times as often as residents countywide; self-selection was evident in that 40 percent of the respondents who moved close to transit stops said they were influenced in their move by the presence of LRT [light rail transit]. (*p. 41*)

They cite another empirical study that found a statistically interdependent relationship between office development and

ridership: "jointly developed office space atop or near a rail stop spurred ridership and ridership in turn spurred office development" (*p. 42*). Another benefit of TODs is "increased off-peak and reverse-flow patronage—i.e., mixed-use, all-day trip generators help fill up trains and buses at all hours of the day and in both directions" (*p. 42*).

The authors conclude that the "research shows that living and working near transit stations correlates with higher ridership" (*p. 40*). However, the authors caution that current research does not allow for definitive conclusions on the relationship between TODs or TJD and transit use:

> No empirical research has been produced to date that traces causal pathways between TODs or TJDs, resulting ridership gains, and eventual improvements in traffic or environmental conditions. Given the daunting methodological challenges of conducting such a causal analysis, qualitative case studies have been largely relied upon in making the connections between TODs and broader transportation and environmental outcomes. (*p. 43*)

Smart Growth and the Transportation–Land Use Connection: What Does the Research Tell Us?—In her 2005 synthesis, Handy also reviews the influence of land use on travel behavior (*14*). Like the other reviewers, she finds that research to date has not established a solid foundation to predict the travel behavior effects of smart growth policies and strategies. Handy contends that some have "argued that the connection between transportation and land use has weakened," while others believe that it "still greatly matters" (*p. 2*). She believes that the results from empirical studies are "mixed" and focuses her review on a microeconomic theoretical framework, current studies, and comprehensive reviews (*p. 2*).

Handy begins her review by outlining the microeconomic theoretical basis of the land use and travel behavior hypotheses. She states that "travel choices made, such as the choice of mode or destination, are determined by the characteristics of the choices available. Each possible choice offers a certain 'utility' or value to the individual, who seeks to maximize her utility" and "maximizing utility generally means minimizing travel time, but other factors can outweigh time" (*p. 20*). This, in turn, results in a "mixed [effect] on travel for new urbanism strategies: these strategies may increase the utility of alternatives to driving, but they also tend to increase the utility of making trips, so that savings from a shift in travel modes may be offset by increases in the frequency of trips" (*p. 20*).

In terms of mode choice, trip length, and trip frequencies, Handy references Ewing and Cervero (*12*) and states that the weight of the evidence suggests that mode choice depends on socioeconomic and built environment characteristics (though more so on socioeconomic characteristics); trip length is a function of the built environment first and of socioeconomic characteristics second; and trip frequencies are just the opposite, first a function of socioeconomic characteristics and second a function of the built environment. Finally, in regards to VMT, "characteristics of the built environment are much more significant predictors of VMT, which is the outcome of the combination of trip lengths, trip frequencies, and mode split" (*p. 21*).

Handy also discusses attitudinal variables, which, according to one study, "had the greatest impact on travel behavior among all of the explanatory variables and . . . residential location type had little impact on travel behavior, suggesting that 'the association commonly observed between land use configuration and travel patterns is not one of direct causality, but due primarily to correlations of each of those variables with others'" (*p. 23*). Like Cervero et al. (*13*), she proposes that the connection between travel behavior and residential type is better explained through self-selection—i.e., "residents with certain attitudes . . . [select] certain kinds of neighborhoods" (*p. 23*).

Handy concludes that "new urbanism strategies make it easier for those who want to drive less to do so" (*p. 24*) and that "the lack of reliable predictions does not necessarily mean that communities should not proceed with smart growth efforts" (*p. 26*). She argues that determining the role socioeconomic characteristics play in determining travel behavior, separate from the built environment, is a challenge. She continues, "It is safe to conclude that land use and design strategies such as those proposed by the new urbanists may reduce automobile use a small amount" (*p. 23*).

Continued research, Handy writes, has shown "promising" use of geographic information systems (GIS), which she believes will lead to "more detailed measures of the built environment . . ." (*p. 25*). She also recommends "experimental designs and longitudinal studies . . . and analysis techniques, including path analysis, structural equations modeling, and multi-level modeling" (*p.25*). A key question is whether "land use and design strategies can fundamentally change attitudes towards transportation and thereby change desired behavior rather than simply enabling it" (*pp. 23–24*).

Land Use and Site Design—In Chapter 15 of *TCRP Report 95: Traveler Response to Transportation System Changes,* Kuzmyak et al. provide another comprehensive summary of the known impacts of land use on travel demand (*15*). The report looks at the impact on travel of building codes and site-level zoning requirements, as well as traditional neighborhood and pedestrian-friendly development. The summary judgment from the report is that much is still unexplained in travel behavior, even after land use and urban form are taken into consideration.

> While this chapter draws from a broad range of research studies that have attempted to identify, measure and explain the links between land use and travel demand, the level of confidence imparted by these studies is less than with most measure reported elsewhere in this Handbook . . .

> The better assessments are often made through development of regression or logit models. The resulting statistics almost always show, excepting certain narrowly focused investigations, that significant sources of variation in travel behavior still remain unexplained after key variables—land use, urban form and transportation—are incorporated, to a degree the same may be said of most conventional travel demand models, but not quite to the same extent. (*p. 15–6*)

Selected Additional Studies

As the reviews cited above point out, our knowledge of the effect of land use on transportation is limited. Unexplained variation in models of travel behavior based on land use means that much is left unknown about the relationship. The variables describing transit and walking-friendly urban design have not been carefully measured. In addition, if people self-select into neighborhood types according to their travel inclinations, then those inclinations, rather than urban design, would be the explanation for their travel patterns. Urban design might merely be enabling some residents to travel the way they prefer.

A recently published study on the effect of urban form on walking (commonly known as SMARTRAQ) (*16*) attempts to address one of the key methodological limitations of previous studies. Many studies on walking behavior rely heavily on self-reported data (often in the form of travel diaries) that are subject to validity concerns. The SMARTRAQ study addressed this problem by using accelerometers that electronically recorded walking activity. Many studies are also limited by "large-scale regionally averaged . . . measures of the built environment that do not provide the detailed information needed by policymakers" (*p. 117*). SMARTRAQ addressed this as ". . . each environmental variable was computed individually for each participant, using GIS to describe the 'microenvironments' that people experience regularly where they live" (*p. 118*). The results revealed that "measures of land-use mix, residential density, and intersection density were positively related with number of minutes of moderate physical activity per day" (*p. 117*). Moreover, the study states the following:

> This research supports the hypothesis that community design is significantly associated with moderate levels of physical activity. These results support the rationale for the development of policy that promotes increased levels of land-use mix, street connectivity, and residential density as interventions that can have lasting public health benefits. (*p. 117*)

In sum, their analysis is more conclusive on the specific characteristics of land use that affect travel behavior related to walking. However, their study does not deal with the issue of self-selection.

As noted by Handy (*14*), some studies have shown that attitudes are more important than land use characteristics as determinants of travel behavior. Kitamura et al. (*17*) developed models to predict travel behavior given salient characteristics of neighborhoods, including measures of residential density, public transit accessibility, mixed land use, and the presence of sidewalks. Additional data were then added to the analysis of attitudinal variables, which grouped attitudes into factors with such labels as pro-environment, pro-transit, suburbanite, automotive mobility, time pressure, urban villager, and workaholic. When all of the explanatory variables were examined together, the attitudinal variables explained the highest proportion of the variation in the data. This led the researchers to suggest that land use policies promoting higher densities may not alter travel demand unless residents' attitudes also change.

The paper by Kitamura (*17*) provides support for the concepts being examined in this project, which call for the integration of psychological (attitudinal) research techniques into the set of tools utilized by the transportation manager and planner. A later paper by Bagley and Mokhtarian (*18*) "empirically examines the relationship of residential neighborhood type to travel behavior, incorporating attitudinal, lifestyle, and demographic variables."

> In terms of both direct and total effects, attitudinal and lifestyle variables had the greatest impact on travel demand among all the explanatory variables. By contrast, residential location type had little impact on travel behavior. This is perhaps the strongest evidence to date supporting the speculation that the association commonly observed between land use configuration and travel patterns is not one of direct causality, but due primarily to correlations of each of those variables with others. In particular, the results suggest that when attitudinal, lifestyle, and sociodemographic variables are accounted for, neighborhood type has little influence on travel behavior (*p. 279*).

The authors acknowledge that a drawback to their analysis is the use of cross-sectional data rather than longitudinal data. That is, people might change their attitudes over time in response to their residential environment.

> Thus, people do change, both their attitudes and their behavior, in response to external stimuli—the questions are, how many people, which kinds, how much, and how long does it take? A process of attitudinal and behavior adjustment, whether due to physical constraints as described above or due to a more subtle alteration of attitudes over time, comes into play most forcefully when people's predispositions and residential locations are mismatched, and the extent to which that is the case is unknown. The current study not only found little effect of residential location on (travel) behavior, it found no impact of residential location on attitudes . . . Travel behavior, on the other hand, showed a tendency to reinforce related attitudes: vehicle miles positively affected the pro-driving attitude and negatively affected the pro-high-density attitude, and the converse was true for walk/bike miles . . . However, a major limitation of the current study is the inability of the available cross-sectional data to

> capture dynamic changes . . . To conclude, evidence strongly suggests that land use characteristics have little independent impact on travel behavior. But a need still exists . . . through the use of more appropriate data and analysis techniques, to improve our understanding of the extent to which one's residential environment influences the attitudes and lifestyle that do affect travel demand. (*p. 295*)

Bhat and Guo (*19*) reported on research that attempted to sort out the impact of the built environment on travel, separately from the effect of auto ownership and demographics. They found that the attributes of the built environment do affect residential choice decisions, as well as car ownership decisions. They also found that the commonly used population and/or employment density measures are actually proxy variables for built environment measures, such as street block density and transit accessibility. Both household demographics and the built environment affected car ownership, with demographics being the more important. Household income was the key variable influencing the choice of type of residential neighborhood and the accessibility of the neighborhood. The researchers indicated that ignoring the effect of income on car ownership and the travel decisions related to car ownership could lead to an inflated effect of the built environment on travel behavior. Finally, the results did not support the notion that unobserved factors (like attitudes) predisposed people to select certain types of residential neighborhoods or to make car ownership decisions.

> This result implies that independent models of residential choice and car ownership choice (after accommodating the residential sorting effects of demographics) are adequate to examine built environment effects on car ownership choice, in the current empirical context. But, in general, it is important to consider the methodology developed in this paper to control for the potential presence of self selection due to both observed and unobserved household factors. Only by estimating the joint model can one conclude about the potential presence or absence of self-selection effects due to unobserved factors. (*p. 20*)

Research on Choice of Residential Location

Another approach to examining the relationship between land use and transportation is to examine the reasons that people choose certain residential locations and determine whether transportation options have an impact on the choice of residence. Research into the choice of residential location is extensive since it is of interest to those in the business of developing homes, as well as to policymakers wishing to influence residential location. On a more theoretical level, the trade-off between residential location and travel time has been a subject of much research in the related fields of geography, regional planning, economics, and transportation.

Key to this project is to learn what the research says about variables that would encourage living in areas that feature TOD. Two sets of studies follow: *(a)* a selection of surveys of homebuyers and *(b)* academic research into residential choice.

Surveys of Homebuyers

There are many examples of homebuyer surveys that examine the reasons a particular home is purchased. The results of these surveys vary according to slight variations in the questions asked, and so caution is required in the interpretation of results. An important source of information concerning the reasons for American residential location decisions is the report *Smart Growth: A Resource for Realtors*, which was prepared by the Economics Research Group of the National Association of Realtors (*6*). The document includes a discussion of the "Top Reasons for Deciding Where to Live," as determined by a survey of registered voters in February 2000. More than 30% of the survey population selected "safe area with little or no crime," with the second highest (17%) consideration being good public schools. "Ability to afford to live in neighborhood of choice" was third (10%). By contrast, access to stores (a key element in some TODs) was chosen by only 3% of the sample. The minimization of traffic congestion was ranked most important by just 5% of the survey. "Close to work" was chosen by 8% of the sample. Thus transportation-related considerations were ranked lower than other attributes of the home and neighborhood.

In addition to its survey of voters, the National Association of Realtors also regularly surveys recent homebuyers. The 1999 survey found that 82% of homes purchased that year were single-family homes, 7% were townhouses, and 8% were condominiums or apartments. The city is chosen by 44% of first-time buyers, but by only 36% of repeat buyers. Nearly half of the buyers within a city neighborhood are first-time buyers. In response to questions about why homebuyers moved, the two most cited reasons were the desire to own a home (33%) and space considerations (25%). The survey responses indicate some of the reasons why homebuyers are choosing suburban locations (*20*).

Over three-quarters of the homebuyers said that a key reason for their decision to purchase a specific home was the neighborhood. Other factors that influenced buyers included the following:

- Proximity to place of business—34%
- Location and quality of local schools—32%
- Parks/recreational facilities—15%
- Shopping centers—13%
- Public transportation—5%

Note that while there is agreement between the two surveys quoted above on the relative importance of schools, the results

differ on the relative importance of being close to work and of access to shopping. Other findings are found in several other surveys summarized in a review by Malizia and Exline (*21*). For example, the 1998 Vermonters' Attitudes on Sprawl Survey found that 74% of respondents preferred a home in an outlying area with a larger lot and a longer commute over a similarly priced home in an urban area close to transportation, work, and shopping. That same survey found that 65% of respondents considered lot size as somewhat or very important when choosing a home. However, 48% preferred communities with houses, stores, and services within walking distance.

The National Association of Realtors study (*6*) points out that changes in demographics over the next decade may cause an increase in demand for city living. Because there will be a decline in the absolute number of households headed by persons aged 25 to 35—the ages at which households traditionally leave cities for the suburbs—growth of the suburbs relative to cities will decelerate. The expected increase in single-family households will also increase demand for city housing, as these households opt for city living at higher rates than other households.

Myers and Gearin (*4*) describe the results of a variety of surveys on home and neighborhood preference. A consistent share of respondents preferred alternative residential styles to the single-family home. Those preferring townhouses ranged from 15% to 17%; for condominiums, the range was 9% to 14%. Some consumers also prefer higher density living, ranging from 37% in a 1998 Professional Builder survey to 57% in a 1996 National Association of Home Builders survey. The 1998 American Lives survey found 49% of respondents prefer a less auto-oriented street pattern, with narrow streets that encourage walking.

The Seattle Planning Department conducted a residential preference study to determine whether TOD developments might have appeal (*22*). The study involved a telephone survey of 600 residents in the area to determine the most important features of a home. That was followed by a series of focus groups to further explore the findings from the survey. The third phase was a telephone and mail survey using the conjoint measurement technique to measure the importance of features in choosing housing. The objective of the study was to determine those persons who would be most likely to choose a denser housing environment, as well as to determine the features that would make such housing more appealing. The initial survey responses to rating questions about housing preferences were used to segment the market into three different market segments using cluster analysis. Mirroring the National Association of Realtors study, crime and school quality were found to be important factors, but much less important than the type of residence and the desire for home ownership. Affordability was found to be slightly more important than concern about crime and schools.

One segment was found to be much more likely to be interested in residences with greater density. That segment, named "Urban Village," represented 34% of the population. This segment tended to have lower incomes than other groups, to be more mobile, and to rent rather than own their homes. The group had the largest proportion of college-age individuals and also a large number of retirees. This segment ranked affordability and crime as most important, followed by travel time to work and school quality.

Models of Residential Location

Understanding how homebuyers rank factors in home purchase decisions does not necessarily help to forecast home purchase decisions. For this a model of the choice process, which shows the effects of different factors and which sorts out cause and effect, is needed.

The traditional economic approach to understanding residential location has been relied upon for years. The Dutch geographer Petter Naess (*23*) summed up the traditional approach as follows:

> According to theories of transport geography and transport economy, the travel between different destinations is assumed to be influenced on the one hand by the reasons people may have for going to a place, and on the other hand by the discomfort involved when traveling to this location (Jones, 1978; Beimborn, 1979). *Or, in other words, by the attractiveness of the locations and the friction of distance.* (*p. 1*)

In the classic view, transportation is the cost that must be borne to make possible those things valued most highly. Early models, such as the gravity model, expressed attraction in easily quantifiable terms, such as square feet of space (in the numerator) and travel discomfort (as travel time or distance in the denominator), raised to an empirically determined power. Transportation was viewed as a derived demand—as something to minimize as the required travel activity is accomplished.

More sophisticated models, such as utility maximizing models, attempt to measure the utility of items that are cited as attractive to homebuyers and the disutility of travel. Early work in this area was by Weisbrod et al. (*24*) and Lerman (*25*).

Consistent with the various opinion surveys, Weisbrod (*24*) found that the consumer tends to place a lower value on transportation attributes than those of other aspects of life.

> The empirical results suggest that households make significant tradeoffs between transportation services and other public service factors in evaluating potential residences, but that the role of both in determining where people choose to live is small compared with socioeconomic and demographic factors. (*p. 1*)

The authors note that about 20% of the nation's population changes its place of residence every year, and 42% move

within a 5-year period; about half of these relocations are within the same metropolitan area. There is considerable consistency in the literature concerning the important factors affecting residential choice.

> Factors beyond the scope of public policy, such as the desire for single-family, detached homes among families with children, and the reduced moving rates for older persons and families with several children, all affect mobility and location patterns more than other factors related to public expenditures. (*p. 9*)

As part of this research effort, Lerman (*25*) developed a discrete choice model of residential location that identified some of the factors that influence residential choice and the relative importance of transportation accessibility. That work found that although transportation accessibility is a factor that households consider in residential location decisions, socioeconomic and demographic factors (including the match between a neighborhood's demographics and the individual's demographics) were more important than transportation accessibility in determining residential locations.

A more recent study by Srour et al. (*26*) tested various accessibility measures for their effect on residential choice and property values. Findings were that access to jobs, retail employment, and park space were statistically and practically significant in both choice models and models of property values. That work suggests that consumers are willing to pay for location. "The access may be to jobs, retail centers, parks, good schools, views, or other amenities; it is all capitalized into rent through market bidding" (*p. 32*).

Work by Waddell and Nourzad (*27*) incorporated neighborhood accessibility measures in an integrated land use and transportation model. Findings were that regional access to employment was positively related to choice of a residential neighborhood. There was a preference for residential locations that had more walking access to retail shops. This effect was stronger for those households where there was less than one automobile per worker. Other findings were that there was an overall preference for lower density locations, and this was more pronounced for households with children. Younger households favored higher density residential locations, and households with fewer cars were more likely to favor higher density locations than households with more cans. Higher income households with children were very unlikely to choose the most urban sites, whereas lower income and childless households, particularly those in which no vehicle was owned, were more likely to choose the most urban sites.

Krizek and Waddell (*28*) point out that life-cycle stage appears to affect the decision about where to live and the importance of accessibility. Through a combination of factor analysis of a lifestyle attributes (including travel characteristics, activity frequency, automobile ownership, and urban form) followed by cluster analysis of respondents by their lifestyle factor scores, the authors defined nine distinct subgroups. The subgroups are similar in their travel patterns and the urban form of their neighborhoods, and thus illustrate the pairing of longer term decisions on residential choice with short-term decisions on travel. Findings were that five out of nine lifestyle groups, or 60% of the sample, rated highly on the accessibility of their residential location. Two groups were those typically expected to gravitate to new urbanist communities: retirees and transit users, which together made up 18.4% of the sample. Other groups with high accessibility also are associated with high rates of travel. These included the single busy urbanists (7.8%), who took vehicle trips with complex tours, and the family and activity-oriented participants (12.3%), who took lots of nonwork trips. The largest group was urbanists with higher incomes (21.3%), who were average as far as activity and travel dimensions. This group would seem to be attractive for new urbanist communities in that they appear in high accessibility locations and do not take lots of trips with complex tours.

Lessons from the Literature on the Relationship Between Land Use and Transportation

The results of literature reviews on the effect of land use on travel behavior indicate that studies on this subject to date are not conclusive because of inherent methodological and or theoretical challenges. However, the weight of the evidence suggests the following:

- A relationship exists between mode choice and land use, but socioeconomic variables may be of greater significance.
- Just the opposite is true for trip lengths: land use is of primary significance, and socioeconomic variables are of secondary significance.
- Trip frequency is almost completely a function of socioeconomic variables.
- The more mix of land uses, density of housing, and streets with intersections, the more residents walked.
- Since residents in more urban communities may be self-selected as desiring a neighborhood where they can drive less and can walk and take transit more, observed comparisons may exaggerate the impact of urban design on mode choice. However, evidence is mixed on the extent of this effect.

In the research on transportation's influences on choice of neighborhood, the findings are also mixed. While a distinct majority of Americans still favor the rural ideal, or at least a home with a large lot, there is a seemingly growing group interested in a home that is in closer proximity to stores and commercial areas. There is evidence that access to jobs, retail employment, and parking does positively affect the value of homes.

CHAPTER 3

Background to the TPB and Its Application in Transportation

One of the objectives of this research project is to explore the TPB as an approach to understanding how individuals make travel and location decisions. This chapter presents key background information from the field of psychology. Literature on TPB, which includes a collection of theories of behavior, is summarized. After a discussion of those theories, the application of the TPB in transportation is reported. Some of the relevant studies exploring how habit and environmental values influence behavior are described, as are ways of overcoming habit in trying to bring about social change.

Literature on the Theory of Planned Behavior

An excellent summary of the development and use of the TPB is provided in an article by Icek Aizen in *Organizational Behavior and Human Decision Processes* (*29*). The article covers some of the background research behind the TPB, as well as analysis techniques. The article starts by acknowledging the low empirical relationships between personality traits and behavior. Although relationships can be improved by aggregating multiple instances of behavior so that random influences specific to a particular occasion can be canceled out, a model that explains behavior at the more disaggregate level would be desirable. The TPB is suggested as such a model for explaining behavior at a more disaggregate level.

The TPB grew out of the theory of reasoned action (*30, 31*), which holds that behavior is the direct result of *intent*, and that intent is influenced by a person's ATT and the SN. Because of problems predicting behavior with intent alone, Aizen added PBC as a predictor. Performing a behavior may depend on having requisite opportunities and resources that enable the performance. PBC, as defined by Aizen, is similar to the concept of self-efficacy developed by Albert Bandura (*32, 33*), the originator of social learning theory. Bandura (*34*) found that an individual's behavior is strongly influenced by his or her confidence that he or she can perform the behavior. Self-efficacy beliefs influence behavior by influencing the choice of activities, preparation for an activity, effort expended, thought patterns, and emotional reactions (*29*).

In general, if the behaviors being investigated pose no serious problems of PBC, there will be a strong relationship between intent and behavior. Aizen illustrates this with a series of 17 studies using the TPB (*29*). For each of the studies, he shows the results of regression analyses, with behavior as the dependent variable and with intent and PBC as independent variables. There is a significant coefficient for intent in the prediction of behavior in 15 of the 17 situations. PBC, however, also adds to the prediction of behavior, with 11 of the 17 analyses having significant coefficients for PBC. In most of these studies, the coefficients for intent were greater than the coefficients for PBC. If there is a problem of behavioral control, however, intent may not have a strong relationship to behavior. This was the case in two studies on weight loss, where only the PBC was significant.

The theory holds that PBC also contributes to intent, as do ATT and SN. Aizen uses a set of studies to illustrate the relationship between ATT, SN, PBC, and intent (*29*). A considerable amount of variance in intent is accounted for by the three predictors in the TPB. The coefficients of ATT were significant in 15 of 16 cases, the coefficients of SN were significant in 10 of 16 cases, and the coefficients of PBC were significant in all cases. On the basis of consistent evidence linking ATT and PBC to intent, Aizen concluded that personal factors (ATT and PBC) are more influential in the prediction of behavioral outcomes than are social (or normative) factors (SN).

Aizen also discusses attitude formation in the TPB model, including the use of the expectancy-value model of attitudes (*30*). The expectancy-value model says that, for example, ATT can be indirectly measured by summing the product of belief measures times measures of the belief's relevance. While results of numerous studies support the expectancy-value model, the magnitude of the relationship between indi-

rect and direct measures of constructs like ATT, SN, and PBC has been only moderate (*29*).

Armitage and Conner (*35*) provide a metareview of the many research papers that used the TPB.

> The Theory of Planned Behaviour (TPB) has received considerable attention in the literature. The present study is a quantitative integration and review of that research. From a database of 185 independent studies published up to the end of 1997, the TPB accounted for 27% and 39% of the variance in behaviour and intention, respectively. The perceived behavioral control construct accounted for significant amounts of variance in intention and behaviour, independent of theory of reasoned action variables . . . Attitude, Subjective Norm and [Perceived Behavioral Control] account for significantly more of the variance in individuals' desires than intentions or self-predictions, but intentions and self-predictions were better predictors of behaviour. The Subjective Norm construct is generally found to be a weak predictor of intentions. This is partly attributable to a combination of poor measurement and the need for expansion of the normative component. (*p. 471*)

The TPB has had broad application in the health field, and more recently in transportation. The breadth of applications of the TPB in health had been described in several articles, including "The Theory of Planned Behavior: A Review of Its Applications to Health-Related Behaviors," by Godin and Kok (*36*), whose purpose was "to review applications of Ajzen's theory of planned behavior in the domain of health and to verify the efficiency of the theory to explain and predict health-related behaviors" (*p. 87*). The findings of the study included the following:

> The results indicated that the theory performs well for the explanation of intention; an averaged R^2 of .41 was observed. Attitude toward the action and Perceived Behavioral Control were most often the significant variables responsible for this explained variation in intention. The prediction of behavior yielded an averaged R^2 of .34. Intention remained the most important predictor, but in half of the studies reviewed Perceived Behavioral Control significantly added to the prediction. (*p. 87*)

Godin and Kok conclude that "the efficiency of the model seems to be quite good for explaining intention, Perceived Behavioral Control being as important as attitude across health-related behavior categories. The efficiency of the theory, however, varies between health-related behavior categories" (*p. 87*).

The Application of the TPB to Transportation

The TPB has been applied directly to the issue of mode choice in several studies. The European Union's ADONIS (Analysis and Development of New Insight into Substitution of Short Car Trips by Cycling and Walking) project applied the theory to the modal choice in short-distance trips in Scandinavia. Bamberg et al. (*37*) applied the theory to the change in bus ridership in northern Germany as a result of a change in the fare collection method. An issue in both of these studies was the importance of habit in transportation mode choice. This issue is described more fully after descriptions of the two projects.

The ADONIS Project

The ADONIS Project is described in a report titled *A Review of the Effectiveness of Personalized Journey Planning Techniques* (*38*). The report reviews various learning models and notes the extent of application of Aizen's TPB. The report summarizes the application of the work of Aizen in a survey process undertaken in Scandinavia, as follows:

> [Aizen's theory] has recently been used extensively in travel behaviour change analysis (notably in the ADONIS project, Forward et al., 1998), to explain the likelihood of behavioral change in different circumstances. The theory (through successive adaptations) currently posits that the intention to change behaviour is related to:
> - the attitude the person has to the change;
> - what the person feels others will feel about them if they change;
> - the extent to which the person feels they are able to change; and
> - the depth of habit that the person has relating to current behavioral patterns. (*paragraph 2.16*)

The ADONIS studies are important to this project because of their direct application of psychological theories of attitude formation in a planned intervention to alter travel behavior, in this case concerning the short-distance trip. The psychologist who undertook the study, Sonja Forward of the Swedish National Road and Transport Research Institute, described the project as follows:

> This study analyzed short journeys on foot, cycle and car with the aid of a travel diary and an attitude survey . . . The attitude survey was designed in accordance with an expanded version of the Theory of Planned Behaviour, which included attitudes, subjective norm, perceived behavioral control and habit. (*39*)

The ADONIS questionnaire was administered by phone, followed by a second wave which rated "a short imaginary journey." Based on an analysis of the surveys and the diaries, Forward concluded that the factor of habit was the most powerful explanatory variable in understanding the rational for mode change, or the lack of mode change, and that the concept of self-efficacy (labeled *perceived behavioral control* in the TPB) was highly explanatory in interpreting the results.

> The variables with the highest explanatory value were perceived behavioral control and habit. Since perceived behavioral control describes the subjective opinion of a person's own resources ability, it may be concluded that non-users experience

> more obstacles than others do. . . . [T]hus, we were able to find that the expanded version of the Theory of Planned Behaviour can advantageously be used in the evaluation of different projects and that it helps to increase our understanding of the best way of motivating road users to select more environmentally friendly modes of transport. (*39*)

The Bamberg/Aizen/Schmidt Study of Mode Change

The role of habit in predicting mode change was explored in some depth by Bamberg et al. (*37*) in an article titled "Choice of Travel Mode in the Theory of Planned Behavior: The Roles of Past Behavior, Habit, and Reasoned Action." The authors undertook a longitudinal study of attitudes of students before and after the implementation of a prepaid bus pass for all students.

> Relying on the theory of planned behavior (Aizen, 1991), a longitudinal study investigated the effects of an intervention—introduction of a pre-paid bus ticket—on increased bus use among college students . . . The intervention was found to influence attitudes toward bus use, *Subjective Norm*s, and perceptions of behavioral control and, consistent with the theory, to affect intentions and behavior in the desired direction. Furthermore, the theory afforded accurate prediction of intention and behavior both before and after the intervention. (*p. 175*)

The authors found that while habit (past use of a mode) was a significant predictor of mode choice prior to the introduction of a prepaid bus pass, the introduction of a prepaid bus ticket was sufficient to "break the habit" and allow students to reassess their mode choice. That is, habit was not a significant predictor of mode choice following the introduction of the prepaid bus pass.

> It is concluded that choice of travel mode is largely a reasoned decision; that this decision can be affected by interventions that produce change in attitudes, subjective norms, and perceptions of behavioral control; and that past travel choice contributes to the prediction of later behavior only if circumstances remain relatively stable. (*p. 175*)

The authors also found that the incorporation of a measure of self-efficacy, which they refer to as perceived behavioral control, helped to provide explanatory power in the study of the prepaid bus ticket. As they approached their examination of change in bus ridership, they posited that the TPB could be extended to this transportation issue.

> The theory of planned behavior has received good empirical support in applications to a wide variety of different domains. . . . However, the study reported in the present article is one of the few attempts to use the theory as a conceptual framework for an intervention to effect change in behavior . . . *According to the theory, it should be possible to influence intentions and behavior by designing an intervention that has significant effects on one or more of the antecedent factors, i.e., on attitudes toward the behavior, subjective norms, and perceptions of behavioral control.* (*p. 176*)

Importantly, the Bamberg et al. article concluded that the theory did indeed help to understand the behavioral implications of the change in attitudes.

> The results of the present investigation demonstrate the utility of the theory of planned behavior as a conceptual framework for the prediction of travel mode choice and for understanding the effects of an intervention on this behavior. Attitude, subjective norm, and perceived behavioral control were found to influence students' intentions to take the bus to the campus, and these intentions in turn permitted quite accurate prediction of reported behavior. (*p. 184*)

The Role of Routine "Habit" in Transportation

A major theme being addressed in the above studies, as well as in others, is the power of habit. To what extent is behavior influenced by reception of new information and new environments, as opposed to the rote repetition of routines that have become habit? Cognitive experts within social psychology have differing viewpoints about the role of habit.

In the study of bus use among university students reported above, Bamberg et al. (*37*) found that choice of travel mode is based more on reason than on habit:

> Only when circumstances remain relatively stable does prior behavior make a significant contribution to the prediction of later action. Complex human behavior is cognitively regulated and, even after numerous enactments, appears to be subject to at least some degree of monitoring. As a result, new information, if relevant and persuasive, can change behavioral, normative and control beliefs; can affect intentions and perceptions of behavioral control; and can influence later behavior. We thus conclude that human social behavior, although it may well contain automatic elements, is based on reason. (*p. 186*)

Others, however, emphasize the difficulty of altering behavior away from established routinized behavior, such as the dependence on the automobile for all tripmaking. The question has been explored in depth by three European cognitive theorists, Aarts, Verplanken and van Knippenberg, whose article "Habit and Information Use in Travel Mode Choice" is widely referenced in reports about the difficulty of decreasing the use of the automobile (*40*). Their article

> . . . focuses on travel mode choice behavior in order to test theoretical propositions as to habitual decision making. In particular, we are interested in the role of habit in information processing underlying daily travel mode choices. Like many behaviors routinely performed in every day life, travel mode decisions are supposed to

> be often made in a rather 'mindless', automatic fashion. . . . In other words, travel behavior is often habitual. (*p. 2*)

The role of habit in mode choice addressed in this article was summed up by Gärling, Gärling, and Loukopoulos in the article titled "Forecasting Psychological Consequences of Car Use Reduction: A Challenge to an Environmental Psychology of Transportation" (*41*). They describe the effect of habit on mode choice as follows:

> The frequent use of cars can be partly attributable to the way in which attitudes, beliefs, and choices work together. Work by Gärling, Fujii, and Boe (2001) and by Verplanken, Aarts, and van Knippenberg (1994) has shown that *attitudes or preferences guide initial deliberate choices of car for the majority of a person's activities, but that eventually these choices become a car habit which is difficult to alter*. That is, positive attitudes toward driving lead to frequent choices to drive that, in turn, lead to automatised driving choice. Indeed, depending on the type of reduction required, habitual trips may not be reduced at all. Gärling, Gillholm, and A. Gärling (1998) claimed that both planned and habitual trips are equally easy or difficult to reduce in a planning phase, but that such *changes in the case of habitual travel would be harder to implement.* (*p. 97*)

In an article titled "Habit versus Planned Behaviour: a Field Experiment," Verplanken et al. (*42*) concluded that the strength of a habit had a powerful impact on the outcomes that would have been predicted by the cognitive models.

> Car use during seven days was predicted from habit strength . . . and antecedents of behaviour as conceptualized in the theory of planned behaviour (attitude, subjective norm, perceived behavioral control and behavioral intention). Both habit measures predicted behaviour in addition to intention and perceived control. Significant habit x intention interactions indicated that intentions were only significantly related to behaviour when habit was weak, whereas no intention-behaviour relation existed when habit was strong. . . . The results demonstrate that, although external incentives may increase the enactment of intentions, *habits set boundary conditions for the applicability of the theory of planned behaviour.* (p. 111)

A Swiss researcher, Sylvia Harms, has examined the tension between those who look at transportation decisions as a cognitive activity and those who see it as the result of a rote activity, dominated by habit. In an article titled "From Routine Choice to Rational Decision Making Between Mobility Alternatives," Harms (*43*) concludes that the TPB is not inconsistent with the incorporation of acts that are seemingly driven by habit. In a series of studies concerning the relationship between habit and rational decision making, Harms has placed the TPB into a larger context of understanding the propensity to change one's transportation (here called mobility). In her model, an individual's own life situation influences mobility requirements and opportunities, and these influence attitudes and perceived behavioral control. The quantitative studies confirmed that people are more vulnerable to new transportation solutions at a time when their personal lifestyle is changing. The study found that habit is indeed the weakest when people's behavioral context has recently changed. When the lifestyle context remains stable, the force of habit is stronger. However, during periods of situational change, the influence of attitude and perceived behavioral control grows in relation to the influence of habit.

The quantitative finding was consistent with earlier observations about the personal context of individuals who had selected to join car-sharing groups. Harms documents that many who changed their transportation behavior did so because of a change in their personal situation, not in response to some new information about the alternative. In an observation that could have significant implications for this project, Harms noted the following:

> [A]bout 85% of those people who owned a private car before becoming a car-sharing member reported on significant changes in their personal life situation when being asked about their motivation to join a car-sharing organisation. Only in the second place, the attractiveness of certain product attributes like environmental friendliness or low car-use costs were mentioned. The reported changes referred to a new working place, moving the own house, the breakdown of the own car or other things that significantly influenced the private mobility context and the availability and/or usefulness of an own car. (*p. 7*)

Harms' conclusions could be relevant to the selection of key market segments for this study.

> If routines indeed impose cognitive barriers to information perception and attitude formation . . . marketing efforts for innovative mobility concepts should be adjusted to this phenomenon: They should be bundled in moments where routines are the weakest and people are most open to conscious, rational decision-making, i.e., in moments of important context changes (e.g. moving, changing the job). (*p. 25*)

As the result of the quantitative research to confirm (or disprove) earlier hypotheses concerning the dominance of the force of habit, Harms concluded that the general structure of the TPB was not inconsistent with the implications of a serious role for habit. At the same time, Harms points out how the subject becomes more vulnerable to incoming information when the "behavioral context" is upset or changed.

> [But] under changed context conditions this shortcut doesn't work anymore and the earlier cognitive elements are consciously activated again and adapted to the new situation. . . . *Even rational decision-making approaches like the theory of planned behaviour allow attitudes and control beliefs to be retrieved from memory, without being consciously constructed again each time a similar decision is made.* (*p. 9*)

Environmental Values in the Context of the TPB

A question for this project is whether environmental values have an impact on intentions and behavior related to choosing a CN or choosing to walk or take public transportation. The evidence for relationships among components of the TPB in the context of environmental behavior is provided in a comprehensive review by Kaiser et al. (*44*). It was found that if only the relationship between environmental attitude and behavior was examined, then the "relationships appear to be at best moderate across different studies." The literature also indicates that the relationship between values and intention ranges from weak to strong, and that if it is between values and behavior the relationship is less strong. Kaiser et al. found that "the most striking effect" is between intention and behavior; "ecological behavior intention is strongly related to ecological behavior or at worst moderately related." They note, however, that the strength of the relationship may vary in different environmental behavior contexts. The authors conducted a survey of members of two Swiss transportation organizations with different ideologies. They found that "environmental knowledge and environmental values explained 40% of the variance of ecological behavior intentions which, in turn, predicted 75% of the variance of general ecological behavior."

Swensen and Wells (*45*) reviewed the literature on the relationships between demographic characteristics, personality traits, environmental attitudes, and environmental behavior. They reported that past studies indicate that "demographic and personality characteristics correlated with pro-environmental attitudes in one investigation failed to correlate with pro-environmental attitudes in others" and that "attitudes that predicted pro-environmental behavior in one study failed in replications." (*p. 91*)

Swensen and Wells conduct their own analysis using data from national consumer surveys from the early 1990s. The results indicate that "pro-environmental behavior is correlated with some major demographic variables (education, income, and community size) and with concern for the environment, cosmopolitanism, liberalism, frugality, planfulness, community involvement, health concerns, perceptions of financial distress, and dissatisfaction with life" (*p. 91*). They conclude that their results, "without negating the value of aspect-specific investigations," show that "the general concept of pro-environmental behavior is strong enough and consistent enough to provide valuable guidance to theoretical and practical work" (*p. 104*).

Conclusions from the Literature on the TPB

The extensive use of the TPB as a model for understanding behavior in the health field, plus many examples in the transportation field, indicated that it will be a worthy tool for exploration in this project. Some key lessons from the literature review include the following:

- If intent and perceived behavioral control (self-confidence) can be changed, it is likely that behavior can also be changed.
- The opportunity for mode change increases when other lifestyle changes are occurring, such as a change in job or residence.
- Although mode choice is often habitual, interventions can succeed in changing mode choice. However, the habit of driving is difficult to break.
- Although the relationship between environmental values and behavior varies, it will be worthwhile to measure environmental values and their relationship to mode and location decisions.

CHAPTER 4

The Model of the Theory of Planned Behavior

Chapter 3 described background literature for the TPB. This chapter describes the TPB model itself. Guidance on the structure and use of the TPB can be found at Icek Aizen's website (*46*).

The TPB is illustrated in Figure 4-1. This model, which comes from the field of psychology, holds that human action is guided by three types of considerations:

- Attitude toward the behavior (ATT)—refers to an individual's own evaluation of an action, such as riding transit. This is also called *attitude*.
- Subjective norm (SN)—refers to an individual's perception of what others will think if he/she takes an action (e.g., what friends and parents will think if he/she rides transit).
- Perceived behavioral control (PBC) or SCF—refers to an individual's assessment of his/her own ability to take an action (e.g., his/her self-confidence in using transit).

ATT, SN, and SCF all contribute to an individual's intent to carry out a behavior. Whether an individual actually carries out the intent depends also on his or her SCF in carrying out the behavior. For each individual, these three considerations will have different importance or weighting depending on the behavior or action. For example, young teens, as compared with older adults, may be more influenced by the opinions of their peers in a decision to take transit.

This research also focuses on two additional areas of input to the TPB model that the literature review shows to be relevant to residential choice and mode choice. These are *(a)* life-cycle stage and *(b)* the environment and services available. Life-cycle changes—leaving home for the first time, getting married, having children, having an empty nest, and so forth—will have a great impact on an individual's attitudes about choice of residence. Life-cycle stage also can be expected to have an impact on an individual's subjective norm (for example, "what my parents expect will influence when I have children"). The environment and services available will affect SCF (e.g., transit has to exist for me to be able to take it). Figure 4-2 shows this extended model of the TPB.

Direct measurement of the different constructs of the TPB can be done by asking respondents to provide ratings on a set of scales. The scales will vary depending on the behaviors being investigated.

For example, **intent** can be measured by a set of scales such as the following:

I intend to move to a compact neighborhood in the next 2 years.

Strongly disagree: _1_:_2_:_3_:_4_:_5_:_6_:_7_: Strongly agree

I will make an effort to move to a compact neighborhood in the next 2 years.

Definitely false: _1_:_2_:_3_:_4_:_5_:_6_:_7_: Definitely true

I plan to move to a compact neighborhood in the next 2 years.

Extremely unlikely: _1_:_2_:_3_:_4_:_5_:_6_:_7_: Extremely likely

Attitude can be measured by a set of scales that should capture both the experiential quality of a behavior and the judgment of the value of the behavior. For example, ATT can be measured by responses to the following statements:

For me to move to a compact neighborhood in the next 2 years would be

Extremely undesirable: _1_:_2_:_3_:_4_:_5_:_6_:_7_: Extremely desirable

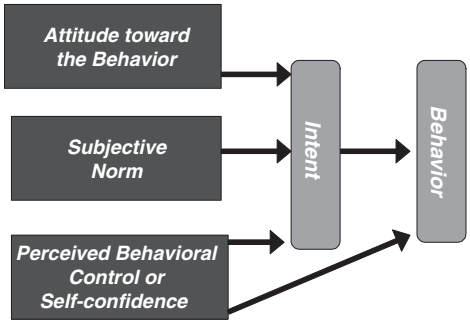


Figure 4-1. The theory of planned behavior.

For me to move to a compact neighborhood in the next 2 years would be

Extremely unpleasant: 1 : 2 : 3 : 4 : 5 : 6 : 7 : Extremely pleasant

For me to move to a compact neighborhood in the next 2 years would be

Boring: 1 : 2 : 3 : 4 : 5 : 6 : 7 : Interesting

Subjective norm can be measured with a set of questions that not only measures what others think about a behavior, but also what others do themselves. For example, SN can be measured with the following:

Most of the people who are important to me live in, or would like to live in, a compact neighborhood.

Definitely false : 1 : 2 : 3 : 4 : 5 : 6 : 7 : Definitely true

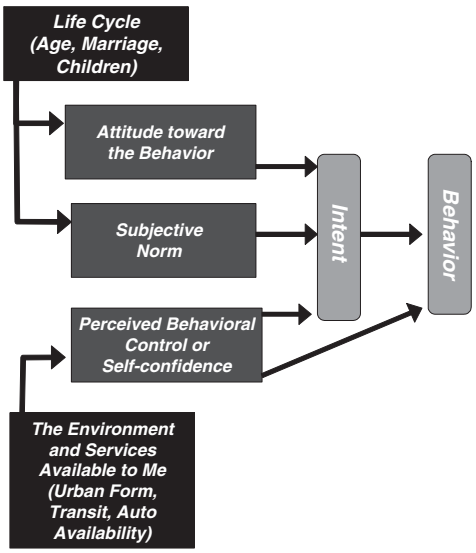


Figure 4-2. The extended model of the TPB.

Most people whose opinions I value would approve of my moving to a compact neighborhood in the next 2 years.

Definitely false : 1 : 2 : 3 : 4 : 5 : 6 : 7 : Definitely true

It is expected of me that I move to a compact neighborhood in the next 2 years.

Strongly disagree : 1 : 2 : 3 : 4 : 5 : 6 : 7 : Strongly agree

Self-confidence can be measured with statements that reflect respondents' confidence in themselves in performing an action. The statements can reflect the difficulty of performance or the likelihood that a respondent will be successful in performing a certain behavior. Other statements can reflect the degree to which the respondent has control over the situation in question. The following are examples of statements that may be used to measure SCF:

Whether or not I move to a compact neighborhood in the next 2 years is completely up to me.

Strongly disagree : 1 : 2 : 3 : 4 : 5 : 6 : 7 : Strongly agree

I am confident that if I wanted to, I could move to a compact neighborhood in the next 2 years

Definitely false : 1 : 2 : 3 : 4 : 5 : 6 : 7 : Definitely true

For me to move to a compact neighborhood in the next 2 years would be

Impossible : 1 : 2 : 3 : 4 : 5 : 6 : 7 : Possible

In the fully specified TPB model, as explained by Aizen, each of the three psychological components (ATT, SN, and SCF) is potentially driven by a set of factors that may be thought of as a composite of belief and the relevance of the belief to the individual. Relevance means *outcome evaluation* when applied to ATT, *motivation to comply* when applied to SN, and *power of control* when applied to SCF. Each factor can be represented as the product of belief and its relevance. The sum of the factors represents indirect measures of ATT, SN, and SCF.

The sum of the products of behavioral beliefs and outcome evaluations is an indirect measure of ATT. The behavioral belief represents an individual's assessment of how likely an outcome is given a particular behavior. The outcome evaluation is the individual's assessment of the desirability or undesirability of this outcome. Typically these are measured on a seven-point scale.

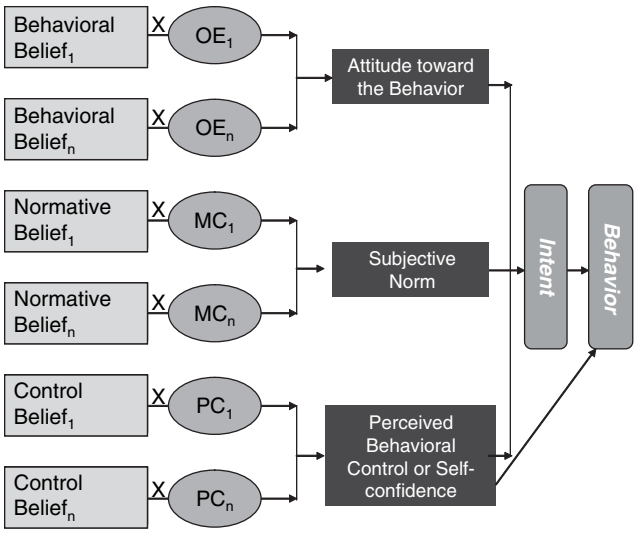
For example, if the behavior being considered is a move to a CN, then an example of a *behavioral belief* would be "If I move to a compact neighborhood, I will exercise by walking and bicycling." This can be measured using a scale labeled disagree/agree or unlikely/likely. An example of an *outcome evaluation* would be "For me, living in a neighborhood where I could exercise by walking and bicycling would be (undesirable/desirable)." Moving to a compact neighborhood is the behavior, and exercising by walking and bicycling is the outcome.

The sum of the products of normative beliefs and motivation to comply is an indirect measure of SN. The normative belief represents the individual's belief regarding some other person or group's opinion of a particular behavior. The motivation to comply is the degree to which the individual cares about that opinion.

An example of a *normative belief* would be "My family thinks I should move to a compact neighborhood" (typically measured using a scale ranging from "unlikely" to "likely"). An example of a *motivation to comply* would be the answer to the question, "How much do you care what your family thinks?" (measured on a scale ranging from "not at all" to "very much").

The sum of the products of control beliefs and power of control is an indirect measure of SCF. The control belief is an individual's assessment of his/her ability to perform an action related to a particular behavior, whereas the power of control is the individual's assessment of the importance of that component in allowing him/her to execute a behavior. An example of a *control belief* would be the answer to the question, "How likely is it that you could find an affordable home in a compact neighborhood?" The response would typically be measured on a scale labeled unlikely/likely. An example of a *power of control* would be "It would be easier for me to move to a compact neighborhood if I could find an affordable home there," with the response typically measured on a scale labeled agree/disagree.

Figure 4-3 shows the full TPB model. The TPB can be used in several ways to illuminate how individuals make decisions. First, it provides a framework for better understanding of the decision-making process, for example, examining how individuals choose mode or residence depending on their attitudes, what they say others think, and their circumstances that can be expected to affect their SCF (e.g., how close they live to transit or how easy it is to walk).



OE: *outcome evaluation*
MC: *motivation to comply*
PC: *power of control*

Figure 4-3. The fully specified theory of planned behavior.

Second, the TPB provides a general model to explore a particular decision (such as moving to a CN) by posing a set of rating questions to a group of respondents. That is, ask a large number of questions that might be related to a decision to move to a CN and then explore how the responses relate to ATT, SN, SCF, and intent.

Third, the TPB provides a specific model that explicitly relates indirect measures of beliefs and indirect measures of the relevance of beliefs to direct measures of ATT, SN, and SCF. The research makes use of the TPB as a framework, as a general model, and as a specific model.

CHAPTER 5

Research Approach

This chapter summarizes the approach taken in this research project. The research was divided into two phases that emphasize different parts of the overall objectives. The focus in Phase 1 was on the choice of residence, whereas in Phase 2 the focus was on choice of mode. However, as will be seen, Phase 1 itself already provides much insight into the decision as to which mode to take. Figure 5-1 shows the overall flow of the research, along with the research objectives being explored at each step. The steps shown in Figure 5-1 can be described as follows:

- **Experts** and the **literature** provided input to analysis techniques and considerations for choice of neighborhood and mode.
- Phase 1
  - **Focus groups** considered the pros and cons of CNs, transit, and walking, as well as the concepts of the TPB.
  - An Internet **panel** provided data on neighborhood and mode choice, motivating factors, and the Phase 1 TPB model for neighborhood choice.
  - **Analysis** provided information on the relationship between neighborhood type, walking, and transit use; childhood and social influences; and key issues and market segments for CNs.
- Phase 2
  - **Focus groups** evaluated messages and alternatives that could lead to increased use of transit and walking.
  - An Internet **panel** provided data for TPB exercises before and after exposure to the messages and alternatives encouraging transit.
  - **Analysis** and the TPB provided information on key issues and market segments for increasing walking and transit use.

In addition to the research discussed in the literature review section of this report, this project received guidance from experts in the field who generously offered their time to talk to the research team. Interviews were conducted with the following individuals (a summary of the interviews is included in Appendix A):

- Icek Aizen, Professor and Department Head of the Division of Personality and Social Psychology, University of Massachusetts at Amherst
- Kay Axhausen, Professor at the ETH University in Zurich Switzerland
- Albert Bandara, Professor of Social Science in Psychology, Stanford University
- Werner Brog, Managing and Scientific Director of Socialdata, Institute for Transport and Infrastructure Research
- Lawrence Frank, Associate Professor, J. Armand Bombardier Chair in Sustainable Transportation Systems for the University of British Columbia
- Susan Handy, Associate Professor, Department of Environmental Science and the Institute of Transportation Studies at the University of California at Davis
- Pat Mokhtarian, Associate Director of the Institute of Transportation Studies and Professor of Civil and Environmental Engineering at the University of California at Davis
- James Sallis, Professor at San Diego State University and Director of the Active Living Policy and Environmental Studies Program

Both phases of the research included a set of focus groups and a larger survey using an Internet survey panel. The focus groups were selected to match with what are thought to be the main market segments interested in living in a CN. In each phase there were both a group of younger people (in their 20s) and a group of older people (ages 55-plus). The focus groups were held in Silver Spring, Maryland, (both phases) and Portland, Oregon, (Phase 2). The locations were selected

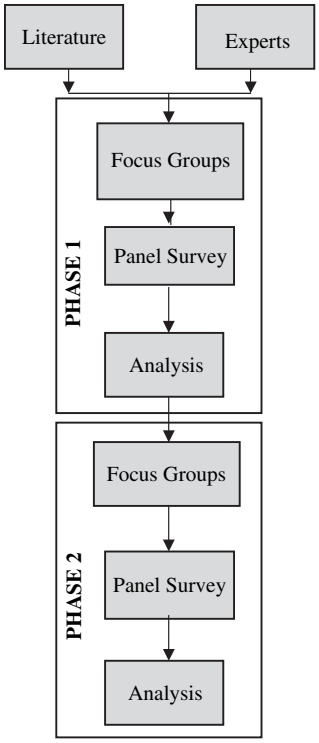


Figure 5-1. Research approach.

partly because each region had excellent public transportation, as well as many examples of CNs.

Both Internet surveys made use of the Resource Systems Group's 40,000-person Internet Survey Cafe panel as a source of panelists. The Survey Cafe panel includes households that have been recruited from transportation intercept and other surveys conducted by the Resource Systems Group throughout the U.S. The panel has good geographic representation and provides high response rates compared with other similar panels. A particular advantage of the Internet panel is that each of the questions presented must be answered for the panelist to complete the survey. The high response rate results from the commitment made to participants—sharing results where possible and providing tangible incentives for participation (a choice of specialty Vermont dessert products, such as Ben & Jerry's ice cream, Green Mountain Coffee Roasters specialty coffees, and Vermont maple syrup, with a value of approximately $7/survey). The participants are, overall, geographically representative of the U.S. population by state and, although the age distribution includes fewer of those who are 65-plus, otherwise reasonably representative of the U.S. age distribution (*47*).

To ensure an adequate number of transit users in the Internet panel, members of New Jersey Transit's e-panel were also included in the sample. The NJ Transit e-panel members were recruited through intercept sampling on the transit agency's rail lines. The e-panel members thus are all individuals who have used rail at least once; many are commuters who regularly travel from New Jersey to Manhattan during peak periods, while others are only very occasional (or one-time) rail passengers. The e-panel members are quite representative of NJ Transit's rail passengers.

Phase 1 Survey: Choice of Residence

Phase 1 Focus Groups

Phase 1 began with focus groups, followed by an Internet panel survey. Two focus groups—one of people under 30 and one of people ages 55 and over—were held in Silver Spring in July 2004. The group discussion centered on their choice of place to live, their use of transit, and their memories of neighborhoods and transit use from their childhoods. The groups were asked to give their reactions to pictures of CNs. The focus group participants filled out questionnaires that asked about their thoughts on the advantages and disadvantages of CNs, who influenced their decision making, and what factors would allow them to move to, or would keep them from moving to, a CN. The questionnaire and the general discussion topics were designed to get at the variables of the TPB.

The group members had differing racial and ethnic backgrounds, educational backgrounds, exposure to urban living, and experience in using transit. Responses from the groups helped to define the types of considerations that individuals have in a decision about moving to a CN or in using transit. Some of the responses are paraphrased in Table 5-1.

The focus groups indicated that the following attributes of CNs would affect individual attitudes toward moving to a CN.

- Having shopping and restaurants within walking distance
- Being close and making friends with neighbors
- Having public transportation nearby
- Being able to live with one less car
- Noisy conditions
- Lack of space
- Problems parking
- Crime
- Difficulty raising children

In terms of who might influence a move to a CN, focus group members indicated that family and friends would have the most effect on their decision.

In addition, the focus groups listed several conditions that would affect their self-confidence about moving to a CN, including the following:

- Cost of housing
- Needing a car

Table 5-1. Phase 1 focus group discussion—selected items.

Topic/Model Consideration	Responses
Conditions that have changed in my personal life (from a discussion of why a respondent moved)	The kids are grown so we didn't need as much space.
	I moved because my job moved.
	I moved because my job moved and I wanted to be near transit.
	I moved for more affordability even with a longer commute.
The environment and services available to me (from a discussion of transit and walking)	Public transit just isn't an option where I live.
	There are no sidewalks for half a mile.
	I have a bus nearby and I can walk to the Metro.
	I take the Metro when I'm going drinking.
Attitude (impressions of a compact neighborhood, advantages and disadvantages)	Easy commute to work
	Public transit at your front door
	Everything is within the community
	Places to walk to
	One less car
	Easy to shop and eat in the neighborhood
	People close enough to be social with
	Active night life
	There would be young people like me
	Too close to neighbors
	Noise
	Difficult to raise kids
	Crowded
	No space for parking
	Lack of space
	High cost of living
	Safety concerns
	I think I could give up my car, and I would enjoy that.
Subjective norm (opinions of friends and family)	I could live in a compact neighborhood, but my wife wouldn't want to.
	My father from NYC thinks I'm crazy to move to the suburbs.
Self-confidence (what would make it easier or more difficult to move to a compact neighborhood)	Easier to move if it were affordable
	Easier to move if I didn't need my car
	Easier to move if I didn't have so much stuff
	Difficult to move if I have to leave my friends/roots

- Having to leave friends
- Needing space

Phase 1 Internet Panel Survey

Questionnaire Design

After the focus groups were conducted, a questionnaire was developed for the Internet panel survey. The content of the section on the TPB was based largely on the responses from the focus groups, as well as on the literature review and the researchers' expertise. This Internet panel survey was a retrospective survey in that it asked about the respondents' childhood experiences and about their move to their current residence, as well as their current attitudes and beliefs. A copy of the questionnaire is included in Appendix B.

One section of the questionnaire was structured to ask questions that related to the TPB model. In that section, a CN was described as follows:

> We are also interested in your thoughts and opinions about moving to a particular type of neighborhood. The neighborhood

has good sidewalks, a mix of housing types (including a mix of townhouses, apartments, condos, and single family dwelling s on quarter-acre lots), shopping or restaurants within walking distance, and nearby public transit. You would be able to take public transit to work or to shop, and you would be able to walk, bike or drive to nearby shops, restaurants, pubs, and a library, but parking would be limited. You would be close to cultural events and entertainment. The neighborhood would be as safe as where you live today. Parking near your home would be limited to one car per household or street parking or you could rent a garage space. In this survey, we will call this a *compact neighborhood*.

Respondents were asked many questions about the CN, including their attitude toward various characteristics of such a neighborhood, the attitude of their family and friends toward such a neighborhood, and the respondents' ability and intention to move to a CN.

The questionnaire focused on choice of residential location, but also asked many questions about mode choice. Table 5-2 provides a description of each of the questionnaire sections, along with the research objectives explored in each section.

Sample Selection

Invitations to participate in the Phase 1 survey were sent to *(a)* a random selection of Survey Cafe panelists in 11 large metropolitan areas with good transit systems and *(b)* a random selection of panelists on the NJ Transit e-panel. Panelists in two key age-groups (ages 21-30 and 55-plus) were oversampled at a rate of three times their incidence in the Survey Cafe.

To be included in the Phase 1 survey, panelists must either have moved within the past 2 years or be contemplating a move within the next 2 years. The reason for this criterion was to be sure the survey group included those for whom the decision to move was relevant or who had recently contemplated the trade-offs involved in choosing a neighborhood. This follows the thinking of the research reported by Harms (*43*), in which she notes that mobility choices are likely to change when other large changes occur, such as a change in residential location. The initial question asked of the panelists was as follows:

Which of the following best describes you?

1. I moved to a different address within the past 2 years.
2. I am considering a move within the next 2 years.
3. None of the above.

To be accepted as a respondent to the survey, the panelist must have selected either the first or second response to that question.

The plan for the Phase 1 survey was to get 800 respondents, and indeed there were 865 who participated. Of the total sample, 639 were selected from the Survey Cafe panel of 40,000 Internet respondents, and 226 were drawn from NJ Transit's research panel. The number of respondents was determined by budget and by the desire to ensure adequate group size for market segmentation purposes. The survey was specifically designed to oversample groups with proximity to good public transportation and was not meant to represent any kind of national random sampling. Oversampling in the younger age-group was successful in that there were 350 respondents from that group. Oversampling in the older age-group was less successful—there were 89 respondents. The screening question that asks whether they had moved or were contemplating moving seemed to negate the effect of the oversampling in the older group. The net overall response rate is estimated at 42%, based on the incidence rate for those who have moved within the past 2 years and accounting for undeliverable email invitations.

The Internet panel survey was conducted in December 2004.

Phase 1 Analysis Plan

The analysis plan for Phase 1 consisted of the following four main steps:

1. Examine the results of the survey, by a priori market sectors of age and e-panel (Survey Cafe and NJ Transit). *Purpose:* Explore the characteristics of market sectors that are more likely to be favorable to an urban residential environment, particularly an environment characterized as a CN.
2. Examine the results of the survey by market segmentation based on attitudes. *Purpose:* Explore the characteristics of market sectors that are more likely to be favorable to an urban residential environment, particularly an environment characterized as a CN.
3. Examine the relationship between urban form and mode choice. *Purpose:* Explore the propensity for increased use of transit and walking with a change in neighborhood type.
4. Examine the responses to the TPB-related questions in Phase 1 to test whether the ATT, SN, and SCF were able to predict intent and whether the measured beliefs were relevant to an individual's ATT, SN or SCF. *Purpose:* Explore the TPB as an approach to understanding how individuals make travel and location decisions. In particular, explore the TPB in the context of a decision to move to a CN.

The findings from the Phase 1 panel are discussed in Chapters 6, 7, and 8 of this report.

Table 5-2. Phase 1 panel survey questionnaire contents and research objectives.

Questionnaire Section	Research Objective
Section 1: Why respondents moved and why they chose their current home location.	Provide information to distinguish the market sectors that are more likely to be favorable to an urban residential environment.
Section 2: Nature and transit friendliness of the current neighborhood. This section defines the characteristics of the respondents' current neighborhoods and whether a respondent lives in a compact neighborhood.	
Section 3: Characteristics of the current neighborhood. The respondents use a seven-point rating scale to indicate whether their neighborhood has particular characteristics (disagree/agree).	
Section 4: Current type of transportation for various trip purposes. This section includes explicit questions about the frequency of public transit use and walking.	Provide information used to examine the propensity to increase use of transit and walking with a change in neighborhood type (provides information for cross-sectional comparison).
Section 5: Attitudes toward current home location. The respondents use a seven-point rating scale to indicate the importance of particular neighborhood characteristics.	Provide information to distinguish attitudes of market sectors that are more likely to be favorable to an urban residential environment.
Section 6: Questions about childhood home and transportation. This section asks about the character of the childhood home and the transportation modes used, as well as asks about memories of the neighborhood and of their parents' attitudes toward the environment and public transportation.	Provide information on motivating factors from childhood.
Section 7: Questions to elicit the variables for the TPB (TPB-1 to distinguish it from Phase 2 exercises). This is a complex section that asks respondents to provide ratings for the range of TPB variables. These include intent, ATT, SN, SCF, behavioral beliefs, control beliefs, normative beliefs, outcome evaluations, power of control, and motivation to comply.	Provide information to explore the TPB in the context of a decision to move to a compact neighborhood, to distinguish favorable market sectors, and provide insight into motivating factors.
Section 8: Other values that may impact transportation mode and home location choice. These include attitudes toward the environment, exercise, and driving.	Provide information to distinguish motivating factors of market sectors that are more likely to be favorable to an urban residential environment.
Section 9: Friends and family values. These are similar to the values in Section 8.	
Section 10: Conjoint exercise. This section asks respondents to choose from among three neighborhoods with varying features, including type of home/lot, proximity to local destinations, home location parking, distance to public transportation, street design, one-way commute to work, and home price (or rental price). One of the choices is always a neighborhood like their current neighborhood.	

Phase 2 Survey: Choice of Mode

Phase 2 Focus Groups

As in Phase 1, Phase 2 started with a series of focus groups to qualitatively explore the concepts that would be the subject of a more in-depth Internet panel survey. There were four focus groups, two in Portland, Oregon, and two in Silver Spring, Maryland. In each location, one group consisted of young people (in their 20s), and one group consisted of older people (ages 55-plus). The focus groups did the following:

- Explored briefly the concept of a compact community and obtained participant reactions to it.
- Discussed how participants would travel in a compact community.
- Discussed transportation options that might encourage people to walk and take transit more. These transportation options included excellent rail transit, a community shuttle, a taxi-like dial-a-ride service, a smart card for fare payment, a smart phone that provided real-time transit information, and car-sharing arrangements.
- Discussed messages that might encourage more walking and transit use. The messages were that transit could save money, help the environment, improve health by encouraging more walking, and reduce our dependence on foreign oil. The messages are shown in Figure 5-2.

The focus group companies did an excellent job of attracting a good number of urban-oriented participants. Many lived in CNs, and there were many transit users.

Message 1: Using transit and walking more can save you money.

The cost of a transit pass is small compared with the cost of an automobile. Public transportation trips in Portland will cost you $62 for a monthly pass that lets you travel anywhere on TriMet. For a year, this will cost you $744. The average cost of an automobile per year in the US is $8431 (in 2004), according to the American Automobile Association.

You can get a mortgage that costs you less if you take public transportation. To be eligible, you must select a home within half a mile of a MAX (light rail) station or a quarter mile of a bus stop, and have no more than two cars. Just promise to leave one car at home and use public transit instead of driving, and you could have your transportation savings added to your qualifying income. That could mean more buying power and more home for your money! As an extra incentive, qualified buyers receive free TriMet passes or tickets for 3 months.

You can buy a transit pass with before-tax dollars. Your employer can sell you a transit pass that is paid for before taxes. For example if your employer lets you purchase, through a payroll deduction, a monthly pass that lets you travel anywhere by transit in the Portland area, this pass will cost you around $484 dollars a year. This same pass purchased from the transit agency in after-tax dollars will cost you $744 a year. This is because you save on federal, state, FICA, and unemployment taxes.

Message 2: Using transit and walking more can improve your health.

Our nation is suffering from an obesity epidemic. In Oregon, more than one out of five adults is now considered obese. Obesity is a key risk in heart attacks, strokes and cancer according to National Cancer Association and the Centers for Disease Control. Medical costs that can be attributed to obesity are well over 25 billion dollars per year.

Our lifestyles are part of the reason. Because of all of our labor-saving devices, especially the automobile, we are expending less energy than we did just a decade ago. In addition, experts are finding that many of us cannot or do not make time for exercise. The result is that many of us are gaining weight slowly year in and year out.

Walking or taking transit as part of our normal daily routine can help. Walking to work, or to a bus or MAX stop, provides a built-in opportunity for exercise. In addition, walking to work or to do errands is a great way to meet the daily exercise recommendations of a half hour to an hour each day of physical activity.

Message 3: Using transit and walking more can help the environment.

The United States has made substantial progress in cleaning up our air by improved technology for manufacturing, utilities and cars. Unfortunately, we have been using our cars more and more, so we are offsetting the good done by the emission controls on our cars.

Communities can reduce air pollution generated locally if residents reduce the number and length of their car trips. Substituting walking trips or a combination of walk and transit trips is therefore a great way to help the environment.

Message 4: Using transit and walking more can help reduce our dependence on foreign oil.

The United States is in a vulnerable position with regard to our dependence on foreign oil. Currently, we import around 60% of our oil. If current trends continue, the United States could be importing 70% of our oil from foreign sources by 2020. Many of us have only faint memories of the oil crises and gas lines in the 1970s, but we are now even more vulnerable than we were then.

While each citizen can't solve the crisis alone, we can help. If we can substitute walking to work or taking transit to work on most days, we reduce our use of automobiles and gasoline. That helps each of us personally since we have to pump and pay for less gas. Overall, with many people joining in the effort to conserve, it helps our country.

Figure 5-2. Focus group messages (Portland, Oregon, example).

Observations from the Phase 2 focus groups can be summarized as follows.

- All groups had some difficulty with the concept of responding as if they were in an imaginary neighborhood. Instead, they mostly responded from their current experience. Given this observation, the approach was changed for the Internet survey so that questions about mode choice were not based on an imaginary neighborhood.
- There were interesting differences between the older and younger groups. In particular, the older group in Portland loved the concept of a "neighborhood circulator bus," while the younger group thought the concept was only for older people. Similar sentiments were expressed by the groups in Silver Spring.
- In Portland, several in the older group acknowledged that they were fairly dependent on their cars. They thought that the younger generation was more enthusiastic about using transit. Indeed, the younger generation did seem to be quite comfortable with using transit. The Portland groups expressed a high level of concern about environmental issues.
- In Silver Spring, several in the older group were unsure whether they would "fit in" in a compact community. They thought such a neighborhood would be more for a younger generation.
- There were mixed reactions to most of the transportation options. The shared-taxi concept was not, in general, viewed favorably, as participants had difficulty with the idea of sharing a taxi.
- Most of the groups thought that the smart card option should be a pay-as-you-go system. They did not like the idea of receiving a bill at the end of the month. Their concern was the need to keep costs under control.
- Most of the groups were negative about the concept of a phone-based customer information system. The older group in Portland thought the concept sounded too complicated, others didn't want a second phone, and still others thought the system would be too expensive. Given this finding, it was decided to stress to the Internet panel that the system would be accessed from an individual's own cell phone, to obviate concerns about needing to carry two phones.
- Car sharing was understood better by the younger groups than by the older groups.
- The groups had mixed reactions to most of the messages. While many thought the message about cost was compelling, they did not believe the AAA average car costs, which were included in the message about saving money. Many liked the message about helping the environment, but only the younger group in Portland was truly enthusiastic; they suggested ways to improve the message. The health message offended those participants who were obese, while others thought it was an acceptable message. There was a strong negative reaction to the foreign oil message. As a result of this observation, the foreign oil message was eliminated and the AAA statistic on yearly average car costs was removed from the follow-up Internet survey.

The participants also filled out a questionnaire that focused on the TPB questions about walking and using transit more and driving less. An analysis of the results of that questionnaire yielded the responses shown in Table 5-3.

Phase 2 Internet Panel Survey

Questionnaire Design

After the focus groups were conducted, the Phase 2 Internet panel questionnaire was constructed with three clearly definable parts, as shown in Figure 5-3. First, a "pre-intervention" application of the full TPB was undertaken to determine the participants' intention to change their personal transportation patterns. Second, an "intervention" was undertaken in which the respondents were exposed to different messages and then to seven separate potential strategies/services that might improve the marketability of the alternative transportation concepts. Finally, another application of the TPB was undertaken to allow the documentation of any shift that might have occurred as a result of the messages or the alternatives. A copy of the questionnaire is included in Appendix B.

The questionnaire was constructed of seven sections. Table 5-4 describes the sections and their relationship to the project objectives. The messages used in the survey are shown in Figure 5-4, and the alternatives are shown in Figure 5-5. The participants were randomly divided into three groups: two of the groups were exposed to one of two messages, and the third group (the control group) was not exposed to any message.

Sample Selection

The Phase 2 Internet survey took place in October 2005. The respondents to the first Internet survey were invited to participate. In all, 380 respondents from the Phase 1 survey answered the Phase 2 survey. Additional Survey Cafe respondents from the original set of metropolitan areas were then invited to participate, until the number of respondents reached 500. The final number of respondents to the Phase 2 survey was 501. In total, 44% of those who completed the Phase 1 survey also completed the Phase 2 survey. The attrition from Phase 1 to Phase 2 likely reflects the length of the survey, the amount of elapsed time between survey waves, and the fact that the population being sampled was, by design, mobile and likely to have moved over that period.

Table 5-3. Questionnaire responses from the Phase 2 focus groups.

Topic/Model Consideration	Responses (Number of Mentions)
Advantages of making more trips by walking and by public transportation, and fewer trips by private car.	Exercise (30)
	Environment (28)
	Money (26)
	Convenience (15)
	Sociability (8)
Disadvantages of making more trips by walking and public transportation, and fewer trips by private car.	Inconvenience (25)
	Time (24)
	Privacy (8)
	Destination (7)
	Cargo (5)
Factors or circumstances that make it easier for you to make more trips by walking and public transportation, and fewer trips by private car?	Proximity (24)
	Money (15)
	Convenience (13)
	Improvement (10)
	Lifestyle (9)
Factors or circumstances that make it more difficult or impossible for you to change the way that you travel?	Time (21)
	Lifestyle (14)
	Destination (12)
	Automobile (6)

Phase 2 Analysis Plan

The analysis plan for Phase 2 is similar to that for Phase 1, but it also includes a comparison of the results of the two Phase 2 TPB exercises, one that happened before the exposure to messages and alternatives, and one that happened afterwards. The analysis plan for Phase 2 consisted of the following four steps:

1. Examine the raw results of the survey. Examine the results after exposure to messages by the groups divided by mes-

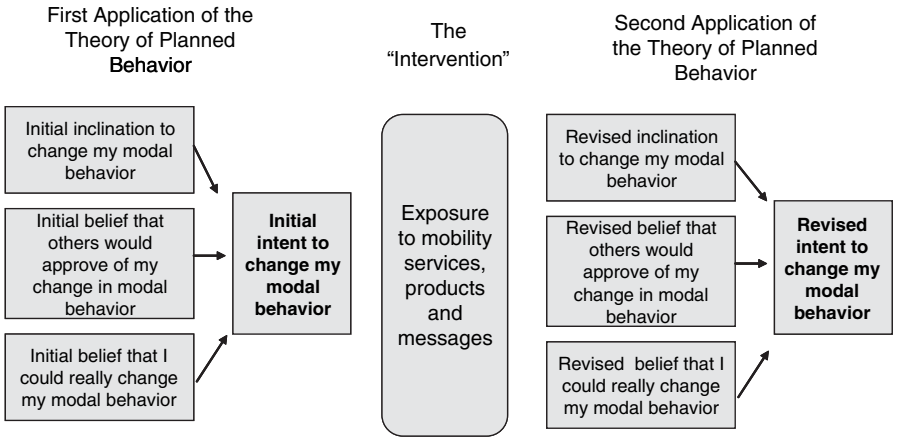


Figure 5-3. Structure of the Phase 2 Internet panel survey questionnaire.

Table 5-4. Phase 2 Internet panel survey questionnaire and project objectives.

Questionnaire Section	Project Objective
Section 1: Key respondent demographic variables. Verify variables that define the neighborhood and the demographics, such as type of residence, distance to transit, commercial districts and work, auto ownership, and number of children.	Provides information that is used to explore the characteristics of market sectors that are more likely to be favorable to an urban residential environment, particularly a compact neighborhood. It also provides data to recheck key information for comparison with Phase 1 results.
Section 2: Initial TPB ratings. Request rating information on statements designed to elicit respondents' intentions toward walking and taking public transportation more and driving less.	Provides information that is used to explore the TPB as an approach to understanding intentions to use environmentally friendly modes, such as walking and transit, and to examine the power of the TPB to distinguish market sectors and provide insight into motivating factors.
Section 3: Follow-up questions about neighborhood preference. Ask again about respondent's preferences for compact neighborhoods.	Provides information that is used to explore the characteristics of market sectors that are more likely to be favorable to an urban residential environment, particularly an environment characterized as a compact neighborhood.
Section 4: The messages. Present the pro-transit messages to the respondents and ask for their reactions. The messages stress that transit can save money and that transit helps improve the environment and public health. The third group was treated as a control and received no message. The messages are shown in Figure 5-4.	Provides information that is used to explore methods for encouraging more walking and transit use.
Section 5: Alternative transportation concepts. Present seven alternative transportation concepts. Ask respondents if they currently have access to similar options and what their preferences are for them. The alternative transportation concepts are shown in Figure 5-5.	
Section 6: TPB ratings, revised. Request TPB rating information on statements designed to elicit respondents' intentions toward walking and taking public transportation more and driving less *given they have access to the seven alternative transportation concepts.*	Provides information useful in exploring the TPB as an approach to understanding intentions to use environmentally friendly modes, such as walking and transit, and in examining the power of the TPB to distinguish market sectors and provide insight into motivating factors.
Section 7: Additional demographics.	Provides information to explore the characteristics of market sectors that are more likely to be favorable to a compact neighborhood.

Message 1: Using transit and walking will save money.

The cost of a transit fare is small compared with the cost of an automobile, and you can deduct the cost of a pass from your taxes. Thus substituting transit and walk trips for auto trips will help save you money.

One of the best features about taking public transportation is that it is an inexpensive way to travel. If you travel daily by transit, then a weekly or monthly transit pass can save even more money than paying each time you ride. Although some transit fares are increasing, so is the price of gasoline and car insurance. For those able to reduce the number of cars they own, savings are even greater.

Your employer can allow you to pay for up to $105/month, on a transit pass before taxes. The transit pass can then be used to pay for bus and rail services. For example, if your employer lets you purchase a transit pass with a payroll deduction, and that pass costs $105 per month, this will cost you around $735 dollars a year. This same amount of service purchased directly from your transit provider with after-tax dollars would cost you $1260 a year. This is because you save on federal and FICA taxes, and possibly state and unemployment taxes, by purchasing the pass through your employer.

Message 2: Taking public transportation and walking helps reduce air pollution and increases physical activity.

The health effects of mobile vehicle pollution can be severe and even life-threatening, particularly to children, older adults, and adults with respiratory illnesses. Air pollution claims 70,000 lives a year, nearly twice the number killed in traffic accidents.

Increased availability and use of public transportation dramatically reduces motor vehicle emissions. In fact, public transportation reduces annual emissions of the pollutants that create smog by more than 97,000 tons. Even modest increases in the uses of public transportation would greatly reduce hazardous pollution in congested areas where pollution now poses the greatest risk.

Another health concern is that nearly 65% of U.S. adults are overweight; 30% are obese. The extra weight and lack of exercise are adding to our risk for heart attack, stroke, and cancer according to National Cancer Association and the Centers for Disease Control.

Obesity and declining physical fitness can be associated with inactive, sedentary, auto-dependent lifestyles. In urban and suburban areas where few travel options are available, cars are now used for 80% of trips *less than one mile in length*. On the other hand, people living in communities with good sidewalks and commercial areas located near residential areas appear to make one-half the automobile trips made by those in areas with only single-family homes. This is because many shorter trips are made by walking or taking public transportation. Walking to work, or to a bus or rail stop, provides a built-in opportunity for exercise.

Figure 5-4. Messages in Phase 2 Internet panel survey.

sages presented. *Purpose:* Explore methods for encouraging more walking and transit use.

2. Examine and compare the responses to the TPB-related questions in Phase 2 pre- and post-intervention. Test whether the measured beliefs were relevant to an individual's ATT, SN, or SCF, and whether the ATT, SN, and SCF were able to predict intent. *Purpose:* Explore methods for encouraging more walking and transit and explore the TPB in the context of a decision to take environmentally friendly modes, such as walking and transit.
3. Determine changes in ATT, SN, SCF and intent before and after the messages and alternatives are presented. *Purpose:* Explore the TPB as an approach to understanding how individuals make travel and location decisions. In particular, explore TPB in the context of a decision to take environmentally friendly modes, such as walking and transit
4. Determine what can be learned from market segmentation of the data based on values. *Purpose:* Explore methods for encouraging more walking and transit use (by focusing on promising market segments).

1. Fast transit service (rail or express bus) to the downtown. This service is available every 15 minutes or better, and a station is located less than a mile away. [TRANSIT TO DOWNTOWN]

2. Good connections by transit to the rest of the region (other than the downtown). This service may involve a transfer from one transit vehicle to another. Service is available every 15 minutes or better throughout the day. [REGIONAL TRANSIT]

3. A shuttle bus that connects your street with the local community center, and other activities within your neighborhood. Service is available every 15 minutes throughout the day. [COMMUNITY SHUTTLE]

4. A community door to door service that you can take at about half the price of taxi service and that you share with others traveling at the same time. This service can be obtained by calling a special number and is immediately available. [COMMUNITY DOOR TO DOOR]

5. Cars are available on your block or near your workplace to be rented by the hour (car sharing) when you need to make a trip that is difficult to make on transit. Cars should be reserved a day in advance, but may also be available immediately. [CAR SHARING]

6. You have a "smart card" that you can use to purchase service on any of the buses, shuttles, trains, or taxis. Just wave the card near the fare reader or meter, and the fare will be debited from your card. [SMART CARD]

7. You have a new kind of cell phone that will tell you exactly when the bus or train will arrive, show you where you are, and provide instructions on getting to your destination by public transportation. It would also have a "911" button that would instantly send your location to police or emergency services. This cell phone can serve as your normal cell phone, or your own phone can be programmed to have this capability. [SMART PHONE]

Figure 5-5. Alternative transportation concepts.

Summary

This chapter provided the details of the research plan for this project. The data collection effort occurred in two phases. Each phase included a set of focus groups and an Internet panel survey. Phase 1 focused on residential choice, whereas Phase 2 focused on mode choice. Each phase contributed to the overall goals of *(a)* exploring methods to increase walking and transit use, *(b)* exploring market sectors more likely to be favorable to TOD and walking and transit, and *(c)* exploring the use of the TPB as a method to increase understanding of motivating factors.

CHAPTER 6

Selected Findings from the Phase I Survey

This chapter presents some selected findings from the Phase 1 survey. The results are presented by age-group since the research was designed to emphasize the younger and older age-groups as being the most positive toward living in a CN. Results are also presented by e-panel so that the effect of enriching the sample with respondents who use transit can be observed.

For those readers curious about the detailed results of the TPB-related responses in the survey, the SPSS files of responses for all of the Internet panel surveys are included as Appendix C. Also included in Appendix C are several Excel files with data from a conjoint analysis done in Phase 1 and a MaxDiff analysis in Phase 2.

Who Were the Respondents?

The survey was completed by 865 individuals who are part of the Resource Systems Group Internet Survey Cafe or part of the New Jersey Transit e-panel. The Internet Survey Cafe individuals were limited to those who live in metropolitan areas where there is rail transit service. Respondents were included only if they had moved within the past 2 years or were considering a move within the next 2 years.

The following screening question was asked when respondents first started the survey:

Which of the following best describes you?

1. I moved to a different address within the past 2 years.
2. I am considering a move within the next 2 years.
3. None of the above

If they chose the first or second answer, they were allowed to continue taking the survey:

It is important to note that the full panel (e-panel plus Survey Cafe) used for this survey is not intended to be representative of the general population. Instead, the panel was selected to ensure that the survey provided information about individuals who are the most likely to be "interesting" with respect to location and transit decisions.

Table 6-1 and Table 6-2 indicate who took the survey, by metropolitan area and by age. NJ Transit respondents are shown as well. As can be seen, the NJ Transit respondents were a little over a quarter of those responding. While the oversampling of those aged 21 to 30 was successful in getting a large group of respondents, the same oversampling was less successful in the 55-plus age-group. Screening for those who had recently moved or were planning to move appears to have negated the effect of the oversampling for the older group. The panels do differ quite a bit by age-group, with nearly half of the Survey Cafe panel being 30 or less, compared with 15% of the NJT e-panel. Alternatively, nearly half of the NJT e-panel is in the next older age-group (ages 31 to 44), compared with 25% for the Survey Cafe respondents.

Our sample tends to have relatively high household incomes. Excluding the NJ Transit panel, the median household income for the Phase 1 survey was $55,000, which is somewhat higher than the relevant statewide median incomes reported by the Census for the year 2003, but metro areas tend to have higher household incomes than nonmetro areas. By way of example, median household incomes in King County, Washington, and San Francisco, California, were somewhat more than $50,000, while their full state averages were less than $50,000. Statewide median household incomes in Massachusetts, Minnesota, and Connecticut were also somewhat more than $50,000 per year. Given our focus on mobile, urban households, the median level of $55,000 seems quite reasonable.

The median income of the NJ Transit panel was $100,000, which reflects the dominant role of the commuter rail system into Manhattan, both directly and connecting with PATH. The median household income of the entire state of New Jersey was $55,000 in the year 2003. Integrating the NJ Transit data with the rest of the sample, the median household income for the full sample is $65,000 per year.

Table 6-1. Respondents by age and e-panel.

Age-Group	Respondents by Age-Group		
	Survey Cafe *n* (%)	NJT e-pane *n* (%)	Total *n* (%)
21–30	316 (49%)	34 (15%)	350 (40%)
31–44	162 (25%)	110 (49%)	272 (31%)
45–54	99 (15%)	54 (24%)	153 (18%)
55-plus	62 (10%)	27 (12%)	89 (10%)
Total	639 (100%)	226 (100%)	865 (100%)

Current Residence/Residential Aspirations/Transit Use

Current Residence and Mode to Work

The sample showed a range of living situations, thus providing a good representation of those living in apparently transit-friendly communities. Following is a summary of some of the indicative data. Note that there were hopes to find respondents who had transit options, and this sample looks good from that aspect, both for the NJT e-panel and other respondents. Table 6-3 shows some of the characteristics of the respondents. Note that the first two rows of data comparing home types add to 100%, as do the next two comparing parking availability, but the following rows do not. Over half lived in other than a single-family home, and over half had some kind of parking limitation. More than 80% had public transportation close by. Nearly a third had a commercial district within one-third mile. Significant differences in Table 6-3, as well as in following tables, are indicated by asterisks.

There are distinct differences by age-group, in that the younger respondents are significantly more likely to live in multifamily housing and to have parking limitations. They are more likely to live close to commercial districts. However, our respondents do not follow the U-shaped curve shown in Figure 2-6 since the oldest group (age 55-plus) is the least likely to live in multifamily housing, have parking restrictions, or live near commercial areas. Our oldest respondents may not be old enough to show these trends, which appear to start in the late 70s, as shown in Figure 2-6.

The NJ Transit e-panel and the Survey Cafe respondents are different from one another on several of the characteristics in Table 6-3, with a higher than average proportion of the NJT e-panel respondents living in single-family homes and having plenty of parking. As expected, a higher percentage of the NJ Transit e-panel respondents have transit services in their neighborhood.

Note that the largest difference between the respondent e-panels was in mode to work: 74% of the NJ Transit e-panel respondents took transit to get to work or school, whereas 13% of the Survey Cafe respondents took transit. Comparing Census Bureau journey-to-work data with the Survey Cafe, nationally 7.3% took transit to work. However, according to the 2000 census, the weighted average mode split in the metropolitan areas from which the survey respondents come is around 16%.[1] Outside of the NJ Transit e-panel, therefore, the survey respondents had a slightly lower mode split to work than the mode split found by the census in their respective metropolitan areas.

Table 6-2. Respondents by metropolitan area.

Metropolitan Statistical Area	Number	Percentage of Total
Total	865	100
NJ Transit e-panel	226	26
Atlanta	57	7
Boston/NH	55	6
Chicago	101	12
LA/Long Beach	77	9
Minneapolis/St. Paul	49	6
New York City, NY	99	11
Philadelphia/NJ	76	9
San Diego	32	4
San Francisco	12	1
Seattle/Bellevue/Everett	28	3
DC/MD/VA	53	6

Reasons for the Most Recent Move

The reasons respondents most often cited for moving to their current residence were external (due to some event) and internal (due to my own needs/desires). Table 6-4 shows the three largest reasons. Wanting to "own my own home" accounted for the largest percentage overall, as well as in each group. Around 15% "needed more space." Recall that these were the top two reasons found in the National Association of Realtors survey (*20*). The category "change in my job or school location" was significantly higher for the youngest group than for the sample as a whole. As might be expected based on life-cycle stage, the youngest group moved around more in response to job location changes and were less concerned about space. The 31- to 44- year-olds were more concerned about space requirements.

[1] Weighting of the standard metropolitan statistical area (SMSA) mode split was done by summing the product of each SMSA mode split times the number of households in the SMSA, and dividing the total by the sum of households for all of the SMSAs represented in the sample.

Table 6-3. Characteristics of respondents by age and e-panel (by group).

Characteristic	Percentage of Total Sample	Age Categories				e-Panel	
		21-30 (%)	31-44 (%)	45-54 (%)	55+ (%)	NJ Transit e-panel (%)	Survey Cafe (%)
Single-family home	48	34*	57*	56*	63*	58*	44*
Apartment, condo—not single family	52	66*	43*	44*	37*	42*	56*
Plenty of parking in own garage and driveway	48	36*	54*	56*	64*	53*	46*
Other parking situations (less parking)	52	64*	46*	44*	36*	47*	54*
One-third mile or less to nearest commercial district	32	40*	32	25*	11*	31	32
Public transit in neighborhood	84	86	87*	77*	79	90*	82*
Use transit to get to work (all)†	30	23*	38*	37*	21*	78*	13*

* Significantly different from the total sample at $p < .05$, $n = 865$.
† Work mode split is based on all respondents, including those not working.

Attitudes Toward Urban Living

One of the hypotheses was that there would be a market segment that was positively inclined toward living in denser communities. The raw data gives some promise that this market segment will be found. The following question was borrowed from a survey of the trade associations representing real estate agents and homebuilders. As reported in the *New York Times* (*48*), the question was as follows:

> Suppose you have a choice between two similarly priced homes. One is an urban town house within walking distance of

Table 6-4. Reasons for most recent move (by group).

Reason	Percentage of Total Sample	Age Categories				e-Panel	
		21-30 (%)	31-44 (%)	45-54 (%)	55+ (%)	NJ Transit e-panel (%)	Survey Cafe (%)
Wanted to own home	20.9	19.0	23.0	24.3	16.1	24.0	19.8
Needed more space	14.8	11.6*	21.1*	11.8	12.6	11.6*	16.0*
Change in job or school location	13.0	17.7*	10.4*	8.6*	11.5	12.0	13.4

*Significantly different from the total sample at $p < .05$, $n = 865$.

stores and mass transit; the other is in the suburbs and requires driving everywhere. Which one would you pick?

The national response was that 17% would choose the townhouse. Overall, the respondents to our survey are more favorable to the choice of a townhouse, which is not surprising given that our survey panelists were in metropolitan areas with good transit or were part of the NJ Transit e-panel. Overall, 44% of our panel picked the urban townhouse. Of the youngest age-group, 52% chose the urban townhouse, whereas only 36% chose it among the 31- to 44-year-olds. Contrary to expectations based on the analysis shown in Figure 2-6, the oldest age-group (55-plus) did not choose the urban townhouse at a higher rate than the sample as a whole.

Table 6-5 shows this result, as well as the percentage preferring to live in a big city. There was little difference between the attitudes of the NJ Transit e-panel and the Survey Cafe e-panel. The differences by age-group again point to the likely influence of life-cycle stage on residential preferences, as the youngest group is much more interested in city living than the next youngest age-group.

Childhood Experience and Attitudes

The Phase 1 Internet survey asked many questions about respondents' impressions of childhood neighborhoods, travel experiences, and other values. The objective was to develop information to allow exploration of links between childhood experiences and current values and choices. The data do reveal considerable differences by age-group.

The youngest group was the most suburban and was driven to school more than the older market segments. Table 6-6 shows these results. The decline in walking to school is seen clearly, with 75% of those 55 and over walking and only 47% of those ages 20 to 29 walking. Transit use for the trip to school also dropped from 38% to 15% for these age-groups. Note that the percentages for mode to school total more than 100% since more than one mode could be selected by the respondents.

Table 6-7 and Table 6-8 show memories of childhood attitudes toward the environment and toward taking transit. As seen in Table 6-7, the older age-group had fewer memories of conversations about the environment or of being concerned about the environment, which makes sense as the environmental movement dates from around 1970. In this regard, the NJ Transit e-panel was like the Survey Cafe panel. As for taking transit as children, the youngest age-group remembered more negative impressions, such as parents disapproving or friends not thinking it was cool. As shown in Table 6-8, the youngest and oldest age-groups are significantly different, with the older age-group remembering transit more positively.

The ratings come from a survey question that asked respondents to indicate, on a scale from one (strongly disagree) to seven (strongly agree), with eight being "don't know," their agreement or disagreement with seven statements about their childhood. The statements were as follows:

- My family discussed environmental issues[0].
- As a child I thought it was important to do what I could to save the environment.
- As a child, I traveled by myself on public transit (e.g., bus, train, trolley).
- My friends considered it "uncool" to take public transit.
- My parents thought it was unsafe for me to ride public transit.
- My parents encouraged me to take the bus or train.
- As a child, my first impressions about riding the bus or train were generally positive.

Current Environmental Attitudes

Several questions were asked to measure respondents' current opinions on environmental issues. Looking at the average ratings on pro-environmental statements by age-group and e-panel, Table 6-9 shows that there is little variation. Even though the older group may not have discussed environmental issues as children, they have similar or slightly greater concerns about the environment now.

Table 6-5. Attitudes toward urban living (by group).

Attitude	Percentage of Total Sample	Age Category				e-Panel	
		21-30 (%)	31-44 (%)	45-54 (%)	55+ (%)	NJT e-panel (%)	Survey Cafe (%)
Choose urban Townhouse	43.9	52.0*	36.4*	40.5	41.6	48.2	42.4
Prefer to live in a big city	23.5	31.4*	20.6	20.3	6.7*	21.7	24.1

*Significantly different from the total sample at $p < .05$, $n = 865$.

Table 6-6. Childhood experiences (percentages by group).

Experience	Percentage of Total	Age Category				e-Panel	
		21-30 (%)	31-44 (%)	45-54 (%)	55-plus (%)	NJ Transit (%)	Survey Cafe (%)
Grew up in a single-family house	76	79	78	73	**67***	80	75
Grew up in a big city	23	14*	24	**36***	29	20	24
Grew up in a suburb	41	47*	40	**33***	33*	39	41
Walked to school	60	47*	68*	69*	75*	69*	57*
Took a car to school	38	54*	35	23*	12*	32*	41*
Took transit to school	20	15*	21	19	38*	22	20

*Significantly different from the total sample at $p < .05$, $n = 865$.

TPB Measures on Moving to a Compact Neighborhood

One way to test whether our hypotheses about the youngest and oldest age-groups being the most positive toward a CN is to compare the responses to direct questions about their ATT, SN, SCF, and intent to move to a CN. A more complete discussion of the TPB variables and respondent choices will follow in other chapters, but Table 6-10 gives a preview

For each of the four TPB concepts, three questions were asked, as follows, with answers provided on a seven-point scale:

Table 6-7. Average ratings for childhood memories of the environment (on a scale of one to seven).

Memory	Total Sample	Age Category				E-Panel	
		21-30	31-44	45-54	55-plus	NJ Transit	Survey Cafe
My family discussed environmental issues	3.3	3.5*	3.3	3.0	2.5*	3.3	3.2
As a child I thought it was important to do what I could to save the environment	3.9	4.2*	3.8	3.8	3.1*	3.9	3.9
Average	3.6	3.9*	3.5	3.4	2.8*	3.6	3.5

*Significantly different from the sample average at $p < .05$, $n = 865$.

Table 6-8. Average ratings for childhood memories of transit.

Memory	Total Sample	Age Category				E-Panel	
		21-30	31-44	45-54	55-plus	NJ Transit	Survey Cafe
As a child, I traveled by myself on public transit.	3.9	3.1*	3.8	4.6*	5.5*	3.9	3.8
My friends considered it "uncool" to take public transit.	2.9	3.2*	2.9	2.9	2.2*	2.9	2.9
My parents thought it was unsafe for me to ride public transit.	3.3	3.8*	3.2	2.9*	2.2*	3.0*	3.4*
My parents encouraged me to take the bus or train.	3.5	3.2*	3.5	4.0*	4.2*	3.6	3.5
As a child, my first impressions about riding the bus or train were generally positive.	5.1	4.7*	5.1	5.5*	5.7*	5.4*	5.0*

*Significantly different from the total sample average at $p < .05$, $n = 865$.

Attitude Toward the Behavior

- For me to move to a CN in the next 2 years would be (1 extremely undesirable . . . 7 extremely desirable).
- For me to move to a CN in the next 2 years would be (1 extremely unpleasant . . . 7 extremely pleasant).
- For me to move to a CN in the next 2 years would be (1 boring . . . 7 interesting).

Subjective Norm

- Most of the people who are important to me live, or would like to live, in a CN. (1 definitely false . . . 7 definitely true)
- Most people whose opinions I value would approve of my moving to a CN in the next 2 years. (1 definitely false . . . 7 definitely true)
- It is expected of me that I move to a CN in the next 2 years. (1 strongly disagree . . . 7 strongly agree)

Self-Confidence

- Whether or not I move to a CN in the next 2 years is completely up to me. (1 strongly disagree . . . 7 strongly agree)
- I am confident that if I wanted to I could move to a CN in the next 2 years. (1 definitely false . . . 7 definitely true)
- For me to move to a CN in the next 2 years would be (1 impossible . . . 7 possible).

Table 6-9. Average environmental ratings.

Statement	Total Sample	Age Category				E-Panel	
		20-29	30-44	45-54	55-plus	NJ Transit	Survey Cafe
I am concerned about global warming or climate change.	4.9	**4.8***	4.8	5.1	**5.4***	5.0	4.9
I think I should be more active…in protecting the environment.	4.8	4.8	4.7	4.8	4.7	4.7	4.8
Protecting the environment should be given top priority, even with taxes.	4.1	4.0	3.9	4.3	4.3	4.2	4.0
Average	4.6	4.5	4.5	4.7	4.8	4.6	4.6

*Significantly different from the total sample average at $p < .05$, $n = 865$.

Table 6-10. TPB measures for moving to a compact neighborhood within 2 years.

Component	Total Sample	Age Category				E-Panel	
		20-29	30-44	45-54	55-plus	NJ Transit	Survey Cafe
Attitude toward the behavior to move to a compact neighborhood	3.8	4.0*	3.6	3.5	3.7	3.9	3.7
Subjective norm (what others think of my moving to a compact neighborhood)	3.2	3.5*	3.1	2.9*	3.1	3.2	3.2
Self-confidence (my ability to move to a compact neighborhood)	4.5	4.5	4.5	4.4	4.6	4.6	4.5
Intent to move to a compact neighborhood in 2 years	2.9	3.2*	2.7	2.6	2.5	2.8	2.9

* Significantly different from the sample average at $p < .05$, $n = 822$.

Intent

- I plan to move to a CN in the next 2 years. (1 strongly disagree . . . 7 strongly agree)
- I will make an effort to move to a CN in the next 2 years. (1 I definitely will not . . . 7 I definitely will)
- I intend to move to a CN in the next 2 years. (1 strongly disagree . . . 7 strongly agree)

These questions were not asked of respondents who had recently moved to CNs. Thus the data shown are for only 822 respondents.

As expected, the youngest group was significantly more positive than the sample as a whole was toward moving to a CN. The youngest group had significantly more positive attitudes, subjective norms, and intent to move. All of the groups had similar SCF for moving. The oldest group was not significantly more positive toward moving.

The NJ Transit e-panel and the Survey Cafe e-panel are similar overall in their responses to these questions. Table 6-10 shows the average value for each of the components of the TPB by age-group and e-panel.

Summary

The overall goal for selecting respondents for the Phase 1 Internet panel survey was to find individuals who represent the likely market for choosing a CN as a place to live. By selecting respondents from larger metropolitan areas, individuals with an interest in living in a more urban setting than the national norm, as measured by their answers to a theoretical question about neighborhood choice were found. Age-groups most likely to be interested in CN—the young (ages 21 to 30) and old (age 55-plus) were oversampled. This oversampling did result in a younger group with higher than average interest in moving to a CN, but did not result in an older group with higher than average interest. This does not imply this group does not exist; rather, it is likely that the instrument of an Internet panel survey combined with the screening requirement about moving reduced the chances of getting participation from the older age-group.

The addition of the NJ Transit e-panel participants to the panel changed the mode choice profile of the sample significantly, but in many other ways the NJ Transit e-panel responded similarly to the Survey Cafe e-panel. There were more significant differences by age-group than by e-panel in terms of childhood experience, attitudes toward the environment, and attitudes toward urban living.

There were significant differences by age-group in many aspects. The younger group grew up in more suburban areas on average; they walked and took transit less to school than older groups. They were also more likely to have experienced negative social pressure regarding use of transit. However, they were more likely to have been concerned about the environment as children.

In terms of interest in moving to a CN in the next 2 years it was hypothesized that both the youngest age-group and the oldest would have the most interest. That proved true for the youngest group, which rated highest on measures of ATT toward moving, SN, SCF and intent. But it did not prove true for the oldest group.

CHAPTER 7

Market Segments for Moving to a Compact Neighborhood

This chapter explores the characteristics of market sectors that are more likely to be favorable to an urban residential environment, particularly an environment characterized as a CN. The results of a market segmentation process based on attitude and belief, rather than age and e-panel, are presented.

An earlier study (*TCRP Report 36: A Handbook: Using Market Segmentation to Increase Transit Ridership*) suggested the method for creating market segments used in this research (*49*). That report includes a valuable review of alternative approaches to market segmentation: predetermined (a priori) segmentation and market-defined (post hoc) segmentation.

> In most cases, pre-determined (a priori) segmentation involves selecting certain groups from a population based on known characteristics and declaring them "segments." (*p. 12*).
>
> Market-defined (post hoc) segmentation attempts to identify segments based on actual market investigations, notably analysis of answers to survey questions intending to predict marketplace responses. . . . Moreover, a variety of multivariate techniques (e.g., cluster analysis, automatic interaction detection, correspondence analysis, conjoint analysis-based clustering) may be used to identify the market segments (*pp. 19–20*).

The report suggests incorporating attitudes and beliefs into the market research process using market-defined segmentation.

The analysis presented in this chapter carries out key aspects of market-defined segmentation. Specifically, the segments created allow the analyst to observe the extent to which groups believe a given outcome—"With a move to a CN, I would get more exercise"—and the extent to which they value this outcome—"For me getting more exercise would be DESIRABLE. . . ." In the language of the TPB, what is believed is the *behavioral belief*, and its relevance is the *outcome expectation*.

Overview of the Market Segments

This chapter presents the findings derived from a market segmentation that utilized a clustering process based on scores for 39 variables from the Phase 1 Internet survey. Since there was interest in respondents' intentions toward moving to a CN, variables throughout the survey were reviewed for the extent of their correlation with the direct measure of "intent to move to a CN." "Intent to move" is measured as the average of scores on the following three statements:

- I plan to move to a CN in the next 2 years. (1 extremely unlikely . . . 7 extremely likely)
- I will make an effort to move to a CN in the next 2 years. (1 I definitely will not . . . 7 I definitely will)
- I intend to move to a CN in the next 2 years: (1 strongly disagree . . . 7 strongly agree)

The Cronbach's alpha for the three statements of intent was 0.97.

Of the candidate variables that were tested, 39 were found with correlations of 0.1 or higher, all of which were significant at the 5% level. The 39 variables are listed in Table 7-1, ordered on the basis on the strength of their correlation with the intent to move. A clustering process on the 39 variables resulted in the creation of five market segments.

Definition of the Five Market Segments for Moving

Of the 822 survey participants exposed to the questions about moving to a CN, five segments clearly emerged. They are defined here, with complete descriptions provided later in the text. They are "ranked" from the highest intent to move to the lowest. Note that those persons who had recently moved to a CN were not asked the set of questions about their

Table 7-1. Thirty-nine variables correlating with intent to move.

Rating Statements from Phase 1 Survey Questionnaire [1 to 7]	Corr.
• It would be easier for me to move to a compact neighborhood if I could find an affordable home there. [strongly disagree/strongly agree]	0.435
• For me, to live within walking distance to stores, restaurants, a public library and a school would be [extremely undesirable/extremely desirable]	0.367
• How likely is it that you could get by with fewer household cars in the coming year? [very unlikely/very likely]	0.352
• I need to drive my car to get where I need to go. [strongly disagree/strongly agree]	-0.307
• If I moved to a compact neighborhood I would take public transportation to work or for other trips. [strongly disagree/strongly agree]	0.298
• For my household to need to own fewer cars would be...[extremely undesirable/extremely desirable]	0.294
• For me, to be able to take public transportation to work or for other trips would be... [extremely undesirable/extremely desirable]	0.278
• For me, to live in a neighborhood with more noise on the streets would be... [extremely undesirable/extremely desirable]	0.270
• How likely is it that you could get by with less living space in the coming year? [very unlikely/very likely]	0.265
• For me, to live in less living space (in my home and lot) would be... [extremely undesirable/extremely desirable]	0.265
• If I moved to compact neighborhood, I would have less living space in my home and lot. [strongly disagree/strongly agree]	-0.264
• If I moved to a compact neighborhood it would be easy for me to get to stores, restaurants, a library and other activities. [strongly disagree/strongly agree]	0.262
• If I moved to compact neighborhood, my household could own fewer cars. [strongly disagree/strongly agree]	0.254
• I'd be willing to drive less to reduce my use of foreign oil. [strongly disagree/strongly agree]	0.251
• I love the freedom and independence that owning several cars provides for my household. [strongly disagree/strongly agree]	0.248
• If I moved to compact neighborhood, the streets would be noisier than where I live now. [strongly disagree/strongly agree]	-0.246
• If I moved to a compact neighborhood I would make friends with more of my neighbors. [strongly disagree/strongly agree]	0.228
• If I moved to a compact neighborhood I would exercise by walking or bicycling. [strongly disagree/strongly agree]	0.218
• Protecting the environment should be given top priority, even if it means an increase in taxes. [strongly disagree/strongly agree]	0.209
• My family: They'd be willing to drive less to reduce their use of foreign oil. [strongly disagree/strongly agree]	0.205
• My family: They think that protecting the environment should be given top priority, even if it means an increase in taxes. [strongly disagree/strongly agree]	0.200
• Neighborhood bus goes where I need to go. [strongly disagree/strongly agree]	0.196
• Neighborhood bus goes where I need to go. [strongly disagree/strongly agree]	0.196
• Neighborhood bus goes where I need to go. [strongly disagree/strongly agree]	0.196

(continued on next page)

Table 7-1. (Continued).

• How likely is it that you could find an affordable home in a compact neighborhood? [very unlikely/very likely]	0.195
• Neighborhood has adequate parking. [strongly disagree/strongly agree]	-0.194
• How likely is it that you could find an affordable home in a compact neighborhood? [very unlikely/very likely]	0.195
• Neighborhood has adequate parking. [strongly disagree/strongly agree]	-0.194
• How likely is it that you could find an affordable home in a compact neighborhood? [very unlikely/very likely]	0.195
• Neighborhood has adequate parking. [strongly disagree/strongly agree]	-0.194
• It would be easier for me to move to a *Compact Neighborhood* if I was sure I would not lose touch with my current friends. [strongly disagree/strongly agree]	0.185
• My family: They are concerned about global warming and/or climate change. [strongly disagree/strongly agree]	0.168
• My family: They need to drive their cars to get where they need to go. [strongly disagree/strongly agree]	-0.165
• My family: They love the freedom and independence that owning several cars provides for their household. [strongly disagree/strongly agree]	-0.160
• I am concerned about global warming and/or climate change. [strongly disagree/strongly agree]	0.159
• It would be hard for me to reduce my auto mileage and use of gasoline. [strongly disagree/strongly agree]	-0.152
• My family: They think they should be more active in doing their part to protect the environment. [strongly disagree/strongly agree]	0.150
• Staying active and getting regular exercise is a top priority for me. [strongly disagree/strongly agree]	0.150
• Overall, how satisfied are you with your current home location? [completely dissatisfied/completely satisfied]	-0.144
• I think I should be more active in doing my part to protect the environment. [strongly disagree/strongly agree]	0.139
• Other people like my neighborhood. [strongly disagree/strongly agree]	-0.137
• It would be easier for me to move to a *Compact Neighborhood* if I required less living space. [strongly disagree/strongly agree]	0.123
• Neighborhood has lots of trees. [strongly disagree/strongly agree]	-0.118
• I really enjoy driving. [strongly disagree/strongly agree]	-0.114
• Other people think my home and neighborhood are very nice. [strongly disagree/strongly agree]	0.112
• My family: It is important to them to have control over the things that they do. [strongly disagree/strongly agree]	-0.103

intention to move to a CN; thus the sample size is reduced to 822.

The Transit Movers Group. This group is categorized by its extensive experience with transit and walking. It is driven not by environmental concerns, but rather by an understanding of what services and conditions are necessary to live in a transit-oriented neighborhood. This group has the highest intent to move to CN.

The Environmental Movers Group. The second group, in terms of their intent, is markedly different from the first: their use of transit to work, for example, is the lowest of the five market segments reported here. Rather, this group is categorized by the extent of belief in environmental causes, and the belief that they could make a positive contribution by moving to a more transit-oriented location.

The Conflicted/Contented Group. This group, whose level of intent ranks in the middle, is the most complex of the five segments. They rank their concern with environmental issues (e.g., global warming/climate change) among the highest of any group, while, at the same time, reporting a level of auto dependence among the highest of any group. While they express their commitment to environmental change, altering their neighborhood to attain that change is not a desired option for this group.

The Low Expectations Group. Of the two groups with the lowest rating for intent, this group shows its displeasure with just those attributes of a CN that are desired by those who value the urban attributes. In general, this group expresses less hostility to environmental issues than does the Anti-Environmental group, but does not place a positive value on the things that might be expected to occur in a CN, such as getting more exercise or even making more new friends.

The Anti-Environmental Group. The group with the lowest rating of intent expresses its displeasure most specifically to the concept of environmental causes, thinking those causes are "overblown" and unnecessarily costing them money. They report the highest propensity to love the freedom and independence of owning several cars, and the highest propensity to need a car to get where they need to go.

An introduction to the five segments is presented in Table 7-2. For each of the five market segments, two cells are highlighted with an asterisk, indicating data that will help the reader to understand the salient characteristics of each segment.

Of the sample exposed to the questions on moving ($n = 822$), 30% of respondents were assigned by the clustering process to the two groups that rated intent most highly. If the respondents who recently moved to a CN (who were asked different TPB questions) were added, this raises the "positive" segment of the 865 sample to about 35%. Note with caution, however, that the two "mover" groups together have a combined level of "intent to move" of about 4 out of a scale from 1 to 7. It can be argued that, on a scale that allows for a "neutral" response, the rating of 4 is not a strong indication of intent to move. The two positive groups, however, can be seen as a logical "market" for further exploration of the concept of moving to a neighborhood more supportive of walking and transit.

Demographics: Who Are They?

The demographics can provide an early clue to the membership of each of the five segments. Most obviously, the Transit Movers are geographically distinct from the other four groups: only 18% of them live in single-family homes, compared with 63% of the Environmental Movers. Ninety percent of the Transit Movers live in a neighborhood with a mix of single- and multiple-unit housing, while only 47% of the Environmental Movers group lives in a neighborhood that offers a mix of housing types. At present, 55% of the Transit Movers live in a CN, compared with only 15% of the Environmental Movers. In terms of marital status, 38% of the Transit Movers group is married, compared with 64% of the Anti-Environmental group.

Age of the Five Segments

Those under 30 years of age are overrepresented in both the Transit Movers group (young people who value the pro-transit attributes) and the Low Expectations group (young people who do not.) Those over 55 years of age appear disproportionately in the Environmental Movers group. Table 7-3 shows the age categories of the market segments and indicates which age-groups are overrepresented.

E-Panel for the Five Segments

Table 7-4 shows the percentage of each segment that came from the Survey Cafe e-panel and the percentage from the NJ Transit e-panel. As can be seen, the Conflicted/Contented group had the highest proportion coming from the NJ Transit e-panel, whereas the Environmental Movers had the lowest proportion. This means that the inclusion of the NJ Transit e-panel is not overly influencing the two most positive groups for moving to a CN.

Residential Preferences

There is consistency between the ranking of the market segments by their average score on intent to move and resi-

Table 7-2. Average ratings for the five market segments.

Market Segment	Intent to Move (average rating)	Monthly Utilitarian Walk Trips (No.)	Transit Share of Work Trips† (%)	Average Rating, from 1 (strongly disagree) to 7 (strongly agree)			
				I am concerned about global warming/ climate change.	I need to drive my car to get where I need to go.	If I moved to a compact neighborhood I would exercise by walking or bicycling.	If I moved to a compact neighborhood I would make friends with more of my neighbors.
Transit Movers (*n* = 107)	4.1	**29.2***	**61%***	5.2	2.4	5.9	5.1
Environmental Movers (*n* = 98)	3.9	13.1	**20%***	**6.1***	5.4	6.2	5.9
Conflicted / Contented (*n* = 188)	2.8	10.2	39%	**5.9***	**5.9***	5.7	5.1
Low Expectations (*n* = 162)	2.5	8.7	27%	4.6	5.1	**4.1***	**3.8***
Anti-Environmental (*n* = 158)	1.9	5.4	25%	**3.2***	**6.3***	4.5	4.4
Total (n = 822)	2.9	11.9	34%	4.9	5.2	5.2	4.8

* Data that help the reader understand salient characteristics of each segment.

† Work trip mode share in this table is computed only for workers. This differs from Chapter 6, where mode share is computed for all respondents.

dential preferences, as shown by other variables. For example, in the choice between an urban townhouse with transit and a suburban house that requires driving, 80% of the Transit Movers chose the townhouse, compared with 24.5% of the Anti-Environmental group. Likewise, 42.5% of the Transit Movers would prefer to live in a big city, versus 11.2% of the Anti-Environmental group. Finally, 55% of the Transit Movers currently live in a CN, compared with 10.6% of the Anti-Environmental group. The Environmental Movers are the second most favorable group toward

Table 7-3. Age categories for the five market segments.

Segment	Age Category				
	21-30 (%)	31-44 (%)	45-54 (%)	55+ (%)	Total (%)
Transit Movers	**44.2***	29.2	17.5	9.2	100.0
Environmental Movers	38.4	23.2	**21.4***	**17.0***	100.0
Conflicted/Contented	36.4	**34.1***	19.4	10.1	100.0
Low Expectations	**45.4***	28.6	15.1	10.8	100.0
Anti-Environmental	39.0	**34.2***	18.2	8.6	100.0
Total	40.4	30.7	18.1	10.7	100.0

* Category in which a given segment is overrepresented.

Table 7-4. Source of e-panel members for the five segments for moving.

	E-Panel Source		
Segment	NJ Transit (%)	Survey Cafe (%)	Total (%)
Transit Movers	27.5	72.5	100.0
Environmental Movers	18.8	81.2	100.0
Conflicted / Contented	32.3	67.7	100.0
Low Expectations	23.2	76.8	100.0
Anti-Environmental	22.9	77.1	100.0
Total Sample	25.5	74.5	100.0

choosing an urban townhouse or living in a big city. However, only 15% currently live in a CN. Table 7-5 shows these results.

Income Levels of the Five Segments.

Table 7-6 shows the income levels for the five market segments. The variations in median household income level are not dramatic, but do reveal the difference between the Transit Movers ($60,000) and the Environmental Movers ($75,000). Variations in the mean values are somewhat more dramatic, but can be influenced by the relatively small number of participants at the higher income levels. The per-person income of the Transit Movers is somewhat understated in this table, as the size of their households is smaller than for the other groups.

Table 7-6. Household income, by market segment.

	Household Income ($)	
Market Segment	Mean	Median
Transit Movers	67,973	60,000
Environmental Movers	81,432	75,000
Conflicted / Contented	81,831	70,000
Low Expectations	77,232	60,000
Anti-Environmental	79,841	70,000
Total Sample	78,304	65,000

Childhood Memories

Table 7-7 shows some of the market sector ratings from childhood. The asterisks indicate the market segments with the high and low scores for each rating statement.

Concerning the role of environmentalism in youth, the Environmental Movers stand out as the most likely to have dealt with these issues both as a family and as an individual. Note that this group rated environmental memories much more positively than the age/e-panel groups shown in Table 6-7. The Environmental Movers were the most likely to have been able to walk or bike to a commercial district. However, they were also the most likely of the market sectors to have had friends who thought it was "uncool" to take public transportation.

Understanding the Travel Patterns of the Five Market Segments

Table 7-8 shows characteristics of the transportation patterns of the five market segments. The first column shows a

Table 7-5. Living preferences and current choice of neighborhood for the five segments.

Segment	Choose Urban Townhouse (%)	Prefer to Live in a Big City (%)	Currently Live in a Compact Neighborhood (%)
Transit Movers	80.0	42.5	55.0
Environmental Movers	59.8	33.9	15.2
Conflicted / Contented	35.9	17.5	20.7
Low Expectations	35.1	18.4	16.8
Anti-Environmental	24.5	11.2	10.6
Total Sample (n = 822)	42.8	22.1	21.8

Table 7-7. Childhood memories of neighborhood/environmental issues.

Market Sector	Average Ratings, from 1 (strongly disagree) to 7 (strongly agree)				
	As a child I thought it important to do what I could to save the environment.	**My family discussed environmental issues.**	**Average of 2 environmental ratings**	**There was a commercial district I could walk or bike to.**	**Friends considered it uncool to take public transit.**
Transit Movers	4.0	3.3	3.7	5.0	**2.5***
Environmental Movers	5.0	4.4	**4.7***	**5.3***	**3.6***
Conflicted / Contented	4.4	3.6	4.0	4.8	3.1
Low Expectations	3.6	3.0	3.3	**4.1***	2.9
Anti-Environmental	2.9	2.5	**2.7***	4.5	2.8
Total Sample	3.9	3.3	3.6	4.7	2.9

* Market segments with the high and low scores for each rating statement.

surrogate for the combined number of walk trips for utilitarian purposes (i.e., walk trips to a destination). The second column shows walk mode share for all trips. As can be seen, the Transit Movers are very different from the other segments in terms of the amount of walking they do and the high percentage of trips that they make by walking.

The transit share for all trips is shown in the third column of Table 7-8. As with work trips, the Transit Mover segment chooses transit at a rate that is twice as high as the other market segments. Looking at all modes other than a private vehicle, the Transit Movers market segment takes modes such as transit, walking, bicycling, and taxi more than half of the time.

Table 7-8. Travel behavior by market segment.

Segment	Monthly Utilitarian Walk Trips (No.)	Walk Share for All Trips (%)	Transit Share for All Trip Purposes (%)	Total Transit and Walk for all Trip Purposes (%)	All Alternatives to Private Vehicles (including bike and taxi)
Transit Movers	29.2	26.7	21.7	48.5	51.5
Environmental Movers	13.1	12.0	7.2	19.2	21.1
Conflicted / Contented	10.2	9.4	9.2	18.6	19.1
Low Expectations	8.7	8.0	7.2	15.1	16.6
Anti-Environmental	5.4	5.0	4.5	9.5	9.9
Sample Average	11.9	10.9	9.2	20.2	21.4

Understanding the Two Market Segments with the Highest Intent to Move

The five segments are discussed in this section, ranked from highest to lowest intent to move to a CN, in particular, their propensity to take transit and to move.

Transit Movers Group

The Transit Movers currently experience a wide variety of green-mode travel behavioral patterns. As shown in Table 7-8, they walk more and take transit much more than all the other market segments. The group makes about 29 walking trips per month, which is about five times the rate experienced by the Anti-Environmental group. Logically enough, the Transit Movers report the lowest need for a car to get where they need to go, with a rating of 2.4 on the seven-point scale; they do not think they are wasting too much time driving in congestion. They enjoy driving less than any other group.

The transit group is the youngest in our sample, a trait quite similar to that of the Low Expectations group, as shown in Table 7-3. Consistent with this, they have lived in their present home for less time than any other group, and they have the lowest contemplation of moving in the next 2 years. As urbanites, they have the highest reported access to frequent transit and the best access to reliable taxis. More than any other group, they have a commercial district within walking distance. Their houses do not have significant amounts of parking or a large lot. Emotional commitment from these young people to their neighborhood is somewhat low, with the lowest propensity to believe that *others* think their home and neighborhood is nice. They share with the Low Expectations group a lack of overall satisfaction with their current home location.

In general, their expectations for the positive outcomes of a move are less optimistic than that of the Environmental Movers. While they have high ratings for issues (discussed below for the Environmental Movers) such as getting more exercise and making friends, these ratings are uniformly lower than those for the Environmental Movers. They are more likely to think they could live with fewer cars than any other group. While their environmental concerns are less intense than the Environmental Movers group, they are more likely to believe that cars do contribute significantly to degradation of the environment, and they are less likely to find it hard to reduce auto mileage.

Environmental Movers Group

In terms of the present modal behavior, the Environmental Movers would seem to have a long way to go before making a residential move and following that up with a transit-oriented travel pattern: this group has less propensity to take transit to work than any other group. More predictably, the group has the second highest propensity to make utilitarian walk trips, although with a walking rate far behind that of the Transit Movers. Its propensity to take green-mode trips is about the same as that for the Conflicted/Contented group, discussed below. Its trip lengths are the longest of any group.

Consistent with their name, this group wants to save the world. They have the highest propensity of any group to be concerned about global warming/climate change, to protect the environment with more taxes, and to be more active doing their part. They are most likely to disagree that environmental concerns are overblown. They remembered their environmental leanings from childhood.

The group is suburban and quite satisfied with that. More of this group lives in single-family homes than any other group. Their homes have the largest lots, the most parking, and most amounts of trees and bushes. They are more satisfied with the size of their lots than any other group. They have the highest propensity to be satisfied with their location and to believe that other people think their home and neighborhood are nice. They are happiest with their access to work/school and with the quality of biking. The group tends to show the highest ratings for the attributes associated with urban life: the group has the highest propensity to believe they should be spending more time walking, just to be healthier, making exercise a top priority.

In spite of the level of contentment experienced, the Environmental Movers seem open-minded about a change of lifestyle. The group is the oldest, and they have been living in their present homes longer than any other group. They, more than any other group, think that they are wasting too much time driving in congestion. The group tends to have a positive expectation of the results of a move; more than any other group, they think they would exercise more, make more friends, and find it easy to get to local destinations. With such a move, they could own fewer cars and get by with less living space. In short, they are optimistic that they could make the changes associated with life in a neighborhood supportive of transit and walking.

The level of affection for their present lifestyle, however, suggests that a change in travel patterns as the result of the hypothesized move might be somewhat incongruous with their present conditions. At once they value the concept of moving, and at the same time report little change in their desire for a large lot and for parking for two or more cars (see Table 7-9).

Table 7-9. Selected ratings of the market segments.

	Average Ratings, from 1 (not important at all) to 7 (extremely important)			
Segment	Having frequent bus or other transit (train or trolley) services	Having transit services serve areas in which I frequently needed to travel	Having adequate room for parking two or more cars	Having a large lot
Transit Movers	6.1*	6.0*	2.8	2.8
Environmental Movers	4.7	4.7	5.5*	4.7*
Conflicted/Contented	4.4	4.3	5.2	4.5
Low Expectations	4.0	4.0	4.9	4.2
Anti-Environmental	3.2	3.1	5.7	4.6
Full Sample (n = 865)	4.3	4.3	5.0	4.2

* Indicate the differences between the two groups with the highest intent to move.

Understanding the Three Groups with Lowest Intent to Move to a Compact Neighborhood

Conflicted/Contented Group

The Conflicted/Contended group (characterized by a low intent to move) has a significantly higher propensity to use transit (particularly for work) than the higher ranked Environmental Movers group, discussed above. But at the same time, the group has the second highest level of auto dependency, after the Anti-Environmental group. In addition to a desire to do right by the environment, the group has expressed the second highest level of feelings of freedom and independence from owning several cars.

As shown in the two cells highlighted in Table 7-2, this group would also like to save the world, but does not intend to change neighborhoods in order to do so. Compared with the Transit Movers, the Conflicted/Contended group is more concerned with global warming, being active in protecting the environment (with more taxes), and believing they are wasting too much time in congestion. But compared with the Transit Movers group, the Conflicted/Contended group is also less willing to reduce driving and more likely to say it would be hard to reduce auto mileage.

In short, in this group there is a perceptible difference between the holding of environmental values and the translation of those values into a propensity to alter present levels of auto use. They report a low intent to move to a CN.

Low Expectations Group

This group does not value those attributes associated with the move to a neighborhood more supportive of walking and transit. As shown in Table 7-2, the group has the *lowest* level of belief that they would exercise more in a CN and that they would make more friends; and they do not believe it would be easy to get to stores and restaurants. They have the lowest propensity to believe they could get by with less space or that they could even find an affordable house in a CN. And they have the lowest propensity to say that a move would be easier if they could find an affordable house—in short, they just do not seem to want to move to a CN.

This group has a lower propensity to use either transit or walking in their present behavior than the average for the total sample. Its neighborhood tends to look like the average condition for the sample. Their need for a car to get where they need to go is somewhat less than for the sample as whole.

On many issues, the group does not have an optimistic outlook on life. They have the lowest levels of satisfaction with their present location, coupled with the lowest belief that others like it, the lowest belief that their location is convenient, and the lowest satisfaction with biking conditions. They have the lowest propensity to believe that staying active is a top priority. They have the lowest need to minimize travel time, as well as the lowest need to have control over the things that they do.

This group has significantly lower levels of formal education than the other groups, and it has the highest participation of

minorities. Its median household income level is lower than that of the sample as a whole and similar to the Transit Movers, with whom it has much in common demographically.

Anti-Environmental Group

This group has the lowest overall use of green modes, as well as the lowest walking and transit use, when examined separately. They have the longest one-way commute, and the highest rates of auto availability.

The group does not have an overall set of values that would encourage the move to a neighborhood supportive of less auto dependency; thus they need not be seen as at all "conflicted." More than any other group, they really enjoy driving, love the freedom and independence that owning several cars brings, and need their car to get to where they need to go. More than any other group, they think that environmental concerns are overblown, and they are less willing to reduce driving to reduce dependence on foreign oil, less concerned about global warming, and less willing to take action to protect the environment. Of all groups, it would be hardest for them to reduce their auto mileage. More than any other group, it is important for them to have control over things that they do.

Interpretation, Based on the Theory of Planned Behavior

The market segmentation analysis based on attitudes and beliefs suggests that there are two different groups currently giving consideration to moving to neighborhoods more supportive of walking and transit. This section briefly reviews the patterns of the five segments as measured by their ATT, SN, SCF, and intent to move. Table 7-10 shows the average values for these variables.

Attitude Toward the Behavior

The five segments rank as expected in terms of their attitude. The members of the Anti-Environmental group have a low ATT, but they have a slightly higher propensity than the Low Expectations group to say they *could* undertake the move (self-confidence) if they wanted to.

The Environmental Movers represent something of a challenge to the policymaker, particularly when examined in terms of their underlying attitudes. They value the concept of walking more and of having less dependence on the automobile. However, when priorities are set, having more trees and bushes and having adequate parking seem to trump the need for buses that go where they need to go. In short, they do not seem to approach the CN with a strategy for lowered auto orientation. The Environmental Movers have a clear-cut idea about the benefits of the new neighborhood, but perhaps less knowledge of what it takes to bring it about. They believe they would walk more, make more friends, and easily get to local destinations. But they have less belief than the Transit Movers that they could get by with fewer cars, even though they start with many more.

Subjective Norm

More than any other group, the Environmental Movers tend to believe that the members of their personal social network would approve of the move (SN); this level of implied approval is slightly higher than for the Transit Movers. The members of the Anti-Environmental group seem to be equally sure that those they value the most would disapprove of such a move, which is consonant with their lack of intent to do so.

Self-Confidence

Intuitively, the Transit Movers already seem to understand the rules of the game. They know how to use bus and taxis as part of the strategy. They have a higher appreciation that the new neighborhood should not only have frequent buses, but have frequent buses that are going where they need to go. Using the terms of the TPB, they have the highest level of SCF over their feeling that they could make this

Table 7-10. TPB measures for the market segments.

Segment (n = 865)	Attitude	Subjective Norm	Self-Confidence	Intent
Transit Movers	5.1	4.1	5.2	4.1
Environmental Movers	4.9	4.2	4.9	3.9
Conflicted/Contented	3.8	3.3	4.4	2.8
Low Expectations	3.1	2.9	4.1	2.5
Anti-Environmental	2.8	2.4	4.3	1.9
Total	3.8	3.2	4.5	2.9

residential move; they have high confidence about making it work.

Summary of Findings for Five Market Segments for Moving

The approach of defining market sectors by clustering on the 39 variables that correlate with the intent to move to a CN provides a set of distinct market segments. The differences in attitudes are more pronounced for the market segments than for the different age-groups shown in Chapter 6, as might be expected given that the attitudes help to define the segments. However, in addition to the attitude differences, there are also large differences in mode choice and trip making by green modes.

The Transit Movers market segment is a younger, transit-oriented segment, which is likely to deal well with a more urban residential environment. The Environmental Movers market segment is somewhat favorable to moving to a CN, and they see such a move as compatible with their environmental leanings. However, this older and wealthier market segment is also used to larger homes and yards and plenty of parking for cars.

The three negative market segments (Conflicted/Contented, Low Expectations, Anti-Environmental) have little or no interest in moving to a CN. They either are quite happy driving their cars or place little value on what are seen as the advantages of a CN.

In looking for the most likely market for a CN, the Transit Movers and the Environmental Movers are key segments. The Transit Movers are likely to be at home with a lifestyle that requires or allows more walking and transit, whereas the Environmental Movers will be challenged to do without their cars. The relationship between different value sets and neighborhood types will be examined further in the following chapter.

CHAPTER 8

Travel Behavior by Values, Urban Form, and Auto Ownership

Introduction and Structure of the Chapter

This chapter continues the exploration of market sectors that are more likely to be favorable to an urban residential environment, particularly a CN. It also explores the propensity for transit use and walking to increase with a change in neighborhood type.

This project has created a new source of data that integrates information about personal attitudes and values with more traditional information about travel behavior and neighborhood form. The new data set makes possible the examination of the interrelationship between values held by the traveler and the characteristics of the built environment in the formation of travel behavior and modal choice.

In the first part of this chapter, the relationship between travel behavior and two separate independent variables is examined. First, the relationships between personal values and travel behavior for walking and transit are explored. Then new data on the relationship between the built environment (in this case, neighborhood type) and travel behavior for walking and transit are presented.

The second part of the chapter examines the interaction of two of the independent variables, noting their combined effect on the dependent variable of travel behavior. The combined effect of personal values and urban form is examined in terms of a variety of measures of transit and walking patterns.

The third part of the chapter examines the revealed relationship between auto availability and travel behavior for walking and transit. The chapter explores the interaction of the three variables on the propensity to walk or take transit. The document reviews what can and cannot be observed from examination of cross tabulations, which reveal the combined role of personal values, urban form, and auto availability on the propensity to walk and take transit.

The fourth part of the chapter uses structural equation modeling (SEM) to investigate the relative importance of personal values, urban design, and auto ownership.

The fifth part summarizes observations about the role of each of the three variables and the need for further research.

Personal Values and Travel Behavior; Urban Form, and Travel Behavior

Overview of an Approach to Creating a Personal Values Factor

This section examines the relationship between travel behavior concerning walking and transit and the independent variable representing personal values. In a later section of this chapter, travel behavior will be examined in relationship to the interaction of personal values and urban form.

Over the past decade, a substantial contribution has been made to the professional literature of travel behavior by those who have argued that travel times and travel costs must be examined in the context of the values, perceptions, and attitudes held by the traveler in making modal decisions (*17, 18*). This project's Phase 1 survey was designed to contribute to this literature in several ways. The new database is unique in its basis in a nationwide sample of transit-oriented metropolitan areas and on its use of the TPB in the survey design.

In this chapter, the concept of "personal values" is reflected in the use of two groups within the total sample. In a process described below, two groups were defined in terms of their attitudes toward basic conditions of an urban, pedestrian-friendly, and environmentally friendly lifestyle. In this method, a combined factor was created from similarity of responses to 15 key rating statements, as shown in Table 8-1. A combined factor of "urban and environmental values" was created by summing scores on the rating statements shown in Table 8-1. The group whose score was higher than the average (mean) on this combined factor was labeled the *high urban/environmental values* group; the group with lower than average scores on the combined factor was labeled the *low urban/environmental values* group.

Table 8-1. Fifteen rating statements for urban/environmental values.

Rating Statements
Having an adequate number of sidewalks in good condition.
Having frequent bus or other transit (train or trolley) services.
Having buses or other transit services serve areas in which I frequently needed to travel.
Having a commercial district (with things like a coffee shop, retail stores, and restaurants) within walking distance of my home.
Having access to reliable taxi service whenever I need it.
For me, to live within walking distance to stores, restaurants, a public library and a school would be desirable.
For me, to be able to take public transportation to work or for other trips would be desirable.
For my household to need to own fewer cars would be desirable.
I am concerned about global warming and/or climate change.
Protecting the environment should be given top priority, even if it means an increase in taxes.
I'd be willing to drive less to reduce my use of foreign oil.
Friends and family think they should be more active in doing their part to protect the environment.
Friends and family are concerned about global warming and/or climate change.
Friends and family think that protecting the environment should be given top priority, even if it means an increase in taxes.
Friends and family would be willing to drive less to reduce their use of foreign oil.

Number of cases: 865, alpha = 0.85.

Technical Explanation of the Approach

A set of rating statements created for application of the TPB were examined for their role in the creation of a "personal values" factor. Two statements were examined first: "For me to live within walking distance to stores, restaurants, a public library, and a school would be (desirable/undesirable), and "Having a commercial district (with things like a coffee shop, retail stores, and restaurants) within walking distance of my home would be (not important at all/extremely important)." These statements represent the essence of a CN, where walking is a reasonable option.

The next step was to add additional statements to the set so that the set would more fully describe values associated with an urban, pedestrian-friendly, and environmentally friendly lifestyle. To create this set of statements, a statistical test known as Cronbach's alpha was used, which is a way to determine if a set of variables is successfully measuring a single construct, albeit one containing different substantive concepts. Starting with the original two statements, additional statements that related to urban or environmental values were tested one at a time. When the addition of the candidate statement raised the level of the alpha of the set, that statement was accepted for inclusion in the set. With the final list of candidates, each statement was then manually deleted to see if its absence raised the level of the alpha; if so, it was deleted. This process resulted in a final list of 15 statements, reproduced here as Table 8-1. The combined factor resulted in a Cronbach's alpha of 0.85, which is considerably above the level generally accepted as stable. The 15 statements selected by this process include four that reflect the SN. In short, this set of values represents an integration of personal and interpersonal attitudes. In the language of the TPB, it represents a combination of measures of attitude toward the behavior and SN.

The 15 variables were integrated by summing the responses to the 15 rating statements. The sample of respondents was divided into two groups, one with higher than average (mean) scoring on the combined factor, labeled as the high urban/environmental values group, and the second with scorings lower than the sample mean, labeled as the low urban/environmental values group. Of the responding sample (865), 467 respondents are categorized as being in the high urban/environmental values group, and 398 are categorized has being in the low urban/environmental values group.

Personal Values and Travel Behavior

One's personal values toward urbanity and the environment seem to be strongly associated with the propensity to walk and take transit, as shown in Table 8-2. In this table, *green mode* is the sum of the transit and walk modes.

Table 8-2. Personal values and green mode shares.

Values Group (15 Variables)	Green Mode Share, All Trips (%)	Green Mode Share, Work Trips* (%)	Green Mode Share, Nonwork Trips (%)
High Urban/ Environmental Values	33	50	29
Low Urban/ Environmental Values	15	30	11
Full Sample	24	41	21

High/low pair values significantly different at $p <$. 05; n ranges from 467 to 341.

* Work trips mode share in this chapter is computed for workers only. It differs from the values in Chapter 6, which provide work trip mode share for the entire group of respondents

Table 8-2 shows that while 15% of the trips by all purposes for the low urban/environmental values group were taken by green modes, some 33% of trips of those in the high urban/ environmental values group were taken by green modes. Thus, green mode trip making was over twice as prevalent for the high urban/environmental values group as for those in the low urban/environmental values group. The influence of personal values on the work trip was much less pronounced than for the nonwork trip. However, all of the differences between the high urban/environmental values group and the low urban/environmental values group are significant at $p < .05$.

Table 8-3 shows the relationship between personally held values and travel behavior relative to transit and walking, by trip purpose. Clearly, the effect of the urban/environmental values factor is visible for all trip purpose categories shown in Table 8-3. Again, as expected, the nonwork travelers with low urban/environmental values show the least propensity to use transit of any group with a 4% mode share. All of the differences between groups in this table are significant at $p < .05$.

Table 8-3. Personal values and transit mode shares.

Urban Values Group (15 Variables)	Transit Share, All Trips (%)	Transit Share, Work Trips (%)	Transit Share, Nonwork Trips (%)
High Urban/Environmental Values	17	41	12
Low Urban/Environmental Values	8	26	4
Full Sample	13	34	8

High/low pair values significantly different at $p < .05$; n ranges from 467 to 341.

Looking at walking, the variation between the holders of high urban/environmental values and low urban/environmental values is largely consistent with the pattern for green modes as a whole. In general, those who place a positive value on the urban conditions supportive of walking tend to actually walk at a rate roughly 2.5 to 3 times as large as those who place a negative value on those attributes, as shown in Table 8-4. All of the differences between groups are significant at $p < .05$.

Urban Form and Travel Behavior

To undertake the analyses in this chapter, it was necessary to create two groups that represent two levels of supportiveness

Table 8-4. Personal values and walking.

Values Group (15 Variables)	Walk Share, All Trips (%)	Walk Share, Nonwork Trips (%)	Monthly Utilitarian Walk Trips (No.)	Monthly Nonwork Utilitarian Walk Trips (No.)
High Urban/ Environmental Values	16	18	17	16
Low Urban/ Environmental Values	6	7	6	5
Full Sample	11	13	12	11

High/low pair values significantly different at $p < .05$; n ranges from 467 to 398.

from the built environment, in relation to the propensity to walk and take transit. The Phase I survey offers a wide variety of questions in this area, ranging from neighborhood type to size of the town or city; it also offers the chance to examine separately the question of whether your neighborhood has multiunit housing, which is different from whether your personal residence is in multiunit housing. Several of these categorization methods to create the two groups were examined, and one of these (mix of housing) is presented later in this section. However, it became clear that the most comprehensive definition to use was the project's definition of a CN. As noted in the definitions presented in Chapter 1, a location is referred to as a "CN" when (*a*) there is some form of housing other than a single-family home within one-third mile, (*b*) there is a commercial district within one-third mile, and (*c*) the neighborhood has transit service. If any of the preconditions are lacking, the location is categorized as *not in CN*.

The data set divides the 865 respondents into two groups: *living in CN* and *not in CN*. Of the total sample, some 222 reside in a CN and 643 do not. Table 8-5 shows the strong relationship between the type of neighborhood inhabited and the use of transit and walking,

Logically, the use of walking and transit would be higher in a CN than in other locations. Table 8-5 shows the relationship between the built environment and the propensity to take trips by walking or transit, summarized in the green mode share. Table 8-5 also shows that while 18% of the trips by all purposes in areas other than CNs were taken by green modes, some 44% of trips in CNs were taken by green modes. Thus, green mode trip making was almost 2.5 times as prevalent in the CNs as in the non-CNs. The differentiation attributable to the conditions of the built environment is far more prevalent in the analysis of the nonwork trip than for the work trip. The differences between respondents in CNs and outside CNs are significant at $p < .05$.

Transit can be examined separately from walking. From Table 8-6, it can be observed that total public transportation trip making was more than 2.5 times as prevalent in CNs as in non-CNs. Furthermore, it can be observed that the effect of neighborhood type on the propensity to take transit is far more pronounced for the nonwork trip than for the work trip. As expected, this reflects the wider distribution of transit over trip purposes in the CN neighborhoods than in the rest of the region: outside of the transit-rich areas, nonpeak hour, nonwork travel is far less important than in the CN.

Turning our attention to the relationship between neighborhood form and the propensity to walk, Table 8-7 shows that one-fifth of all utilitarian trips in the CN are taken by walking, which is about two times the rate of areas outside of the CN. Interestingly, the walk mode share for the nonwork trip is only slightly higher than the walk mode share for all trip purposes. Looking at the metric of walk trips in terms of absolute numbers, rather than shares, respondents from the CNs reported taking 22 utilitarian walk trips per month, while those outside of the CNs reported taking nine utilitarian walk trips per month.

As noted, the CN has three supportive components that come together to facilitate the choice of transit and walking. The CN has supportive attributes in terms of housing mix, walking destinations, and available transit. To understand the relative importance of various elements of the CN, travel behavior has been calculated as a function of variation in

Table 8-5. Neighborhood and green mode shares.

Location	Green Mode Share, All Trips (%)	Green Mode Share, Work Trips (%)	Green Mode Share, Nonwork Trips (%)
Living in CN	44	56	41
Not in CN	18	35	14
Full Sample	24	41	21

CN/Not CN pair values significantly different at $p < .05$; n ranges from 643 to 197.

Table 8-6. Neighborhood and transit mode shares.

Location	Transit Share, All Trips (%)	Transit Share, Work Trips (%)	Transit Share Nonwork Trips (%)
Living in CN	24	44	20
Not in CN	9	31	4
Full Sample	13	34	8

CN/not CN pair values significantly different at $p < .05$; n ranges from 643 to 222.

Table 8-7. Neighborhood and walking.

Location	Walk Share, All Trips (%)	Walk Share, Nonwork Trips (%)	Monthly Utilitarian Walk Trips (No.)	Nonwork Utilitarian Walk Trips (No.)
Living in CN	20	22	22	20
Not in CN	9	10	9	8
Full Sample	11	13	12	11

CN/not CN pair values significantly different at $p < .05$; n ranges from 643 to 197.

Table 8-8. Neighborhood housing mix and mode shares.

Neighborhood Mix	Green Mode Share, All Trips (%)	Transit Share, All Trips (%)	Walk Share, All Trips (%)	Monthly Utilitarian Walk Trips (No.)
Mixed Housing Types	30	13	16	15
Single-Family Houses Only	15	8	8	7
Total Sample	24	13	11	12

Mixed housing/single housing paired values significantly different at $p < .05$; n ranges from 450 to 415.

housing mix only. The relationship between housing mix and green mode use can be seen in Table 8-8.

Table 8-8 shows the importance of mixed housing characteristics, separated out from the importance of transit service and commercial destinations within walking distance. A total green mode share of 30% is reported for the mixed neighborhoods, compared with 41% in the full CNs (as shown in Table 8-8. In terms of reported utilitarian walking trips, those from neighborhoods with a variety of housing types report making 15 walking trips a month, versus seven trips from those in neighborhoods with only single-family housing. Clearly, the existence of a mix of housing types is a major (though partial) component of the total effect of CNs in terms of travel behavior.

The Combination of Personal Values, Urban Form, and Travel Behavior

This section of the chapter will examine the relationship between travel behavior concerning walking/transit and the combined forces of personal values and the nature of the built environment. To visualize the combined impact of both positive and negative influences on the use of walking and transit, a simple four-cell matrix will be used throughout this section. This format allows the user to examine variation separately (looking along either the rows or the columns) or together (looking at the relationship of the four cells to each other).

Creating the Four-Cell Matrix

The four-cell matrix shows the modal share associated with a combination of personal values (represented by the two columns) and supportive neighborhood conditions (represented by the rows). Table 8-9 shows the basic table, as well as the percentage of respondents that fell into each cell.

Table 8-9. Location and values together—green mode share, all trips.

	Low Urban/ Environmental Values	High Urban/ Environmental Values
Living in CN	26%	51%
Not in CN	12%	24%

Differences between row pairs and column pairs significant at $p < .05$; n= 333 to 65.

As Table 8-9 shows, when both the values and the environment are positive, the highest green mode share results (51%). When both the attitudes and the environment are negative, the lowest green mode share results (12%). For each "conflicted" group, when one factor is positive and the second factor is negative, the value looks something like the average value for the sample (24% green mode share).

The four-cell matrix shows how the two independent variables interact. For example, if someone who holds a set of high urban/environmental values were to move into a CN, and if she were to act like others in the CN with similar values, the result would be a high mode share for transit and walking. On the other hand, if someone with low levels of urban/environmental values were to move to a CN, and if she were to act like others in the CN with similar values, the resultant mode share would be similar to the average for the entire sample.

Relationship to the Theory of Planned Behavior

Seen in terms of the TPB, the urban/environmental values can be viewed as a combination of the attitude and the subjective norm. Similarly, the extent to which the built environment either facilitates or impedes the adoption of the behavior can be viewed as relating to self-confidence. In our admitted simplification of the factors included in the TPB, the subjects with positive attitude/SN, whose decision is facilitated by the built environment, end up with 51% adoption of the behavior. The conflicted subjects with positive attitude/SN, but whose environment impedes the adoption of the behavior, end up with a near-average 24% adoption of the behavior.

On the other hand, the group whose attitude/SN is negative, and whose environment tends to impede adoption of the behavior, winds up with only 12% adoption; the conflicted

Table 8-10. Location and values together, by trip purpose.

	Green Mode Share, Work Trips		Green Mode Share, Nonwork Trips	
	Low Urban/ Environmental Values (%)	High Urban/ Environmental Values (%)	Low Urban/ Environmental Values (%)	High Urban/ Environmental Values (%)
Living in CN	41	63	22	49
Not in CN	27	43	9	19

Difference between row and column pairs significant at $p < .05$; n= 333 to 58.

subject whose attitude/SN is negative, but whose environment is encouraging of the behavior, ends up with a near-average adoption of the behavior (26%). Note that the approach taken in this chapter is highly influenced by the logic put forward in the paper, *Changing Individual Travel Behaviour: From Policy to Perceived Behavioral Control,* by S. G. Stradling (*50*).

Applying the Four-Cell Matrix to Walking and Transit

Table 8-10 shows the four-cell matrix applied to the green mode share for work and nonwork trips. In general, each of the cells of the matrix appears as expected, with both the conflicted cells reflecting a value near the average work trip green mode share of 41%. As noted before, the work trip shows less variance associated with the two independent variables than does the nonwork trip.

The matrix for green mode share for the nonwork trip is also shown in Table 8-10. The lack of use of green modes for the nonwork trip for those outside the CNs and with low urban/environmental values is contrasted with the robust share for the opposite group. The values for the two conflicted groups mirror the full sample nonwork mode share of 21%.

When the four-cell matrix is limited to transit mode share (Table 8-11), there are similar patterns as with the green mode share, except that many of the differences are no longer significant. In this table the differences that are not significant are indicated by pairs of percentages with the same superscripts. The CN residents take transit at a rate several times those in non-CNs. For the work trip, transit attracts a significant share from all four market segments, while for the nonwork trip transit mode split declines more sharply either for those in non-CNs or with low urban/environmental values. Most work trip transit share differ-

Table 8-11. Location and values together—transit share by trip purpose.

	Transit Share, All Trips		Transit Share, Work Trips		Transit Share, Nonwork Trips	
	Low Urban/ Environmental Values (%)	High Urban/ Environmental Values (%)	Low Urban/ Environmental Values (%)	High Urban/ Environmental Values (%)	Low Urban/ Environmental Values (%)	High Urban/ Environmental Values (%)
Living in CN	$16^{x,y}$	27^{y}	$34^{a,c}$	$47^{b,c}$	12	23
Not in CN	7^{x}	12	24^{a}	38^{b}	2	6

Differences between row and column pairs (except subscripted pairs) significant at $p < .05$

n = 333 to 58. Differences that are not significant are indicated by pairs of percentages with the same superscripts.

Table 8-12. Location and values together—walking, by trip purpose.

	Walk Share, All Trips		Walk Share, Nonwork Trips	
	Low Urban/Environmental Values (%)	High Urban/Environmental Values (%)	Low Urban/Environmental Values (%)	High Urban/Environmental Values (%)
Living in CN	10[a]	24	10[b]	26
Not in CN	6[a]	12	6[b]	13

Differences between row and column pairs significant at p <.05 except for pairs a,b; *n*=333 to 65.

ences in Table 8-11 are not significant. The exception is that, for those not living in a CN, there is a significant difference in transit mode share to work between the high values group and the low values group.

Turning to the walking patterns (Table 8-12), it becomes clear that, for each cell of our matrix, walk share does not vary much by trip purpose.

Looking at the data in terms of absolute number of walk trips per month, the most positive group takes about 26 walk trips per month, while the least positive group takes about five trips per month. The two conflicted groups each report about 12 trips per month, as shown in Table 8-13.

Auto Availability and Travel Behavior

In the previous section, modal behavior describing transit and walking was summarized in terms of its relationship to the combination of two independent variables. This section examines the impact on modal behavior of a third factor—auto availability—and its interaction with the original two variables. Lower-than-average levels of auto availability is a key characteristic of life in a CN, and it is associated with higher use of walking and transit.

Several variables were examined in the project for use as a proxy for the latent condition of automobile orientation. The calculations in this section of the chapter were based on the creation of two groups—one group with fewer cars in their household than adults, and a second group with an equal or greater number of cars than the number of adults. The first group is referred to as having a *low auto availability level*, while the second group is labeled the *high auto availability level.*

Other concepts could be used in this analysis. Based on responses to the statement "I need to drive my car to go where I need to go," two groups were formed, one with below-average values and one with above-average values on the statement. When it was applied to the analysis below, the impact of this variable on travel behavior was extremely similar to the results derived from the use of the two auto availability level groups chosen for this analysis. In the end, the variable of auto availability level was chosen because of the simplicity of its logic and because this variable can be created from readily availably sources, such as the National Household Travel Survey and (in aggregate) the U.S. Census.

Table 8-13. Location and values together—number of walk trips.

	Number of Monthly Utilitarian Walk Trips		Number of Nonwork Utilitarian Walk Trips	
	Low Urban/Environmental Values	High Urban/Environmental Values	Low Urban/Environmental Values	High Urban/Environmental Values
Living in CN	12	26	10	24
Not in CN	5	12	5	12

Differences between row and column pairs significant at $p < .05$; $n = 333$ to 65.

Table 8-14. Percentage of group with low auto availability, by neighborhood type.

Location	Low Auto Availability (%)
In CN	51
Not In CN	25

Auto Availability as a Characteristic of Neighborhood Type

A lower level of auto availability is a key characteristic of life in a CN. In our sample, the majority of persons in CNs (51%) come from a household having less than one car per adult (Table 8-14); for those outside of the CNs, only 25% have less than one car per adult. The average auto ownership rate is 1.2 cars per household within CNs and 1.9 outside CNs. Clearly, low levels of auto availability are associated with location in a CN.

Auto Availability and Travel Behavior

Table 8-15 shows the relationship between the two levels of auto availability and the propensity to take a green mode for different trip purposes. Those from households with less than one car per adult have nearly two to three times the propensity to take a green mode than those who have at least one car per adult.

From Table 8-15, the relationship between auto availability level and travel behavior for green modes (transit and walk) can be observed.

Table 8-16. Green mode share, based on auto availability and personal values.

	Green Mode Share, All Trips: Low Urban/Environmental Values (%)	Green Mode Share, All Trips: High Urban/Environmental Values (%)
Low Auto Availability	27	49
High Auto Availability	12	21

Differences between row and column pairs significant at $p < .05$; $n = 324$ to 74.

Auto Availability, Personal Values, and Travel Behavior

The interaction between auto availability and personal values in the formation of travel behavior is shown in Table 8-16. Those with two conditions supportive of green mode use have a 49% share, while those with two conditions unsupportive of green mode use have a 12% share. Those in the two conflicted cells act as expected.

Auto Availability, Urban Form, and Travel Behavior

The relationship between travel behavior and the combination of auto availability and neighborhood type is shown in Table 8-17. When the two conditions supportive of walking and transit are present, the green mode share is 62%; when the two conditions unsupportive of walking and transit are present, only a 14% share is reported.

Table 8-15. Auto availability and modal behavior.

	Green Mode Share, All Trips (%)	Transit Share, All Trips (%)	Transit Share, Work Trips (%)	Walk Share, All Trips (%)	Monthly Utilitarian Walk Trips (No.)
Low Auto Availability	43	24	49	19	21
High Auto Availability	16	8	27	8	7

Differences between column pairs are significant at $p < .05$; $n = 591$ to 249.

Table 8-17. Green mode share, based on auto availability and location.

Green Mode Share, All trips	Not in CN	In CN
Low Auto Availability	30%	62%
High Auto Availability	14%	25%

Differences between row and column pairs significant at $p < .05$; $n = 482$ to 109.

Personal Values, Urban Form, Auto Availability, and Travel Behavior

Table 8-18 shows the derivation of the matrix showing green mode share for all trip purposes, based on the interaction of all three major variables. At the extremes, the best case scenario (i.e., positive attitudes, supportive built environment, and low levels of auto availability) produces a 64% green mode share; the worst case scenario produces an 11% green mode share. Figure 8-1 presents those data in a graphic form. Most of the pairs in the rightmost column are significantly different.

Table 8-19 presents a summary of the all of the categories with transit share, walk share, and the absolute number of walking trips per month in addition to the green mode total (walking plus transit).

Examination of Relationships Using Structural Equation Modeling

A final analysis examines the relative importance of each of the three factors. It is clear that there is a certain amount of correlation between the urban/environmental values and the choice to reside or not to reside in the CN; there is correlation between the choice of the neighborhood and the number of autos owned therein; and there is correlation between number of autos owned and the urban/environmental values. To understand the separate roles of each of the three variables, a statistical process known as SEM was used. This helps to isolate the degree of explanatory power for each of the variables.

A Structural Equation Model with the Three Variables

A path diagram from a structural model using the three variables of personal values, neighborhood type, and auto availability is shown in Figure 8-2. In this model, the binary categories of high urban/environmental values and low urban/environmental values were replaced by the continuous variable representing all reported values on the combined scale. The binary categories of *high auto availability* and *low auto availability* were replaced by the continuous variable *autos per person*, representing all reported levels of autos per adult. For the question about living in a CN, the binary values were retained. Several demographic variables were tested, and income per person was retained.

Figure 8-2 reveals how the three observed exogenous variables relate to each other and to the endogenous variable of green mode share. In relation to the propensity to walk or take public transportation (green modes), the standardized coefficient for personal values is 0.20, while the coefficient for neighborhood is 0.23. The coefficient for autos per person (–0.43) is the largest in absolute value, reflecting a negative relationship with the number of cars owned per adult in the household and the propensity to take green modes.

The signs for each of the correlations between the three exogenous variables (as shown in the double-ended arrows on the left side of the diagram) are logical. Having positive views towards urban attributes and environmental concerns is positively correlated with the decision to live in a CN. Compact neighborhood location is negatively correlated with the number of cars owned, and the pro-urban, pro-environmental personal values are negatively associated with the number of cars owned.

All coefficients from the exogenous variables (including income per person) are significant at $p < .001$. The r^2 equivalent is 0.44. There is no one measure to determine the "goodness of fit" for a structural equation model. The following set of measures indicates that this model performs only moderately well: the normed fit index is 0.898, which is above the minimum level of 0.8; the comparative fit index is 0.9, with 1 being the most desirable value. However, the Tucker-Lewis index is 0.5, when it should be at least 0.9. A root mean squared error of approximation (RMSEA) of 0.16 is above the desired maximum of 0.05. All of these indices combine to suggest that there are more explanatory factors to be identified in future research.

A Better Model

Figure 8-3 shows a path diagram from a structural equation model derived by adding additional exogenous variables.

Figure 8-3 expands upon the exogenous variables of Figure 8-2 to look at factors associated with autos per person, then at the choice of green modes (the share of total trips by transit or walking).

Table 8-18. Green mode share, all trip purposes.

Urban/ Environmental Values Group	Current CN Status	Auto Availability Index	Share (%)
High Urban/Environmental Values	In CN	Low Auto Availability	64
		High Auto Availability	31
		Total	51
	Not in CN	Low Auto Availability	35
		High Auto Availability	18
		Total	24
	Total	Low Auto Availability	49
		High Auto Availability	21
		Total	33
Low Urban/Environmental Values	In CN	Low Auto Availability	50
		High Auto Availability	17
		Total	26
	Not in CN	Low Auto Availability	20
		High Auto Availability	11
		Total	12
	Total	Low Auto Availability	27
		High Auto Availability	12
		Total	15
Total	In CN	Low Auto Availability	62
		High Auto Availability	25
		Total	44
	Not in CN	Low Auto Availability	30
		High Auto Availability	14
		Total	18
	Total	Low Auto Availability	42
		High Auto Availability	16
		Total	24

n = 276 to 17

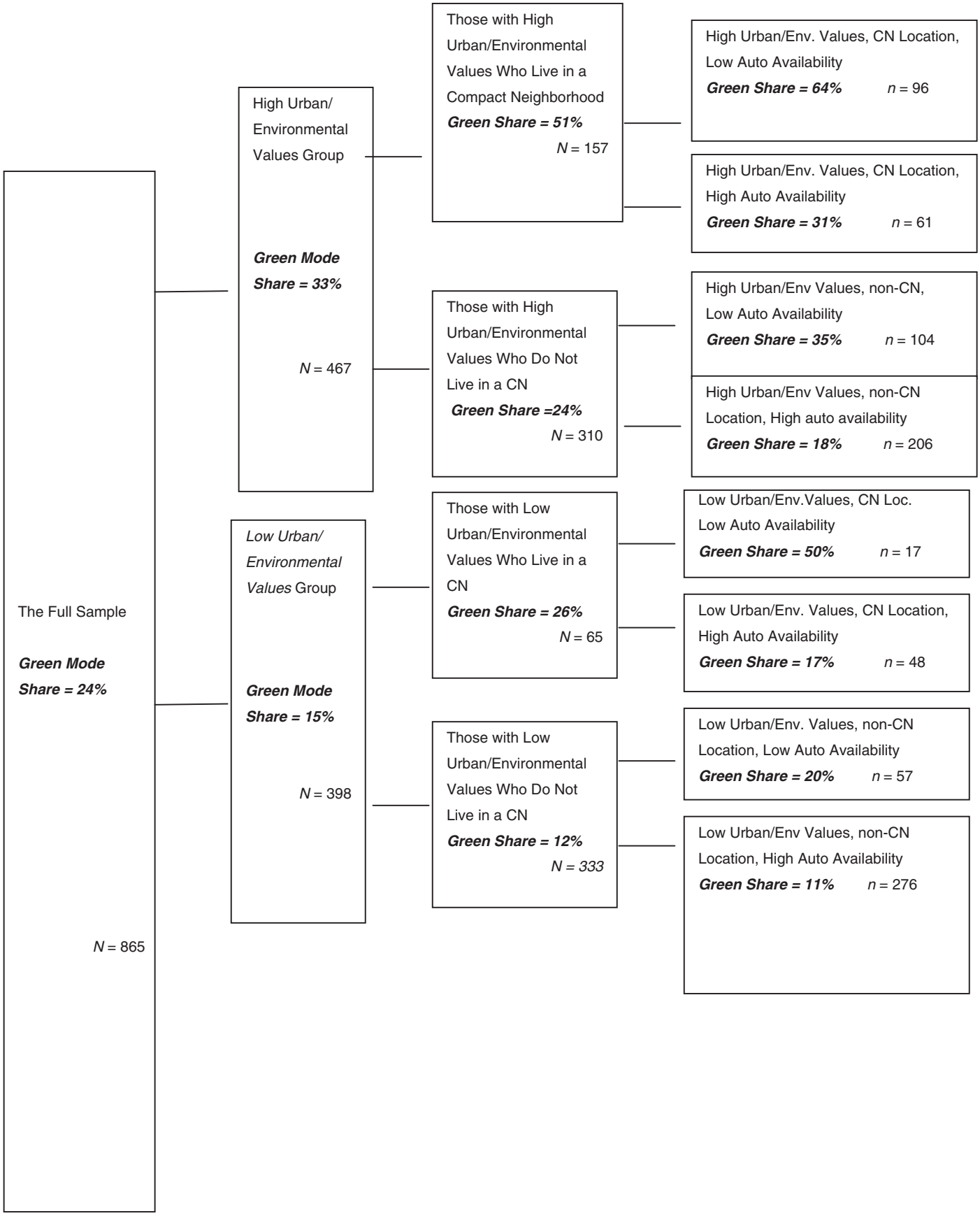


Figure 8-1. Green mode share with all three independent variables combined.

Table 8-19. Mode share by urban form, values, and auto availability.

Current Compact Neighborhood Status	Auto Availability Index	Green Mode Share, All Trip Purposes (%)	Transit Share, All Trip Purposes (%)	Walk Share, All Trip Purposes (%)	Monthly Utilitarian Walk Trips (No.)
High Urban/ Environmental Values, Currently in CN	Low Auto Availability, *n* = 96	64	36	2	31
	High Auto Availability, *n* = 61	31	13	18	19
High Urban/ Environmental Values, Not in CN	Low Auto Availability, *n* = 104	35	20	15	14[a]
	High Auto Availability, *n* = 206	17	8	10	11[a]
Low Urban/ Environmental Values, Currently in CN	Low Auto Availability, *n* = 17	50*	30*	20*	27*
	High Auto Availability, *n* = 48	17*	11*	6*	6*
Low Urban/ Environmental Values, Not in CN	Low Auto Availability, *n* = 57	20	11	9	9
	High Auto Availability, *n* = 276	11	6	5	5

High/low auto availability pairs significantly different at $p < .05$, except *a*.

* = not computed due to small segment size.

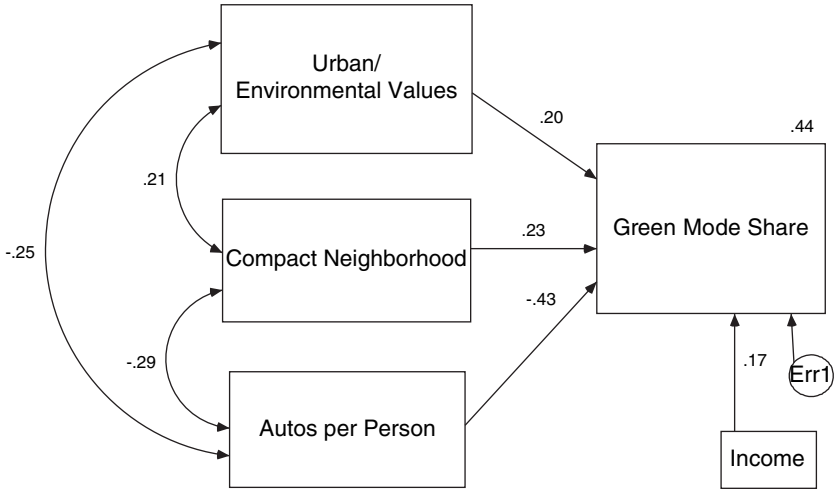


Figure 8-2. Structural equation model with values, neighborhood type, and auto ownership.

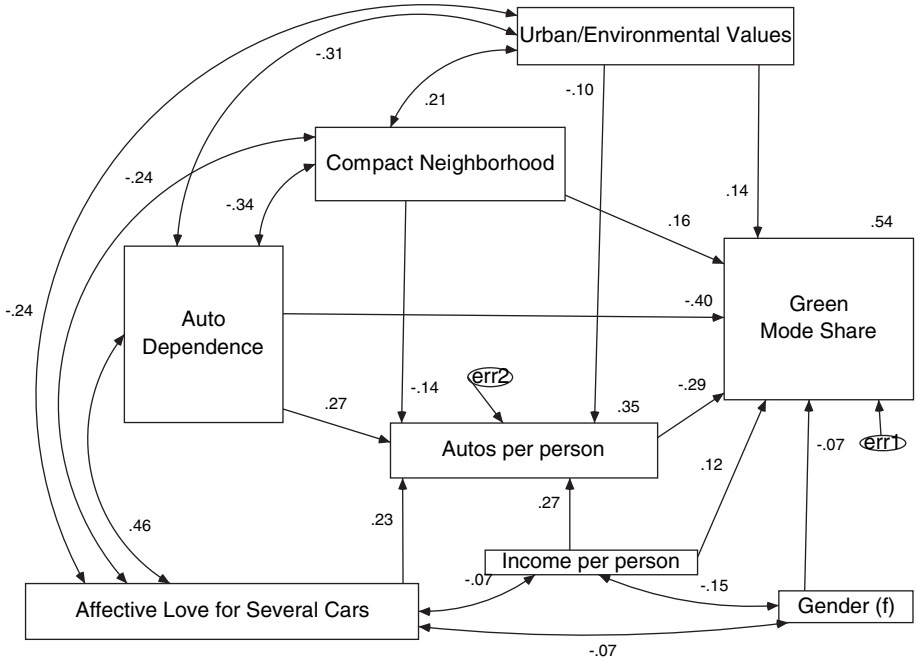


Figure 8-3. Structural equation model with the three variables, plus other values and constraints.

The Variables

This structural equation model uses the three variables used previously: (*a*) a composite variable based on 15 statements reflecting attitudes toward features of an urban neighborhood and toward the environment (*urban/environmental values*); (*b*) a CN variable, which is one if the respondent lives in a CN and zero otherwise; and (*c*) *autos per person,* which is the number of autos per household divided by the number of adults in that household. In addition, the model uses new variables, including *affective love for several cars,* which is based on agreement with the statement "I love the freedom and independence that comes from owning several cars." Another variable is *auto dependence,* which is based on agreement with the statement "I need to drive my car to get where I need to go." The survey text for these new auto-related variables is as follows:

How strongly do you agree or disagree with the following?

When I think of things that are important to ***me*** . . .

1	2	3	4	5	6	7
STRONGLY DISAGREE						STRONGLY AGREE

I love the freedom and independence that owning several cars provides for my household. [*affective love for several cars*]

I need to drive my car to get where I need to go. [*auto dependence*]

The model shown in Figure 8-3 also provides a way to interpret much of what was learned in the first phase of the study. At the top of the diagram lies a surrogate for our values and beliefs, the factor called *urban/environmental values.* It is a composite of concerns about one's personal attitudes about neighborhood characteristics (e.g., "I would like to live where I can walk to the coffee shop"), one's personal attitudes towards environmental issues, and one's belief about the environmental attitudes of one's family and friends. This set of values is applied in the choice of mode (as in Figure 8-2) and also to the question of the number of autos per person in the household. In the Figure 8-3 path diagram, personal values are used to directly explain the green mode share and the dependent variable *autos per person.*

Having these personal values is positively associated with a high green mode share and negatively associated with having more cars. The same path diagram reveals that having these pro-urban and pro-environmental values is positively correlated with living in a CN and negatively correlated with a feeling of auto dependence and a feeling of freedom and independence from having several cars.

Components of the Model

The structural equation model shown in Figure 8-3 can be seen as the simultaneous application of two component submodels.

- *The Mode Choice Submodel*: The path diagram describes several variables associated with green mode share: urban/environmental values, neighborhood type, auto dependence, autos per person, and the demographic values of income per person and gender. This is similar to the content of the Figure 8-2 path diagram, with the addition of auto dependence as a direct independent variable.
- *The Auto Ownership Submodel:* Autos per person in the household is affected by urban/environmental values, neighborhood type, auto dependence, affective love for several cars, and income per person.

Detailed Model Results

- The Mode Choice Submodel. The independent variable with the strongest association with green mode share is auto dependence. Green mode share is negatively associated with auto dependence, with a standardized coefficient of -0.40, and negatively associated with autos per person, with a standardized coefficient of -0.29. Green mode share is positively associated with urban/environmental values, with a standardized coefficient of 0.14, and with living in a CN, with a standardized coefficient of 0.16. Green mode share is positively associated with income per person (0.12) and negatively associated with being female (-0.07). The dependent variable *green mode share* has an r^2 equivalent of 0.54.
- *The Auto Ownership Submodel*: Auto dependence and income per person have the strongest association with autos per person. Autos per person has positive associations with standardized coefficients of (0.27) for auto dependence and (0.23) for affective love for several cars. Autos per person has a negative coefficient (-.10) with urban/environmental values; it is also negatively associated with living in a densely settled neighborhood (-0.14). Autos per person is also positively associated with income per person (0.27). The auto ownership model has an r^2 equivalent of 0.35.

All of the coefficients described above are significant at the $p < .001$ level, except the coefficient between the independent variable *female* and the dependent variable *green mode share*, which is significant at $p < .03$.

As a whole, this model performs well. The Tucker-Lewis index is 0.986, which is close to 1.0, as desired. The comparative fit index is 0.997, also close to 1.0. The RMSEA is 0.026, which is considerably better than the desired maximum value for good fit of 0.05.

In the structural equation model, one variable can be associated with another through direct effects, as shown in Figure 8-3 and also indirectly through its association with intervening variables. For example, auto dependence is associated with green mode share directly and indirectly through its association with autos per person. The structural equation model thus provides the means to examine the total association between variables. Table 8-20 shows the standardized total effects for the model shown in Figure 8-3. As can be seen, auto dependence has the greatest total effect on both of the dependent variables.

Conclusion: Learning from the Revised Model

The revised structural equation model represents the simultaneous examination of several variables that interact in the behaviors that ultimately effect the choice of transit and walking for utilitarian travel. The SEM process allows the cumulative examination of the direct and indirect "standardized total effects" on all endogenous variables. Importantly, the strongest total association with the decision to take green modes comes from (in order) auto dependence (-0.483), autos per person (-0.292), CN (0.204), and urban/environmental values (0.166). The dominance of auto dependence suggests that this variable is deserving of further research.

Summary Observations

A key theme in the development of this research is the understanding of how people's residential decisions are interrelated with their decisions concerning trip making by walking and transit. This chapter has emphasized the impor-

Table 8-20. Standardized total effects for two dependent variables.

	Affective Love for Several Cars	Urban/ Environmental Values	Auto Dependence	Income per Person	CN	Female	Autos per Person
Autos/ Person	0.226	-0.104	0.273	0.267	-0.139	0.000	----
Green Mode Choice	-.066	0.166	-0.483	0.046	0.204	-0.073	-0.292

tance of the simultaneous interaction of key variables concerning neighborhood characteristics and their association with various indices of travel behavior concerning walking and transit.

Based on the presentation of the data up to this point, three summary observations about the key variables can be made.

Personal Values

Consistent with other recent work in this field, it is clear that one's personal values have an impact on one's decision to make trips by walking and transit. An urban infrastructure has an independent effect on walking and transit, but the impact of values is of similar magnitude.

The creation of a single, combined scale of urban/environmental values derived from responses to 15 separate questions allows for a quick and easily replicated categorization of groups. This project has demonstrated that the analysis group with high urban/environmental values has more than two times the propensity to choose green modes as the group with low urban/environmental values. This observation alone is enough to encourage the further study of the effects of personal values on travel behavior concerning walking and transit.

Urban Form (Compact Neighborhood)

A built environment designed to facilitate and support the use of walking and transit is associated with significantly higher use of these modes than experienced in other areas. The definition of a CN as one with mixed housing, with a commercial area within walking distance, and with transit available provides a consistent, easily applied definition for a set of conditions representing the concept of a well-designed built environment. As summarized in this chapter, those in the sample who lived within a CN had walking/transit rates more than twice those reported for those who lived outside of a CN. Noticeably, transit plays a key role in nonwork trips within the CN that do not occur outside of the CNs.

For the conflicted user with high urban/environmental values, but not supported by the conditions of the CN, the combination of positive factors does not occur, reflected in green mode share that mimics the average of the sample. But when the high urban/environmental values group is supported and facilitated by the physical environment, the majority of trips are undertaken by walking and transit.

Auto Orientation

A third phenomenon associated with the propensity to walk and take transit is the orientation of the subject toward his/her automobile. Of the three variables reviewed in this chapter, the one most deserving of future research may be the influence of an individual's orientation toward the automobile.

The difference in the use of walking and transit between (for example) a couple with two cars and a couple with one car is marked. For those living in a CN, green mode selection is much associated with car availability: CN residents with less than one car per adult report a 62% green mode share, which is 2.5 times the share for those with higher car availability, at 25%. A similar relationship by auto availability level occurs in all the cells of the eight-cell matrix (refer to Table 8-19). For example, for the population with high urban/environmental values and location within a CN, the subgroup with low auto availability reports a 64% green mode share, compared with a 31% share for the high auto availability subgroup.

A key variable defined for this research is auto dependence, which is the respondent's agreement with the statement "I need to drive my car to get where I need to go." This variable has the strongest association with a respondent's mode share for walking and taking transit, as well as with the respondent's auto ownership level. (It also has a strong negative correlation with a location in a CN.) The dominance of auto dependence suggests that further research should explore the extent to which the perception that "I need to drive my car to get where I need to go" can be affected by public policy interventions that actually do lower the level of auto dependence, and the extent to which the perceptions themselves can be altered.

CHAPTER 9

Exploring the Choice of a Compact Neighborhood Using the Theory of Planned Behavior

The prior chapters examined market sectors based on the Phase 1 Internet panel responses broken down by age-group and e-panel; by cluster analysis of attitudes and values; and by urban/environmental values, neighborhood, and auto availability. In this chapter, the objective is to explore in more detail the model of the TPB and to determine if the model adds to our understanding of how individuals make residential decisions. As specified in the analysis plan, the following two tasks are to be accomplished in this chapter:

- Test whether the ATT, SN, and perceived behavioral control or SCF could be predictors of intent
- Test whether the measured beliefs are relevant to the individual's ATT, SN, and SCF.

Figure 9-1 shows all of the TPB components that were measured in the Phase 1 survey. Because the Internet panel survey was a cross-sectional survey, cause and effect cannot be distinguished. It can, however, be determine whether the associations between variables in the model are compatible with the TPB. The following sections describe the analyses done to satisfy the research objectives related to the TPB.

Relationship Between ATT, SN, SCF, and Intent

According to the TPB, the predictors of intent are ATT, SN, and SCF. With the Phase 1 Internet panel survey, direct measures of these constructs as related to moving to a CN in the next 2 years were taken.[2]

Table 9-1 shows the average results for the 822 respondents who were asked to give their opinions about moving to a CN. Table 9-1 shows the direct measures of intent, ATT, SN, and SCF. On average, the intent to move to a CN in the next 2 years was ranked on the lower side of the one-to-seven scale. The respondents rated their confidence in being able to move highest (4.5), followed by their ATT (3.8) and their SN (3.2). Their intent to move was lower still, at 2.9.

Table 9-1 also shows Cronbach's alpha, which is an indicator of the internal reliability for each composite measure. As can be seen, all of the measures are acceptable (above 0.7), except that for SCF.[3]

Regression was used to examine the relationship between intent and ATT, SN, and SCF. The result is shown in Table 9-2 As can be seen, the R^2 for the regression was 0.73, significantly larger than the R^2 of 0.41 found in the various studies reported by Godin and Kok (*36*). ATT, SN, and SCF are all highly significant. The coefficients of ATT and SN are of similar magnitude, with the coefficient of SCF being less than 30% of the magnitude of SN.

Although many studies, as reported by Godin and Kok (*36*), do not find SN to be as important as ATT and SCF, SN appears to be important in the choice of a CN. One other question in the survey also corroborates the importance of others' opinions. Respondents were asked to state their agreement with several statements describing their current home location, and they were asked to rate their satisfaction with their current home location. The statement "other people think my home and neighborhood are very nice" correlated with current satisfaction more highly than all the other descriptors (correlation coefficient of 0.52).

[2] Those respondents who had recently moved to a compact neighborhood were asked a different series of questions. Thus there is a smaller data set of 822 respondents for the TPB analysis presented in this chapter.

[3] Removing the least correlated statement ("Whether or not I move to a compact neighborhood in the next 2 years is completely up to me") did not change the regression results reported later in this chapter, and so all three measures of SCF were retained.

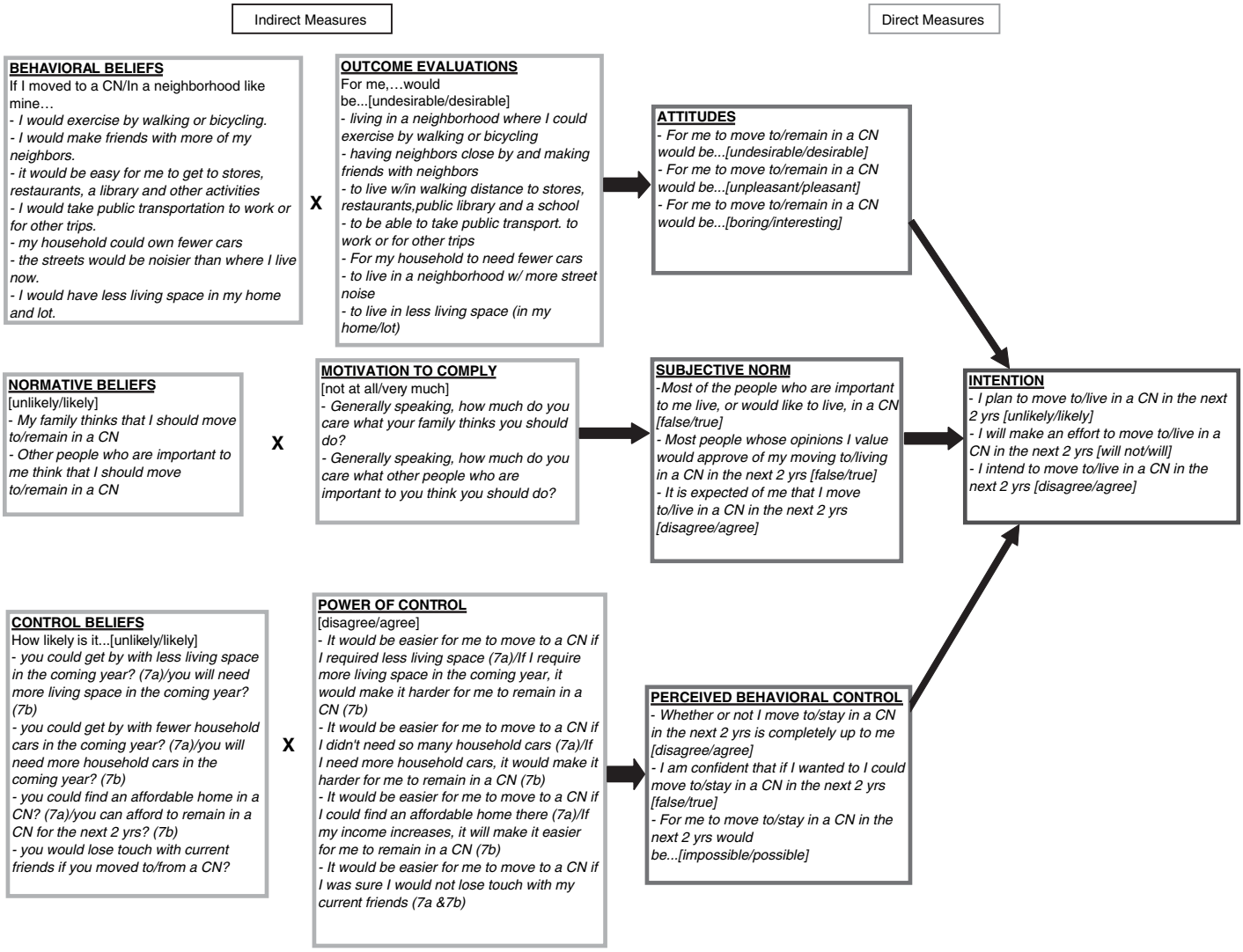


Figure 9-1. The variables of the theory of planned behavior, Phase I application.

Relationship Between Behavioral Beliefs, Outcome Evaluations, and Attitude

A more interesting use of the TPB is to examine the factors that affect ATT, SN, and SCF, as these are the more likely components that a policymaker can affect. As described in Chapter 4, the formal TPB suggests that ATT is influenced by *behavioral beliefs* weighted by *outcome evaluations*. The mathematical formulation calls for summing the products of each behavioral belief multiplied by its outcome evaluation. Figure 9-1 shows the behavioral beliefs and outcome evaluations that the research team hypothesized would influence the ATT. The mean and standard deviation for each belief and outcome evaluation is shown in Table 9-3 ordered by the mean ranking of the outcome evaluations.

As seen in Table 9-3, the respondents on the whole believed that it was more likely than not that most of the hypothesized behaviors would occur in a CN (scores are a neutral 4 or above on a scale ranging from 1 to 7). The most likely belief was that it would be easy to get to stores, restaurants, and other destinations. The second most likely belief was that "I would exercise by walking or bicycling." The least likely belief was that "my household could own fewer cars." Table 9-3 also shows that respondents rated the four most desirable outcomes (independent of neighborhood) as being (*a*) to exercise by walking or bicycling, (*b*) to make friends with neighbors, (*c*) to live within walking distance of restaurants, and (*d*) to be able to take public transportation to work and for other trips. Living in a neighborhood with less living space and with more noise on the street was rated least desirable.

Table 9-1. Mean ratings for the Phase 1 TPB direct measures.

Measure	Source, with Responses on a 1 to 7 Scale	Mean (SD)
Intent	I plan to move to a compact neighborhood in the next 2 years (extremely unlikely/extremely likely)	2.9 (1.9)
	I will make an effort to move to a compact neighborhood in the next 2 years (I definitely will not/I definitely will)	2.9 (1.9)
	I intend to move to a compact neighborhood in the next 2 years (strongly disagree/strongly agree)	2.8 (1.9)
	Average for intent (alpha = 0.96)	2.9 (1.8)
ATT	For me to move to a compact neighborhood in the next 2 years would be (extremely undesirable / extremely desirable)	3.6 (1.9)
	For me to move to a compact neighborhood in the next 2 years would be (extremely unpleasant/extremely pleasant)	3.6 (1.9)
	For me to move to a compact neighborhood in the next 2 years would be (boring/interesting)	4.1 (1.9)
	Average for ATT (alpha = 0.91)	3.8 (1.8)
SN	Most of the people who are important to me live, or would like to live, in a compact neighborhood (definitely false/definitely true)	3.2 (1.8)
	Most people whose opinions I value would approve of my moving to a compact neighborhood in the next 2 years (definitely false/definitely true)	4.0 (1.9)
	It is expected of me that I move to a compact neighborhood in the next 2 years (strongly disagree/strongly agree)	2.5 (1.8)
	Average for SN (alpha = 0.76)	3.2 (1.5)
SCF	Whether or not I move to a compact neighborhood in the next 2 years is completely up to me (strongly disagree/strongly agree)	4.9 (2.0)
	I am confident that if I wanted to I could move to a compact neighborhood in the next 2 years (definitely false/definitely true)	4.6 (2.1)
	For me to move to a compact neighborhood in the next 2 years would be (impossible/possible)	4.1 (2.0)
	Average for SCF (alpha = 0.63)	4.5 (1.5)

Table 9-2. Regression for intent to move.

Dependent Variable: Intent			
Independent Variable	**Coefficient**	***t*-statistic**	**Probability**
Constant	**-1.02***	-9.35	≤.0001
Attitude	**0.50***	16.60	≤.0001
Subjective Norm	**0.47***	12.90	≤.0001
Self-Confidence	**0.12***	4.96	≤.0001

*significant at the probability indicated above
$n = 822$, $R^2 = 0.73$

Regression was used to determine the degree of association between the behavioral beliefs and respondents' attitude toward moving to a CN. The results are shown in Table 9-4. As can be seen, all of the behavioral beliefs had significant coefficients in the regression, indicating that all of these could influence the respondents' attitudes toward moving. The regression coefficients are a statistical measure of the relative importance of each belief, whereas the outcome evaluations are a direct measure. The beliefs that there would be more noise on the street and less space in a CN had negative coefficients, which is logical and in line with the outcome evaluations shown in Table 9-3.

Table 9-3. Mean and standard deviation for behavioral beliefs and outcome evaluations.

Behavioral Beliefs (If I moved to a compact neighborhood) (1 = strongly disagree to 7 = strongly agree)	Mean (SD)	Outcome Evaluations (1 = extremely undesirable to 7 = extremely desirable)	Mean (SD)
I would exercise by walking or bicycling.	5.2 (1.8)	Living in a neighborhood where I could exercise by walking or bicycling	6.0 (1.2)
I would make friends with more of my neighbors.	4.8 (1.6)	Having neighbors close by and making friends with neighbors	5.5 (1.5)
It would be easy for me to get to stores, restaurants, a library and other activities.	5.6 (1.4)	To live within walking distance to stores, restaurants, a public library and a school	5.4 (1.6)
I would take public transportation to work or for other trips.	4.8 (2.0)	To be able to take public transportation to work or for other trips	5.1 (1.9)
My household could own fewer cars.	4.0 (2.1)	For my household to need to own fewer cars	4.3 (2.0)
The streets would be noisier than where I live now.	4.6 (2.0)	To live in a neighborhood with more noise on the street	2.1 (1.6)
I would have less living space in my home and lot.	4.8 (1.9)	To live in less living space (in my home and lot)	2.3 (1.7)

n = 822

The magnitude of the regression coefficient indicates that the belief that it would be easy to get to stores and other destinations had the greatest association with a positive attitude toward moving to a CN. This finding is compatible with findings by Waddell and Nourzad that there is a preference for residential areas with walkable access to retail (*27*), with findings by Srour et al. that access to retail affects residential choice and price (*26*), and with the Vermonters' attitudes on sprawl survey, which found that 48% of households preferred communities within walking distance of retail (*21*).

Most of the other behavioral beliefs with positive association with ATT had coefficients of less than half of the magnitude of "it would be easy for me to get to stores, restaurants, a library and other activities." Nevertheless, being able to take public transportation, make friends with neighbors, exercise by walking and biking, and living with fewer cars were positively associated with ATT.

On the other hand, exercising by walking or bicycling had one of the smallest coefficients. This is surprising since Table 9-3 showed that respondents thought they would exercise by walking or bicycling in a CN and that respondents rated living in a neighborhood where they could exercise by walking or bicycling as desirable. This contradiction may indicate that respondents were rating the outcome evaluation of exercising based on SN—i.e., something they should do, rather than something that would be desirable, pleasant, or interesting to do.

Relationship Between Normative Beliefs, Motivation to Comply, and Subjective Norm

The TPB suggests that SN is influenced by *normative beliefs* weighted by the *motivation to comply*. The mathematical formulation calls for summing the products of each normative belief multiplied by its motivation to comply. The mean and standard deviation for each normative belief and motivation to comply is shown in Table 9-5. As can be seen in the table, the normative beliefs are that family and friends are more unlikely than likely to support a move to a CN. The respondents ratings showed that they cared significantly more what their family thought than what other people thought.

Regression was used to determine how well the normative beliefs accounted for variation in respondents' SN towards

Table 9-4. Regression for attitude toward the behavior.

Dependent Variable: Attitude Toward the Behavior			
Independent Variables: Behavioral Beliefs (If I moved to a compact neighborhood)	**Coefficient**	***t*-statistic**	**Probability**
Constant	**-2.30***	-8.63	≤.0001
I would exercise by walking or bicycling.	**0.10***	2.93	.0035
I would make friends with more of my neighbors.	**0.10***	2.57	.0103
It would be easy for me to get to stores, restaurants, a library and other activities.	**0.27***	5.76	≤.0001
I would take public transportation to work or for other trips.	**0.13***	4.18	≤.0001
My household could own fewer cars.	**0.10***	3.63	.0009
The streets would be noisier than where I live now.	**-0.19***	-5.73	≤.0001
I would have less living space in my home and lot.	**-0.12***	-3.45	.0006

*significant at probability level indicated

$n = 822$, $R^2 = 0.32$.

moving to a compact neighborhood. That regression is shown in Table 9-6. The two normative beliefs tested were both highly significant. As can be seen, the order of the regression coefficients indicates that "other people important to me" have more importance in determining SN toward moving to a CN, contrary to the order in Table 9-5.

Relationship Between Control Beliefs, Power of Control, and Self-Confidence

The TPB suggests that SCF is influenced by control beliefs weighted by the power of control. Figure 9-1 shows the control beliefs and power of control that were tested in the Phase 1 research. The mean and standard deviation for each control belief and power of control is shown in Table 9-7, which is ranked by the power of control statements. As can be seen in this table, the respondents, on average, felt least likely to be able to get by with fewer household cars. They agreed most strongly that it would be easier to move to a CN if they could find an affordable home.

Regression was used to determine how well the control beliefs accounted for variation in respondents' SCF toward moving to a CN. That regression is shown in Table 9-8. Each of the control beliefs was significant. The more likely respondents felt they were capable of living in less space, doing with fewer cars, or finding an affordable home, the more capable they felt about moving to a CN. The more likely they felt they would lose contact with friends, however, the less capable they felt about moving. Finding an affordable home was the control belief with the greatest relationship with SCF, a finding that agrees with the order of the ratings of power of control items in Table 9-7. The overall R^2 of 0.14 is the poorest of this series of regressions and may indicate that there are many other factors that affect the respondents' confidence that they would be able to move to a CN.

Structural Equation Model for the Full TPB

SEM can be used to test the full TPB model, as shown in Figure 9-1. The components of this model include the following:

Table 9-5. Mean and standard deviation for normative beliefs and motivation to comply.

Normative Beliefs (1 = extremely unlikely to 7 = extremely likely)	**Mean (SD)**	**Motivation to Comply (1 = not at all to 7 = very much)**	**Mean (SD)**
My family thinks that I should move to a compact neighborhood.	2.4 (1.6)	Generally speaking, how much do you care what your family thinks you should do?	4.3* (1.8)
Other people who are important to me think that I should move to a compact neighborhood.	2.4 (1.6)	Generally speaking, how much do you care what other people who are important to you think you should do?	3.9* (1.6)

*significantly different at $p < .05$

$n = 822$

Table 9-6. Regression for subjective norm.

Dependent Variable: Subjective Norm			
Independent Variables: Normative Beliefs	**Coefficient**	***t*-statistic**	**Probability**
Constant	**1.67***	23.8	≤ 0.0001
My family thinks that I should move to a compact neighborhood.	**0.28***	5.70	≤ 0.0001
Other people who are important to me think that I should move to a compact neighborhood.	**0.35***	7.01	≤ 0.0001

*significant at probability level indicated

$n = 822$, $R^2 = 0.45$.

- Seven factors hypothesized to influence attitude towards the behavior that are the products of
  - behavioral beliefs and
  - outcome evaluation.
- Two factors hypothesized to influence SN that are the products of
  - normative beliefs and
  - motivation to comply.
- Four factors hypothesized to influence self-confidence that are products of
  - control beliefs and
  - power of control.

Within each intention and direct measures box shown in Figure 9-1, the ratings on each statement are averaged to create a single score. With respect to the indirect measures, each element in the "belief" box is multiplied by its corresponding element in the "relevance" box (outcome evaluation, motivation to comply, and power of control).

The structural equation model attempts to predict intent from the direct measure scores while also attempting to predict each direct measure score from its corresponding set of indirect measure products. The key results that are produced are the coefficients (and significance levels) for (*a*) direct measures predicting intent and (*b*) indirect measures predicting the corresponding direct measures (and, consequently, intent).

Results

In Table 9-9, the columns represent the following (left to right):

- Endogenous variables
- Direction of association
- Exogenous variables

Table 9-7. Mean and standard deviation for control beliefs and power of control.

Control Beliefs (1 = very unlikely to 7 = very likely)	**Mean (SD)**	**Power of Control (1 = strongly disagree to 7 = strongly agree)**	**Mean (SD)**
How likely is it that you could find an affordable home in a compact neighborhood?	3.8 (1.9)	It would be easier for me to move to a compact neighborhood if I could find an affordable home there.	4.6 (2.0)
How likely is it that you could get by with less living space in the coming year?	3.0 (2.1)	It would be easier for me to move to a compact neighborhood if I required less living space.	4.1 (2.0)
How likely is it that you would lose touch with current friends if you moved to a compact neighborhood?	3.2 (2.0)	It would be easier for me to move to a compact neighborhood if I was sure I would not lose touch with my current friends.	3.5 (2.0)
How likely is it that you could get by with fewer household cars in the coming year?	2.9 (2.2)	It would be easier for me to move to a compact neighborhood if I didn't need so many household cars.	3.5 (2.1)

$n = 822$

Table 9-8. Regression for perceived behavioral control.

Dependent Variable: Self-Confidence			
Independent Variables: Control Beliefs	**Coefficient**	***t*-statistic**	**Probability**
Constant	**3.73***	25.9	≤.0001
How likely is it that you could find an affordable home in a compact neighborhood?	**0.20***	7.47	≤.0001
How likely is it that you could get by with fewer household cars in the coming year?	**0.10***	4.12	≤.0001
How likely is it that you could get by with less living space in the coming year?	**0.07***	2.50	.0127
How likely is it that you would lose touch with current friends if you moved to a compact neighborhood?	**-0.14***	-5.80	≤ .0001

*significant at probability level indicated

$n = 822$, $R^2 = 0.14$.

- Operation between exogenous variables (for indirect measures)
- Second exogenous variable (for indirect measures)
- Regression weights (estimate)
- Standard error (SE) of the estimate
- critical ratio (CR), analogous to a *t*-statistic—higher is better
- Probability from significance test (*P*)—lower is better. This is the chance that the coefficient could have been zero.

The values in the estimate and probability columns are the key results to focus on; the bolded text represents relationships that test as significant at the 5% level, which means there is a 5% or less chance that the coefficient is zero.

Based on this model, ATT and SN are more important than SCF as influences on intent to move to a compact neighborhood (although SCF is still a significant factor). Note that the relationship shown between intent and ATT, SN, and SCF is very similar to what was shown in Table 9-2.

With regard to the indirect measure of ATT, it was found that several of the features thought to be important were indeed significant. These included the ability to walk to stores, the ability to take public transportation, and the ability to do with one less car. The ability to make friends with neighbors was also significant. This was a surprise to the researchers, but had come up in the focus groups as a possible advantage of a CN. Surprisingly, the ability to exercise by walking or bicycling did not turn out to be significant. Neither did the two negative factors (noise on the street and less living space).

Based on the output in Table 9-9, the most important relationships are between

- SN and others' opinions,
- ATT and access to commercial districts,
- SCF and affordability, and
- SN and family's opinion.

Relationships that were not significant are between

- ATT and exercise,
- ATT and noise,
- ATT and living space, and
- SCF and requiring less living space.

Thus the SEM result shown in Table 9-9 finds many, but not all, of the same factors to be significant as the regression analyses shown in Tables 9-4, 9-6, and 9-8.

Overall, the fit of the structural equation model is poor. The Tucker-Lewis index is 0.22, when it should be at least 0.9. The comparative fit index is 0.32, when it should be at least 0.9. The RMSEA is 0.21, when it should be less than 0.06. Thus while many of the hypothesized factors do affect the ATT, SN, and SCF, clearly more research is needed to more fully describe the factors affecting choice of a CN.

Chapter Summary

This chapter presented analyses of the relationships between the various components of the TPB as measured by regression analysis and SEM. The ATT, SN, and SCF were significantly associated with intent to move, as the TPB would predict.

Regression analyses found that all of the hypothesized behavioral beliefs were significantly associated with ATT. The most important behavioral belief was that "it would be easy for me to get to stores, restaurants, a library and other activities." Other positive beliefs were "I would take public transportation to work or for other trips," "I would exercise by walking or bicycling," "I would make friends with more of my neighbors," and "my household could own fewer cars." Negative beliefs were that "the streets would be noisier than where I live now" and "I would have less living space in my home and lot." SEM also found most, but not all, of the behavioral belief/outcome evaluation pairs to be significantly associated with ATT. The product pairs not significant

Table 9-9. SEM results for the Phase 1 model.

		Variable Label			Estimate	S.E.	C.R.	P
INTENT	**<--**	**Attitude Toward The Behavior (average of 3 direct measures)**			**0.516**	**0.019**	**26.479**	**0.000**
INTENT	**<--**	**Subjective Norms (average of 3 direct measures)**			**0.478**	**0.023**	**20.708**	**0.000**
INTENT	**<--**	**Perceived Behavioral Control (average of 3 direct measures)**			**0.139**	**0.021**	**6.697**	**0.000**
ATTITUDE	<--	If I moved to a Compact Neighborhood I would exercise by walking or bicycling.	x	For me, living in a neighborhood where I could exercise by walking or bicycling would be...	0.001	0.004	0.403	0.687
ATTITUDE	**<--**	**If I moved to a Compact Neighborhood I would make friends with more of my neighbors.**	**x**	**For me, having neighbors close by and making friends with neighbors would be...**	**0.009**	**0.004**	**2.409**	**0.016**
ATTITUDE	**<--**	**If I moved to a Compact Neighborhood it would be easy for me to get to stores, restaurants, a library and other activities.**	**x**	**For me, to live within walking distance to stores, restaurants, a public library and a school would be...**	**0.048**	**0.004**	**12.579**	**0.000**
ATTITUDE	**<--**	**If I moved to a Compact Neighborhood I would take public transportation to work or for other trips.**	**x**	**For me, to be able to take public transportation to work or for other trips would be...**	**0.015**	**0.003**	**4.731**	**0.000**
ATTITUDE	**<--**	**If I moved to Compact Neighborhood, my household could own fewer cars.**	**x**	**For my household to need to own fewer cars would be...**	**0.017**	**0.003**	**5.179**	**0.000**
ATTITUDE	<--	If I moved to Compact Neighborhood, the streets would be noisier than where I live now.	x	For me, to live in a neighborhood with more noise on the streets would be...	0.001	0.005	0.105	0.916
ATTITUDE	<--	If I moved to Compact Neighborhood, I would have less living space in my home and lot.	x	For me, to live in less living space (in my home and lot) would be...	-0.002	0.005	-0.328	0.743
SUBJECTIVE	**<--**	**My family thinks that I should move to a Compact Neighborhood.**	**x**	**Generally speaking, how much do you care what your family thinks you should do?**	**0.043**	**0.004**	**10.158**	**0.000**
SUBJECTIVE	**<--**	**Other people who are important to me think that I should move to a Compact Neighborhood.**	**x**	**Generally speaking, how much doyou care what other people who are important to you think you should do?**	**0.057**	**0.005**	**12.43**	**0.000**
SELF-CONFIDENCE	<--	How likely is it that you could get by with less living space in the coming year?	x	It would be easier for me to move to a Compact Neighborhood if I required less living space.	0.005	0.004	1.173	0.241
SELF-CONFIDENCE	**<--**	**How likely is it that you could get by with fewer household cars in the coming year?**	**x**	**It would be easier for me to move to a Compact Neighborhood if I didn't need so many household cars.**	**0.010**	**0.004**	**2.183**	**0.029**
SELF-CONFIDENCE	**<--**	**How likely is it that you could find an affordable home in a Compact Neighborhood?**	**x**	**It would be easier for me to move to a Compact Neighborhood if I could find an affordable home there.**	**0.047**	**0.004**	**12.31**	**0.000**
SELF-CONFIDENCE	**<--**	**How likely is it that you would lose touch with current friends if you moved to a Compact Neighborhood?**	**x**	**It would be easier for me to move to a Compact Neighborhood if I was sure I would not lose touch with my current friends.**	**-0.027**	**0.004**	**-6.543**	**0.000**

in the SEM concerned "I would exercise by walking and bicycling," "the streets would be noisier than where I live now," and "I would have less living space in my home and lot."

Both normative beliefs were significantly associated with SN. These included "my family thinks that I should move to a CN" and "other people who are important to me think that I should move to a CN." Both regression analysis and SEM indicated the importance of family members and other people.

Likewise, regression analyses found that the four hypothesized control beliefs were significantly associated with SCF. The most important of these was the belief that one "could find an affordable home in a compact neighborhood." Also

significant and positively associated with SCF were the beliefs that one could get by with "fewer household cars in the coming year" and "less living space in the coming year." A negatively associated belief was that one "would lose touch with current friends." SEM found all of these factors significant, except for the one relating to "less living space."

While all of the hypothesized relationships were significant in regression models, there was much variance unexplained in ATT, SN, and SCF. More research will be needed to uncover other contributors to these three constructs. In particular, *self-confidence* needs much more exploration to understand which characteristics would allow more individuals to feel that they could move to a CN. Also, the fit of the structural equation model of the complete TPB was not satisfactory, as judged by fit statistics. This research left out many issues of importance in neighborhood choice, such as concern about crime and safety and quality of schools. However, the findings in this chapter and others indicate that the TPB appears promising enough to merit further research in the area of residential choice.

CHAPTER 10

Results from the Phase 2 Survey

This chapter discusses the overall results of the Phase 2 survey, which had the following research objectives:

- Explore methods for encouraging more walking and transit use.
- Explore the TPB as an approach to understanding how individuals make travel and location decisions. In particular, explore TPB in the context of a decision to move to a CN and to use environmentally friendly modes, such as walking and transit.
- Examine the power of the TPB to distinguish these market sectors and provide insight into motivating factors.

This chapter provides overall results for the Phase 2 Internet survey. Appendix B provides a copy of the survey questionnaire. For those readers curious about the detailed results of the TPB-related responses in the survey, the SPSS files of responses for all of the Internet panel surveys are included in Appendix C.

This chapter is broken into six sections, as follows:

- Background information on respondents
- TPB questions regarding the respondents' willingness to walk and use transit more
- Follow-up questions about neighborhood preferences
  - Direct TPB questions about a CN
  - The value of alternative transportation services in promoting alternative transportation use in a CN
- Messages about transit: saving money and improving the environment and health
- Alternative services
  - Services the respondent has available
  - Ranking the services
  - Respondents' willingness to use alternative transportation services
- Follow-up TPB analysis
  - Comparison between the first TPB (willingness to walk and use transit more) and the second TPB (willingness to use alternative transportation services)

Background Information on the Respondents

As specified in the research plan, the second survey was to include 500 respondents. First, respondents to the Phase 1 survey were asked to complete the Phase 2 survey. Three hundred eighty responded (44%). Others were then invited to take the Phase 2 survey until the number of respondents reached 500. In all, 501 respondents completed the Phase 2 survey. The 44% response rate is lower than would have been expected, but may have been the result of the long time (10 months) between the Phase 1 and Phase 2 surveys.

Table 10-1 shows some comparative statistics for the various survey groups. Where a question was repeated in both surveys, the fourth column in the table shows the different results. Note that some change in value may be due to changes in age or living situation between the dates of the two surveys (December of 2004 and October of 2005).

The 121 respondents who did not participate in the Phase 1 survey (shown in the last column) were selected from the same metropolitan statistical areas as the first group; however, there was no oversampling by the young and old age-groups, nor was there the requirement to have moved in the prior 2 years or to be contemplating moving in the next 2 years. These respondents were not part of the NJ Transit e-panel. The combined effect of not oversampling the 21 to 31 age-group and not screening on moving was that the sample has only one-third as many young people. The percentage in the age 55-plus group is about the same as in the Phase 1 survey. It is likely that the effect of oversampling of this older group in the Phase 1 survey was offset by the requirement that

Table 10-1. Basic characteristics of the sample.

Characteristic	Phase 1 Survey	Phase 2 Survey Total	Respondents Taking Both Surveys *(1st survey, 2d survey)*	Added Respondents for Phase 2
Respondents	865	501	380	121
Female	67%	71%	70%, 70%	74%
Male	33%	29%	30%, 30%	26%
Age 21-30	40%	30%	39%, 35%	13%
Age 31 to 44	31%	34%	28%, 31%	42%
Age 45 to 54	18%	24%	21%, 21%	34%
Age 55-plus	10%	13%	12%, 13%	11%
Live in Single-Family Home	48%	54%	46%, 53%	60%
Take Transit to Work (of those commuting)	34%	27%	31%, 28%	23%
Take Green Modes to Work (of those commuting)	41%	32%	38%, 34%	26%
Prefer Urban Townhouse	44%	n/a	44%	n/a
Prefer to Live in a Big City	23%	n/a	22%	n/a
Average Cars per Adult in Household	0.88	0.86	0.87, 0.86	0.87
Households with No Children under 18	62%	61%	62%	63%
Single	35%	31%	33%, 33%	31%
Median Income	$70,000	$70,000-$79,999	$70,000-$79,999	$70,000-$79,999
College Degree	69%	68%	68%, 68%	69%
Asian/Asian American/Pacific Islander	5%	3%	4%, 4%	2%
Black/African American	6%	8%	7%, 7%	11%
Caucasian/White (non-Hispanic)	81%	79%	81%, 81%	81%
Hispanic/Latino	4%	4%	4%, 4%	3%

the respondents have moved recently or were planning to move. A higher percentage of the 121 respondents own single-family homes and fewer take green modes to work than those in the original survey. However, these respondents have the same median income, a similar ratio of cars to adults in the household, and similar education levels as the Phase 1 survey respondents.

Note that in all of the presentations of results in this chapter, the total number of respondents is 501.

Of the 501 respondents, 51% said they had transit service within one-third of a mile, and 70% said that transit was within walking distance of their homes. Figure 10-1 shows the distance to the nearest public transit stop and the number who said it was within walking distance.

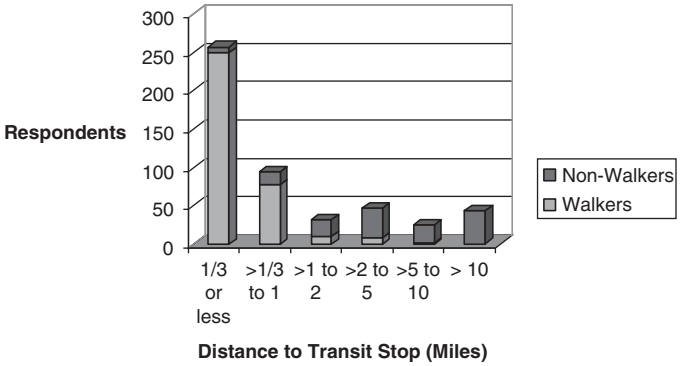


Figure 10-1. Distance to nearest transit stop and whether the stop was within walking distance.

Figure 10-2 shows the number of respondents by distance to the nearest commercial area and the number considering it within walking distance. Figure 10-3 shows the same thing by distance to place of employment. Twenty-seven percent lived within one-third mile of a commercial area, and overall 60% said the nearest commercial area was within walking distance. Five percent said their work was within one-third mile, and overall 16% said that their work was within walking distance. Considering all destinations (transit stop, commercial area, and work), between 76% and 83% of those between one-third mile and 1 mile from their destinations thought the destinations were within walking distance. As can be seen, most of the respondents in this sample do not consider their place of work to be within walking distance of their home.

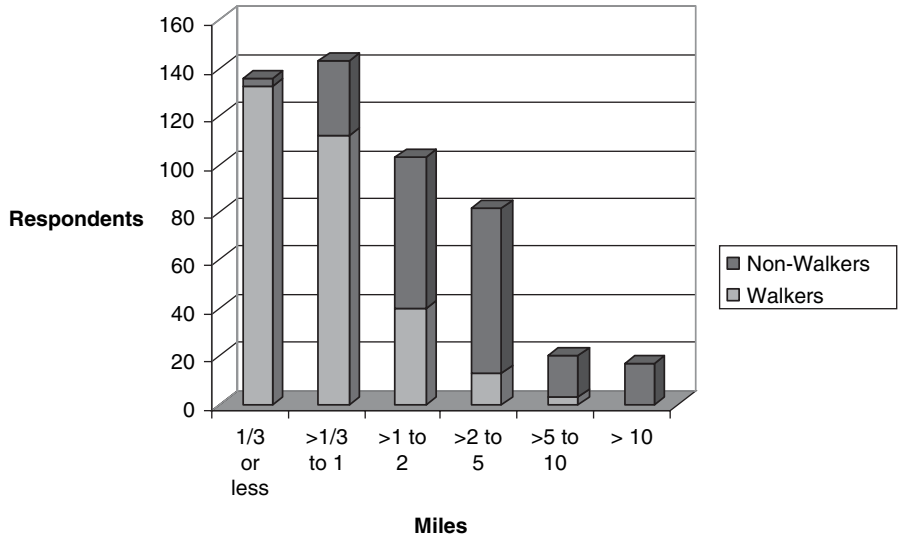


Figure 10-2. Distance to nearest commercial area and whether it was within walking distance.

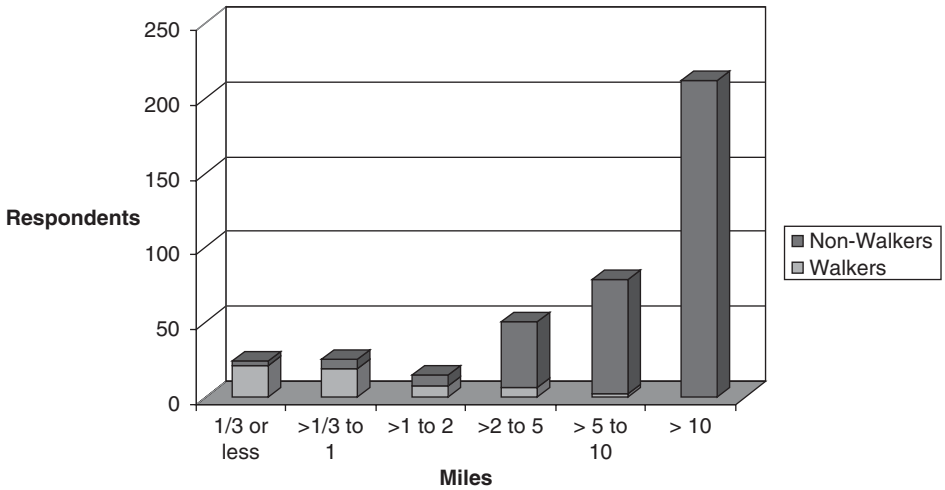


Figure 10-3. Distance to work and whether work was within walking distance.

Respondents' Willingness to Walk and Use Transit More

As shown in Figure 5-3 in Chapter 5, there were two sets of questions asked in the Phase 2 survey for the purpose of gathering information for the TPB. There was an initial set of questions that asked about respondents' intentions to walk and to take public transportation more. Then, following an "intervention" in which respondents were asked to read messages and to consider new services and technologies, respondents were asked to provide a second set of TPB responses. Table 10-2 shows the measures that were gathered in the initial and final TPB exercises.

Following is a discussion of the results for the initial set of TPB questions.

Attitude—Outcome Evaluations and Behavioral Beliefs

In the TPB, the outcome evaluations and behavioral beliefs combine to provide an indirect measure of attitude. The outcome evaluation questions gathered information on the importance or desirability of travel characteristics to respondents.

Table 10-3 shows the mean score and standard deviation for the initial set of outcome evaluations. As can be seen, the top scoring items involved (*a*) having reliable transportation, (*b*) reducing the cost of daily transportation, and (*c*) reducing pollution. The poorest ratings were given to the items that involved spending more time getting to the destination, followed by being dependent on someone else.

Table 10-4 shows the mean ratings and the standard deviation of those ratings for the initial behavioral beliefs. *Behavioral beliefs* indicate how strongly the respondent feels that a certain action will affect an outcome. In this case, the respondent was asked about behavioral beliefs in response to the potential action, "If I were to increase the number of trips I take by public transportation and walking and drive less. . . ."

As can be see from Table 10-4, the top two highest scoring beliefs were the ones rated most negatively in Table 10-3—i.e., "if I were to walk and take public transportation more and drive less, it would take more time to get to my destination," and "I would be dependent upon someone else to get me to my destination on time." This indicates little willingness on the part of respondents to walk and take public transportation more and drive less. The lowest scoring beliefs related to being able to get by with fewer cars and meeting more neighbors.

Subjective Norm—Motivation to Comply and Normative Beliefs

Table 10-5 and Table 10-6 show the results for the set of TPB variables called *motivation to comply* and *normative beliefs*. These make up the components of the indirect measure of SN. Clearly, family has the most influence, with friends second, co-workers third, and neighbors last. All of the components of normative beliefs scored on the low end of the rating scale. On average, there was not much normative support for more walking and more use of public transit.

Self-Confidence—Control Beliefs and Initial Power of Control

The final set of ratings for the initial TPB were for the components of the respondents' indirectly measured SCF. The first set is the *control beliefs,* which could affect respondents' confidence to walk and use public transit more. Table 10-7 shows the control belief ratings. The highest scoring items were "I need to make local trips" and "I need access to a car to make spur of the moment trips." Also scoring on the high side was "I need access to a car to carry heavy things" and "I find waiting for the bus or train and

Table 10-2. Measures for the Phase 2 TPB models.

Direct Measures	Indirect Measures	
	Belief Measures	**Relevance Measures**
Attitude (initial and final measures)	Behavioral Beliefs (initial and final measures)	Outcome Evaluations (measured only once)
Subjective Norm (initial and final measures)	Normative Beliefs (initial and final measures)	Motivation to Comply (measured only once)
Self-Confidence (initial and final measures)	Control Beliefs (measured only once)	Power of Control
Intent (initial and final measures)		

Table 10-3. Outcome evaluations from the Phase 2 survey.

Outcome Evaluations, Rated on a Seven-Point Scale	Mean (SD)
For me to have a reliable type of transportation to take to my destination would be: (extremely unimportant to extremely important)	6.5 (1.0)
For me to reduce the cost of my daily transportation would be: (extremely undesirable to extremely desirable)	5.9 (1.4)
For me to improve my health by walking more would be: (extremely unimportant to extremely important)	5.8 (1.3)
For me to reduce pollution by using my car less would be: (extremely unimportant to extremely important)	5.3 (1.7)
For me to reduce the time I spend driving would be: (extremely unimportant to extremely important)	5.3 (1.7)
For me to meet my neighbors while walking is: (extremely undesirable to extremely desirable)	5.0 (1.5)
For me to be able to leave the driving to someone else would be: (extremely undesirable to extremely desirable)	4.6 (1.8)
For my household to own fewer cars would be: (extremely undesirable to extremely desirable)	3.1 (1.9)
For me to ride with people I don't know while traveling would be: (extremely undesirable to extremely desirable)	3.0 (1.5)
For me to be dependent on someone else to get me to my destination on time would be: (extremely undesirable to extremely desirable)	2.8 (1.8)
For me to spend more time getting to my destination would be: (extremely undesirable to extremely desirable)	1.9 (1.6)

Table 10-4. Behavioral beliefs for initial TPB Phase 2.

***Behavioral Beliefs*:** **If I were to increase the number of trips I take by public transportation and walking and drive less… (1= extremely unlikely, 7=extremely likely)**	**Mean (SD)**
It would take more time for me to get to my destination	6.0 (1.5)
I would be dependent upon someone else to get me to my destination on time	5.7 (1.6)
I would improve my health by walking more	5.6 (1.6)
I would be leaving the driving to someone else	5.6 (1.7)
I would reduce pollution	5.6 (1.5)
I would ride more with people I don't know	5.5 (1.8)
I would reduce the amount of time I spend driving	5.3 (1.8)
I would improve my health by walking more to public transportation	5.1 (1.8)
I would rely on public transportation and walking to get me to my destination in a timely way	4.7 (1.8)
I'd save money	4.6 (1.8)
I would meet more of my neighbors	3.8 (1.8)
My household could get by with fewer cars (asked only of those who have a car, $n = 460$)	3.1 (1.8)

Table 10-5. Motivation to comply, from the Phase 2 survey.

Motivation to Comply **(1 = Not at All, 7 = Very Much)**	**Mean (SD)**
Generally speaking, how much do you care what your family thinks you should do?	5.1 (2.0)
Generally speaking, how much do you care what your friends think you should do?	4.2 (1.9)
Generally speaking, how much do you care what your co-workers think you should do?	2.8 (1.7)
Generally speaking, how much do you care what your neighbors think you should do?	2.5 (1.6)

Table 10-6. Normative beliefs, from the initial TPB Phase 2.

Normative Beliefs **(1 = Strongly Disagree to 7 = Strongly Agree)**	**Mean (SD)**
My family thinks that I should walk or take public transportation more.	2.5 (1.7)
My friends think that I should walk or take public transportation more	2.4 (1.7)
My coworkers think that I should walk or take public transportation more	2.2 (1.5)
My neighbors think that I should walk or take public transportation more	2.2 (1.6)

Table 10-7. Control beliefs for the TPB Phase 2.

Control Beliefs**, Rated on a Scale from 1 to 7**	**Mean (SD)**
I need to make local trips (to reach destinations such as the library, post office, restaurant, or coffee shop). (not very often to very often)	5.5 (1.6)
I need access to a car to make spur of the moment trips. (not very often to very often)	5.1 (1.9)
I need access to a car to carry heavy things. (not very often to very often)	5.1 (1.8)
I find waiting for the bus or train and not knowing when it is coming is a bother. (strongly disagree to strongly agree)	5.1 (1.9)
I worry about being stranded if I rely on public transportation and miss the bus or train. (strongly disagree to strongly agree)	4.7 (2.0)
I worry about crime or other disturbing behavior on public transportation. (strongly disagree to strongly agree)	4.1 (2.0)
I need to travel to other parts of the region. (not very often to very often)	4.1 (2.1)
I find dealing with the fare for public transportation is a bother. (strongly disagree to strongly agree)	3.9 (2.0)
I worry encountering crime or other disturbing behavior when walking. (strongly disagree to strongly agree)	3.8 (2.0)
I need to travel downtown (not very often to very often)	3.4 (2.3)

Table 10-8. Power of control ratings for the initial TPB Phase 2.

***Power of Control*:** **(1 = Strongly Disagree, 7 = Strongly Agree)**	**Mean (SD)**
If I were to walk or take public transportation more, it would be harder for me to carry heavy things.	6.2 (1.3)
I need a car to get where I need to go.	5.5 (1.9)
If I were to walk or take public transportation more, it would be harder for me to make spur of the moment trips.	5.4 (1.8)
If I were to walk and take public transportation more, it would be difficult for me to get to other parts of the region.	5.4 (1.9)
If I were to walk or take public transportation more, it would be difficult to make local trips to reach destinations such as the library, post office, restaurant, or coffee shop).	4.7 (2.2)
It would be easier for me to walk or take public transportation more if I was sure of not being lost or stranded by missing the bus or train.	4.4 (1.9)
It would be easier to take public transportation more if I knew when the bus or train would arrive.	4.3 (2.0)
It would be easier for me to take public transportation more if it were safe from crime and other disturbing behavior.	4.1 (1.9)
It would be easier for me to walk more if it were safe from crime and other disturbing behavior.	4.1 (2.0)
It would be difficult for me to get downtown if I were to walk and take public transportation more.	4.0 (2.3)
It would be easier to take public transportation more if it were simple to pay the fare.	3.3 (1.9)

not knowing when it is coming a bother." Note that in Table 10-7 different descriptions are used for the seven-point scales (i.e., strongly disagree to strongly agree, and not very often to very often).

Table 10-8 shows the power of control ratings for the difficulty in walking or taking transit more, or alternatively, how various obstacles affect the difficulty of walking or taking transit more. Note that the last rating, "I need a car to get where I need to go," is different from the other ratings (it is not a conditional statement, but rather a measure of the respondents' inability to substitute other modes for a car).

The item receiving the highest overall rating was "harder for me to carry heavy things," followed by "I need a car to get where I need to go" and by "harder for me to make spur of the moment trips." The lowest rated items were "easier to take public transportation more if it were easier to pay the fare" and "difficult for me to get downtown if I were to walk and take public transportation more." So for those respondents, getting downtown was seen as less of a problem than other things if they were to walk and take transit more, and easier means of fare payment was not seen as making it any easier to walk or take transit more.

Direct Measures

Another important part of developing the TPB model is to establish direct measures of ATT, SN, SCF, and intent. For each of these direct measures, three rating questions were asked, and the responses were averaged.

Cronbach's alpha is a test of the reliability of each set of the measures. In general, an alpha value of 0.7 is considered

acceptable and indicates that the set of measures is in fact measuring the same construct. In this case, all of the direct measures behaved appropriately. The three measures of intent had a Cronbach's alpha of 0.93. The three measures of attitude had an alpha of 0.84. The alpha for SN was 0.71, slightly above the 0.7 cutoff for acceptable. The alpha for SCF was 0.88.

In some analyses involving SN, an average value of the four normative beliefs was used (Table 10-6), which correlated highly with the measure "it is expected of me." The normative beliefs had an alpha value of 0.95. Table 10-9 shows the mean value for each of the direct measures, the combined value for each direct measure, and the combined value for the four normative beliefs.

Table 10-9. Direct measures for the initial TPB Phase 2.

Direct Measure	Source (rated on seven-point scale)	Mean (SD)
Intent	I plan to walk and take public transportation more (strongly disagree to strongly agree)	3.5 (2.0)
	I will make an effort to walk and take public transportation more (I definitely will not to I definitely will)	3.7 (1.9)
	I intend to walk and take public transportation more (strongly disagree to strongly agree)	3.5 (2.0)
	Average of three *Intent* statements	3.6 (1.8)
Attitude towards the Behavior	For me to walk and take public transportation more would be (extremely undesirable to extremely desirable)	4.3 (2.0)
	For me to walk and use public transportation more would be (extremely unpleasant to extremely pleasant)	3.9 (1.8)
	For me to walk and take public transportation more would be (boring to interesting)	4.4 (1.7)
	Average of three attitudinal statements	4.2 (1.6)
Subjective Norm	Most people who are important to me would like to walk and take public transit more (definitely false to definitely true)	3.3 (1.9)
	Most people whose opinions I value would approve of my walking or taking public transportation more (definitely false to definitely true).	4.6 (1.8)
	It is expected of me that I will walk and take public transportation more (strongly disagree to strongly agree)	2.8 (1.9)
	Average of three *Subjective Norm* statements	3.6 (1.5)
	Average of four *Normative Belief* statements	2.3 (1.5)
Self-confidence	For me to walk and take public transportation more would be (extremely difficult to extremely easy)	3.3 (2.0)
	I am confident that if I wanted to I could walk and take public transportation more (definitely false to definitely true)	3.8 (2.1)
	For me to walk and take public transportation more would be (impossible to possible)	3.7 (2.1)
	Average of three SCF statements	3.6 (1.8)

Table 10-10. Ratings of an idealized compact neighborhood.

Living in a neighborhood like this would be… (1 = Strongly Disagree to 7 = Strongly Agree):	Mean (SD)
Something I would like to do.	5.4 (1.7)
Something people I care about would like to do.	5.1 (1.8)
Something that would be easy for me to do.	4.9 (1.9)
I could live with fewer cars in my household. (only asked of those with cars, *n*=460)	4.2 (2.1)
How do you compare the imaginary neighborhood to your current neighborhood? (1 = strongly prefer my neighborhood and 7 = strongly prefer the imaginary neighborhood)	3.8 (2.0)

Follow-Up Questions on Neighborhood Preferences

Following the TPB questions, a series of questions were asked about the respondents' opinions of an idealized CN. These questions can be used to confirm the TPB responses about neighborhood preferences in the Phase 1 survey. The idealized neighborhood had sidewalks and bikeways throughout, as well as transit service to downtown, with connections to the rest of the region operating at least every 15 min. The neighborhood association provided a private shuttle bus to the town center, which came every 15 min. Car sharing was available. Respondents were told to assume that their employers allowed them to work at home at least 1 day a week. Finally, respondents were told to assume that they owned fewer cars than they did when they took the survey.

Table 10-10 shows the responses to the questions about the idealized CN. As can be seen, the mean response to each item is near 5 (which is 1 point above the average). Respondents gave the highest ratings to their own interests; the approval of their friends and family was rated slightly lower, and their own ability to live in such a community was rated slightly lower still.

Table 10-10 also shows a comparison between the respondents' existing neighborhood and the imaginary CN. Compared with their current neighborhood, the imaginary neighborhood rated slightly lower than a neutral score of 4. The table also indicates the respondents' opinion of their ability to live with fewer cars, which received a rating slightly above neutral.

Table 10-11 shows how the participants rate different options that might allow them to live in the imaginary CN. The ability

Table 10-11. Options to allow living with fewer cars.

Thinking about this imaginary neighborhood, which transportation options would you need to live with fewer cars in your household? (1 = strongly disagree to 7 = strongly agree)	Mean (SD)
I would want to know exactly when the bus or train would arrive.	6.0 (1.4)
I would want a transit pass so that I never had to worry about having cash.	6.0 (1.5)
I would want to be able to walk to a nearby store or coffee shop.	6.0 (1.5)
I would want a transit service that connects me with the rest of the region.	5.9 (1.5)
I would want a shuttle service to take me to the community center and other activities within the neighborhood.	5.4 (1.8)
I would want to be sure that a taxi would come at any hour.	5.4 (1.7)
I would want frequent transit service (rail or express bus) to the downtown.	5.3 (1.9)
I would want a car on my block that I could rent by the hour (car sharing).	4.4 (2.1)

to know when a transit vehicle would arrive is most highly rated. Being able to walk to a nearby store is also highly appealing, as is having transit service to the rest of the region. The average respondent would need to have generally available transit service in order to live in a CN. Car sharing has the lowest score—closest to a neutral value of 4. This ranking may be because the respondents did not understand the concept of car sharing.

The Messages

After the questions about an imaginary and idealized CN, the respondents were asked to read a message about public transportation. The sample was divided randomly into three groups, with approximately one third receiving a message about cost, another third about helping the environment and one's health, and the last third receiving no message (the control group). (The messages are shown in Figure 5-4.)

Respondents were asked their opinions about the messages. Table 10-12 shows the results; significant differences between groups are shown in bold and indicated with an asterisk. The respondents seemed to understand the messages, as those who received the message that transit can save money rated the statement about saving money significantly higher than did those who received the health and environment message. Participants who received the health and environment message rated the appropriate statements higher than those who received the "save money" message. Nonetheless, the respondents rated the messages only slightly above neutral in terms of being convincing and only neutral in terms of making them want to use transit more. Those who received the health and environmental message indicated they had heard it before, which is likely a reference to the extensive media coverage being given to obesity.

Alternative Transportation Services

The final set of information gathered from the Phase 2 Internet survey concerned a set of services that might allow a respondent to increase his or her use of public transportation. Who had access to such services in the first place? The results are summarized in Table 10-13.

Table 10-12. Opinions of the transit messages.

This message made me think about… (1 = strongly disagree to 7 = strongly agree):	**Message**	
	Save Money Mean (SD)	**Environment and Health Mean (SD)**
Why everyone should use transit	4.6 (1.7)	4.6 (1.7)
Why everyone should walk*	**4.0 (1.7)**	**5.1 (1.6)**
The value of transit to me	4.7 (1.7)	4.6 (1.7)
Why I should live close to transit	4.4 (1.7)	4.4 (1.7)
Why my using transit is good for the environment*	**4.4 (1.7)**	**5.4 (1.6)**
Why my using transit is good for public health*	**4.3 (1.8)**	**5.2 (1.6)**
How I can save money using transit*	**5.4 (1.6)**	**4.4 (1.6)**
I found this message understandable	5.6 (1.5)	5.8 (1.3)
I found this message convincing	4.7 (1.7)	4.8 (1.7)
I already knew everything stated in this message*	**4.4 (2.0)**	**5.1 (1.6)**
This message makes me want to use transit more.	4.0 (1.7)	4.0 (1.8)
This message makes me want to walk more*	**3.8 (1.7)**	**4.8 (1.8)**
For me, the disadvantages of using transit still outweigh the advantages of using it.	4.4 (2.0)	4.5 (2.0)
Number of respondents (*n*)	*175*	*166*

* Indicates significant difference between groups at $p < .05$

Table 10-13. Experience with alternative transportation services.

Description of Transportation Alternative	Have Option (%)	Have Similar (%)	Don't Have (%)
Fast transit service (rail or express bus) to the downtown. This service is available every 15 minutes or better, and a station is located less than a mile away.	24	24	52
Good connections by transit to the rest of the region (other than to the downtown). This service may involve a transfer from one transit vehicle to another.	24	29	46
A small community shuttle bus that connects your street with the local community center, and other activities within your neighborhood.	8	16	76
A community door-to-door service that you can take at about half the price of taxi service, that you share with others traveling at the same time. This service is obtained by calling a special number and is immediately available.	4	9	86
Cars are available on your block or near your workplace to be rented by the hour (car sharing) when you need to make a trip that is difficult to make on transit.	4	6	90
You have a "smart card" which you use to purchase service on any of the buses or trains.	22	23	55
You have a cell phone which will tell you exactly when the bus or train will arrive, show you where you are, and provide instructions on getting to your destination by public transportation.	5	9	87
Your employer allows you to work from home at least one day a week. You are provided a computer, a separate phone line, and high-speed Internet connection.	10	12	78

While half of the sample had either downtown or regional transit available, many fewer had access to other services. Although the community shuttle service had been highly popular with the older adults in the focus groups, three-quarters of the Internet respondents did not have such service available, and even fewer had some kind of shared-ride door-to-door service available. Ninety percent did not have any kind of car sharing available (although this concept may not have been well understood).

Smart cards or similar payment systems were options available to 45% of the sample, but the high-tech cell phone was generally not available, with 87% not having this option. Finally, 78% did not have the option of telecommuting, which, as will be seen, is also the most popular option.

Table 10-14 shows the utility values assigned to different alternatives based on a MaxDiff analysis. MaxDiff (maximum difference scaling) is an approach that can be used to measure the relative importance of different product or service features. The method uses a survey instrument that contains a set of structured exercises in which respondents are asked to choose the most important and least important from among sets of three to six features. Standard discrete choice model estimation techniques are used to measure the relative importance ("utility") of each of the features using

Table 10-14. Utility values for transportation alternatives.

Alternative	Number with Option or Similar	Mean Utility (SD)	Number without Option	Mean Utility (SD)
Telecommuting	109	0	392	0
Transit to Downtown	241	-0.73 (0.82)	260	-0.79 (0.99)
Regional Transit	270	-0.84 (0.95)	231	-0.78 (1.03)
Smart Card*	226	-0.84 (0.56)	275	-0.98 (0.63)
Community Shuttle	120	-1.07 (0.67)	381	-1.16 (0.81)
Community Door-to-Door Service	68	-1.44 (0.91)	433	-1.51 (1.06)
Smart Phone	67	-1.71 (1.06)	434	-1.59 (1.03)
Car Sharing*	50	-2.04 (1.51)	451	-2.74 (1.73)

* Significant difference at $p < .05$ between groups with the option and those without

the data from these exercises (*51*). The resulting utilities reflect differences in preference between the alternatives on an interval scale.

In this exercise, correspondents indicated their top choice and their bottom choice out of a subset of four alternatives. They indicated which of the subset of alternatives was the most likely, and which was the least likely, to get them to reduce their travel by automobile. By constructing different sets of alternatives, all of the relative utility values can be computed for each individual respondent. Figure 10-4 shows the average utilities arranged linearly, so that the top preference—telecommuting—is on the right and the lowest preference—car sharing—is on the left. The preferences are arrayed along an interval scale for all respondents.

Table 10-14 provides the mean and standard deviation of utility values for respondents who have the transportation alternative or something similar to it, as well as for respondents who do not have the alternative. In Table 10-14, a value of zero is arbitrarily assigned to the telecommuting option. The values in the table reflect the utility of other alternatives relative to telecommuting. Because all of the values are negative, this indicates that telecommuting was the favorite option, on average. Table 10-14 also shows the number of respondents who indicated they had access to a particular alternative, or at least an alternative similar to the one described.

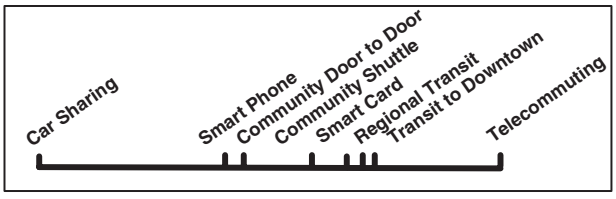


Figure 10-4. Preferences for alternative transportation services.

The values in Table 10-14 indicate that the order of preference for the alternatives did not change much as a result of respondents having or not having a particular transportation alternative or something similar. The only significant differences between the groups were for the smart card and car-sharing alternatives. Those with car sharing as an option preferred it significantly more than those without it, but it was still ranked lowest of the alternatives. Those respondents with a smart card option preferred it significantly more than did those without it.

Ironically, although respondents indicated that they wanted to know exactly when a bus or train would arrive (see Table 10-11), they did not rate the smart phone highly. Perhaps they were not convinced that the smart phone would really perform as promised. Some evidence of this is shown in Table 10-14, where those that had a smart phone rated it lower than those that did not. While such smart phone technology may be common in Europe and Japan, it did not appear to be convincing to the respondents in our survey.

The Influence of Scale

The rankings may have been somewhat influenced by differences in scale (cost) of the options presented. In the MaxDiff exercise, the respondents were asked to choose between four kinds of transit service and between three products that do not provide transit services. Thus, for example, when confronted with a trade-off between better service to downtown and a cell phone, most chose the better service to downtown. It is interesting that the smart card was still more popular than certain service concepts, in spite of the issue of scale. Table 10-15 presents the same rankings as Table 10-14, but divided into two categories that reflect the scale of investment assumed.

Table 10-15. Transit services vs. other products.

Ranking of Transit Services Only	Ranking of Other Products
(Original ranking shown in parentheses)	
To downtown (1)	Smart Card (3)
To region (2)	Cell Phone (6)
Community shuttle bus (4)	Car Sharing (7)
Community door to door (5)	

Observations on the Rankings of the Alternatives

The respondents in the Phase 2 survey were given the opportunity to reveal a preference for local services, with locally managed shuttle buses augmented by community shared-ride taxis. The respondents as a whole, however, rated good transit service to downtown or in the region higher than the local options.

In the modal behavior pattern of many in the sample, transit gets a high share for the work trip, but is *not* the mode of choice for getting to the community center, the doctor, or the neighborhood shopping center. However, the oldest group in the sample (55-plus) ranked a community shuttle and door-to-door service significantly higher than the younger groups did, indicating that these options may be of more interest as individuals age.

The implications for both transit to downtown and the smart phone may merit further examination. With the application of the MaxDiff method, people are forced to pay attention to the issues of trade-off and prioritization; under this method, good service to downtown jumped to first place. Why it was ranked second to last in the "imaginary neighborhood" exercise may be associated with the context of the question, which encourages respondents to think about things they do not presently have—things that would need to change to accommodate the hypothesized conditions.

Finally, it seems clear that the *concept* of getting information about when the next bus would arrive was better understood than the details of the *products* presented. Table 10-11 showed the value of knowing when a bus or train would arrive. Interest in this feature does not seem to have been reflected in the respondents' reaction to the smart phone product.

Similarly, the lack of any evident correlation between concerns about needing a car to carry heavy things and to make spur-of-the-moment trips and the respondents' support for car sharing suggests that there is a general lack of knowledge about car sharing in our sample of respondents. Table 10-13 implies that the advocates of this strategy face a major task in bringing the public up to date.

Follow-Up Analysis: Comparing Phase 2 TPB Results

Two sets of rating questions provided data for the TPB in the Phase 2 Internet panel survey. In the initial set, discussed earlier in this chapter, respondents were asked to give their opinions about making more trips by walking and public transportation and about reducing trips by private automobile. In the final set, they were asked for opinions about how a series of transportation options might allow them to change their trip making.

In the time between these two sets of questions, respondents were exposed to messages that communicated the value of public transportation. Approximately one-third of the respondents received a message about saving money, another third received a message about reducing pollution and improving public health, and the last third received no message. The objective in this final set of TPB questions was to test whether *intent* to change mode would change given the messages and service options, and also to see if the causes of the change could be isolated.

The final set of Phase 2 survey questions obtained TPB ratings where the respondent was to assume that he or she had *all* seven transportation options available. A similar and less extensive set of questions was asked for the initial TPB exercise (where there were no alternatives and prior to the messages being provided). The seven transportation alternatives were:

1. Fast transit service (rail or express bus) to the downtown. This service is available every 15 minutes or better, and a station is located less than a mile away.
2. Good connections by transit to the rest of the region (other than the downtown). This service may involve a transfer from one transit vehicle to another. Service is available every 15 minutes or better throughout the day.
3. A shuttle bus connects your street with the local community center and other activities within your neighborhood. Service is available every 15 minutes throughout the day.
4. A community door-to-door service that you can take at about half the price of taxi service and that you share with others traveling at the same time. This service can be obtained by calling a special number and is immediately available.
5. Cars are available on your block or near your workplace to be rented by the hour (car sharing) when you need to make a trip that is difficult to make on transit. Cars should be reserved a day in advance, but may also be available immediately.
6. You have a "smart card" that you can use to purchase service on any of the buses, shuttles, trains, or taxis. Just wave the card near the fare reader or meter, and the fare will be debited from your card.
7. You have a new kind of cell phone, which will tell you exactly when the bus or train will arrive, show you where

you are, and provide instructions on getting to your destination by public transportation. It would also have a "911" button that would instantly send your location to police or emergency services. This cell phone can serve as your normal cell phone, or your own phone can be programmed to have this capability.

The exact wording of the Internet panel questionnaire was as follows:

> Please answer each of the following questions by choosing the number that best describes your opinion about using any or all of the improved transportation services described above for your trips. Think about how you might use any and all of these services to get to work or other trips—there might be more than one way to do so, and your choice of services could vary by your changing daily needs.

Behavioral Beliefs

Table 10-16 shows average ratings for the behavioral beliefs with the transportation alternatives, broken out by message. Table 10-17 shows the changes from the initial ratings of behavioral beliefs shown in Table 10-4. There are some significant changes in the behavioral beliefs between the initial and final TPB exercises. Overall, the respondents significantly increased their ratings of the following statements:

- I would save money.
- I would rely on alternative transportation and walking to get me to my destination in a timely way.
- My household could get by with fewer cars.

The respondents significantly decreased their rating of the statement "I would improve my health by walking more."

As can be seen in Table 10-17, both the group that received the "save money" message and the group that received the "health and environment" message significantly increased their rating of the behavioral belief "I would save money." The change in the control group was not significant. None of the transportation options suggested that money could be saved, so it is unclear why the rating increased for the group that received the health and environment message.

Another mystery is why all groups decreased their rating of "I would improve my health by walking more." One theory is that the respondents thought they would walk less with options such as door-to-door service or car sharing. The other two groups also decreased their rating of "I would reduce pollution," but this change was not significant.

None of the groups rated "reduce driving" significantly differently than before. In fact, all except the health and environment group rated this statement lower than previously. However, all groups rated "get by with fewer cars" significantly

Table 10-16. Behavioral beliefs for the final TPB Phase 2.

Behavioral Belief Statement: With these seven alternative transportation services available to me… (1 = extremely unlikely to 7 = extremely likely)	Mean (SD)			
	All Respondents	Save Money Message	Env. & Health Message	No Message (Control)
I would save money	5.0 (1.7)	5.2 (1.7)	4.9 (1.7)	4.9 (1.8)
I would be dependent upon someone else to get me to my destination on time	5.5 (1.5)	5.6 (1.4)	5.5 (1.5)	5.5 (1.8)
I would improve my health by walking more	5.3 (1.6)	5.1 (1.6)	5.2 (1.6)	5.6 (1.5)
I would improve my health by walking more to public transportation	5.1 (1.7)	5.0 (1.7)	5.2 (1.6)	5.3 (1.6)
I would reduce pollution	5.5 (1.5)	5.4 (1.5)	5.4 (1.5)	5.6 (1.4)
I would rely on alternative transportation and walking to get me to my destination in a timely way	5.1 (1.7)	5.2 (1.7)	5.1 (1.6)	5.1 (1.8)
I would reduce the amount of time I spend driving	5.2 (1.7)	5.2 (1.8)	5.2 (1.7)	5.4 (1.8)
My household could get by with fewer cars (asked only to those who have a car)	3.8 (2.1)	3.9 (2.2)	3.8 (2.1)	3.7 (2.2)
Number of respondents *(n)*=	*501*	*175*	*166*	*160*

Table 10-17. Change in behavioral beliefs between initial and final TPB.

With these seven alternative transportation services available to me…(1 = extremely unlikely to 7 = extremely likely)	Change in Mean Value			
	All Respondents	Save Money Message	Env. & Health Message	No Message (Control)
I'd save money	**0.42***	**0.61***	**0.43***	0.18
I would be dependent upon someone else to get me to my destination on time	-0.20	-0.11	-0.25	-0.26
I would improve my health by walking more	**-0.33***	**-0.44***	-0.22	**-0.33***
I would improve my health by walking more to public transportation	-0.01	-0.02	0.05	-0.06
I would reduce pollution	-0.11	-0.19	0.02	-0.16
I would rely on alternative transportation and walking to get me to my destination in a timely way	**0.45***	**0.56***	**0.69***	0.08
I would reduce the amount of time I spend driving	-0.05	-0.07	0.20	-0.30
My household could get by with fewer cars (asked only to those who have a car)	**0.70***	**0.76***	**0.68***	**0.65***
Number of respondents (n)=	*501*	*175*	*166*	*160*

*Indicates significant change from earlier TPB exercise at $p < .05$

higher than previously. This might indicate that they thought they would use car sharing, even though it was rated the lowest of all the alternatives. More research would certainly be required to interpret these results, however. Overall, the respondents significantly increased their ratings of "I would rely on (alternative/public) transportation and walking to get me to my destination in a timely way," perhaps indicating that the smart phone along with enhanced transit services would provide more reliability.

The bottom line is that the messages did not appear to have been very effective. While the respondents getting the "save money" message significantly increased their behavioral belief that they would save money with the transportation alternatives, respondents getting the "health and environment" message also significantly increased their behavioral belief about saving money. Those getting the health and environment message did not significantly change their behavioral belief that they would improve their health by walking more, although those not getting the message significantly decreased their belief that they would improve their health by walking more.

Power of Control

Whereas the changes in behavioral beliefs were modest, the changes in power of control were more significant. Table 10-18 shows the respondents' ratings of power of control statements given the availability of transportation alternatives. Table 10-19 shows the rating changes from the initial TPB exercise in cases where the statements were reasonably similar.

Most of the comparable ratings for power of control changed significantly from the initial to the final survey. Respondents agreed that it would be easier to get downtown, to travel regionally, and to travel locally with the new services. They thought it would be easier to make spur-of-the-moment trips and to carry heavy things with the alternative transportation options. However, slight wording changes make the statements about paying fares, understanding the schedules, feeling safer from crime, and being stranded harder to compare with the initial power of control statements. Table 10-18 indicates that respondents are still concerned about crime—that is, the ratings are slightly below neutral for that statement. Note that those who received no message changed their power of control rankings more than the groups who received the messages.

Normative Beliefs

The largest consistent change between the first set of TPB questions, which focused on using more public transit and walking, and the second set, which focused on using alternative transportation and walking, comes in the normative

Table 10-18. Power of control for final TPB Phase 2.

Power of Control Statement: If I were to use the new services… (1 = strongly disagree to 7 = strongly agree)	Mean (SD)			
	All Respondents	Save Money Message	Env. & Health Message	No Message (Control)
It would be more difficult for me to get to downtown.	3.2 (1.9)	3.1 (1.8)	3.3 (1.8)	3.1 (2.0)
It would be more difficult for me to get to other parts of the region.	3.8 (2.0)	3.9 (1.9)	3.8 (2.0)	3.7 (2.1)
It would be more difficult to make local trips to reach destinations such as the library, post office, restaurant, or coffee shop.	3.6 (1.9)	3.5 (1.9)	3.8 (1.9)	3.4 (2.0)
It would be harder for me to make spur of the moment trips.	4.6 (1.9)	4.7 (1.9)	4.5 (1.8)	4.5 (1.9)
It would be harder for me when I have to carry heavy things.	5.3 (1.8)	5.4 (1.8)	5.2 (1.8)	5.3 (1.8)
Paying the fare would be simple.	5.3 (1.5)	5.6 (1.3)	5.1 (1.5)	5.4 (1.7)
It would be easy to know when the bus or train would arrive.	5.1 (1.6)	5.3 (1.5)	4.9 (1.6)	5.0 (1.7)
I would feel safer from crime and other disturbing behavior.	3.9 (1.6)	3.9 (1.6)	3.9 (1.5)	3.8 (1.7)
I would have less concern about being lost or stranded by missing the bus or train.	4.3 (1.7)	4.3 (1.7)	4.2 (1.6)	4.3 (1.8)
Number of respondents (*n*)	*501*	*175*	*166*	*160*

Table 10-19. Change in power of control between initial and final TPB.

Power of Control Statement: If I were to (walk or use transit more/ use the new services)… (1 = strongly disagree to 7 = strongly agree)	Change in Mean			
	All Respondents	Save Money Message	Env. & Health Message	No Message (Control)
It would be more difficult for me to get to downtown.	**-0.80***	**-0.78***	**-0.80***	**-0.83***
It would be more difficult for me to get to other parts of the region.	**-1.56***	**-1.52***	**-1.35***	**-1.84***
It would be more difficult to make local trips to reach destinations such as the library, post office, restaurant, or coffee shop.	**-1.10***	**-1.07***	**-0.98***	**-1.25***
It would be harder for me to make spur of the moment trips.	**-0.84***	**-0.71***	**-0.83***	**-1.00***
It would be harder for me when I have to carry heavy things.	**-0.90***	**-0.75***	**-0.91***	**-1.04***
Number of respondents (*n*)	*501*	*175*	*166*	*160*

*Indicates significant change from earlier TPB exercise at $p < .05$

Table 10-20. Normative beliefs for the final TPB Phase 2.

Normative Belief Statement: With the new services available… (1 = extremely unlikely to 7 = extremely likely)	Mean (SD)			
	All Respondents	Save Money Message	Env. & Health Message	No Message (Control)
My family would be more supportive of my walking more and taking public transportation more.	4.2 (1.9)	4.2 (2.0)	4.1 (1.8)	4.2 (1.9)
My friends would be more supportive of my walking more and taking public transportation more	4.1 (1.9)	4.2 (1.9)	4.1 (1.8)	4.1 (1.9)
My neighbors would be more supportive of my walking more and taking public transportation more.	3.9 (1.8)	3.9 (1.8)	3.8 (1.8)	3.8 (1.9)
My coworkers would be more supportive of my walking more and taking public transportation more.	3.8 (1.8)	3.9 (1.9)	3.8 (1.7)	3.8 (1.9)
Number of Respondents (*n*)	501	175	166	160

beliefs. Table 10-20 shows the ratings for normative beliefs, and Table 10-21 shows the changes from earlier ratings. The change in normative beliefs would seem to be due to the alternatives available, not to the messages. There was no significant difference between the ratings given by the groups receiving different messages.

Direct Measures for the TPB

As in the first set of TPB ratings, a series of rating questions was asked to obtain direct measures of respondents' ATT, SN, SCF, and intent. Table 10-22 shows the results averaged for the relevant questions. Table 10-23 shows the change from

Table10-21. Change in normative beliefs between the initial and final TPB.

Normative Belief Statement: With the new services available… (1= extremely unlikely to 7= extremely likely)	Change in Mean			
	All Respondents	Save Money Message	Env. & Health Message	No Message (Control)
My family would be more supportive of my walking more and taking public transportation more.	**1.69***	**1.71***	**1.60***	**1.77***
My friends would be more supportive of my walking more and taking public transportation more	**1.73***	**1.72***	**1.78***	**1.69***
My neighbors would be more supportive of my walking more and taking public transportation more.	**1.65***	**1.65***	**1.69***	**1.60***
My coworkers would be more supportive of my walking more and taking public transportation more.	**1.63***	**1.65***	**1.62***	**1.61***
Number of respondents (*n*)	*501*	*175*	*166*	*160*

*Indicates significant change from earlier TPB exercise at $p < .05$

Table 10-22. Direct measures for the final TPB Phase 2.

Measure (rated on a seven-point scale)	Mean (SD)			
	All Respondents	Save Money Message	Env. & Health Message	No Message (Control)
Attitude (average of three ratings)	4.3 (1.7)	4.3 (1.6)	4.3 (1.7)	4.5 (1.9)
Subjective Norm (one measure, "it is expected of me")	3.7 (2.1)	3.6 (2.0)	3.8 (2.0)	3.7 (2.3)
Subjective Norm Alternative Measure (average of four normative beliefs)	4.0 (1.8)	4.0 (1.8)	4.0 (1.7)	4.0 (1.8)
Self-Confidence (average of three ratings)	4.1 (1.9)	4.0 (1.9)	4.1 (1.9)	4.2 (2.0)
Intent (average of three ratings)	4.4 (1.9)	4.3 (1.8)	4.4 (1.8)	4.4 (2.0)
Number of respondents (*n*)	*501*	*175*	*166*	*160*

the initial set of ratings. In the final TPB exercise there was but one direct measure of SN: "It is expected of me." This measure, as well as the average of the normative beliefs, is shown in the table. The correlation of the normative beliefs was strongest with the "it is expected of me" measure of SN in the initial TPB exercise, so the average of the normative beliefs serves as another indicator of the SN.

As can be seen, the largest change in the direct measures is in subjective norm. The self-confidence rating changes significantly as well, but not as much as subjective norm. The attitude rating does not change significantly. There appears to be little difference in these ratings for the groups receiving different messages.

Summary

This chapter has provided the detailed results of the Phase 2 Internet panel survey. The results provide information on the respondents' opinions regarding walking and taking transit. The results provide measures based on the TPB that allow us to explore how the use of transit and walking might change given different transportation services and marketing messages.

From an overall look at the results, it does not appear that the marketing messages had much effect on respondents' ratings concerning their use of public transportation and walking. Further exploration of the impact of marketing messages on different market segments will take place in Chapter 11.

Table 10-23. Change in direct measures between the initial and final TPB.

Measure (rated on a seven point scale)	Change in Mean			
	All Respondents	Save Money Message	Env. & Health Message	No Message (Control)
Attitude (average of three ratings)	0.16	0.18	0.15	0.13
Subjective Norm (one measure, "it is expected of me")	**0.88***	**0.78***	**0.91***	**0.96***
Subjective Norm Alternative Measure (average of four normative beliefs)	**1.67***	**1.68***	**1.67***	**1.67***
Self-Confidence (average of three ratings)	**0.53***	**0.58***	**0.43***	**0.58***
Intent (average of three ratings)	**0.80***	**0.87***	**0.72***	**0.80***
Number of respondents (*n*)	*501*	*175*	*166*	*160*

*Indicates significant change from earlier TPB exercise at $p < .05$

The results indicate that respondents did improve their scores on the measures of intent to change mode following the messages and with the assumption that there would be new and better alternative services available. However, their *attitude* did not change much, even when they were offered a comprehensive array of alternative services. They did not find walking and taking alternative transportation services significantly more desirable, pleasant, or interesting than walking and taking transit. What did improve was their self-confidence in being able to take transit and their judgment that those important to them would approve, as measured by the SN. Nearly all of the problems respondents found walking and taking public transportation improved with the alternative services available. With improved transportation alternatives, they said their family, friends, neighbors, and coworkers would be more supportive of their decision to walk and take alternative transportation services.

These results imply that a transit agency wishing to increase ridership should focus on alternatives that make transit easier to understand and use and on ways to increase the social acceptance of transit.

CHAPTER 11

Market Segments for Mode Choice

This chapter presents a market segmentation of the respondents to the Phase 2 Internet survey. In line with the research objectives of this project, this chapter focuses on an examination of the power of the TPB to distinguish market sectors favorable to using public transportation and walking and to provide insight into motivating factors.

The market segmentation is based on values of subgroups with differing intent to alter modal behavior in a variety of contexts. Four market segments have been defined to help explore the variety of values associated with the intent to change modal behavior toward a greater reliance on walking/transit and a lesser reliance on the private car. As will be seen, the market segmentation based on values provides some interesting new insights to the results provided in Chapter 10.

The market segmentation approach is similar to that taken in Chapter 7, which examined market segments for moving to a CN. Segments are based on variables that are related to the behavior of interest, in this case intent to change mode. A cluster analysis was undertaken based on the input of 56 separate independent variables, which were found to be correlated with the intent to change modal behavior with the assumption of new alternative services (termed *final intent*). The overall results for final intent were shown in Table 10-22. As part of the market segmentation process, candidate independent variables were reviewed for their correlation with the direct measure of final intent to change modal behavior. The 56 variables and their level of correlation with final intent are summarized in the addendum at the end of this chapter. For example, the variable with highest level of correlation with final intent was the belief that "I would rely on alternative transportation and walking to get me to my destination in a timely way."

All 56 of the variables associated with final intent were included as input to the clustering process. The process was undertaken several times, with manual specification of three, four, and five market segments. The clustering process resulting in four market segments was selected for further analysis, as it provided clear-cut differentiation for use in the analysis of shift between the initial direct measure of intent created at the beginning of the survey and the final intent created at the end of the survey. The four segments are cross-tabulated with each of the major attitudinal variables in the survey, presented in the order of the questionnaire.

Summary Definition of the Four Segments for Modal Change

Of the four market segments identified, two can be characterized as segments likely to change modal behavior (likely), and two can be characterized as unlikely to change modal behavior (unlikely). Of the total sample surveyed, ($n = 501$), approximately 43% were assigned by the clustering process to the two "likely" markets for modal change. The four segments for change in modal behavior are summarized here, ranked from highest initial intent to change to the lowest.

The Transit Loyalists. This group is characterized by their current use and understanding of public transportation services. For them, issues such as the safety of transit services and the difficulty in paying the fare are not considered deterrents, and therefore those issues need not be addressed with new products and services. This group tends to have a strong idea of what transit is and how it can improve.

The Environmental Mode Changers. Members of this group are characterized by the belief that if certain conditions are improved, they could become transit users, even though transit does not now live up to their standards. They are further characterized by their belief in environmental causes as a motivator for change in modal behavior.

The Happy Drivers. This group likes to drive, values its automobiles, and has no propensity to like the attributes of a transit-oriented life. This group should be considered as being moderately negative.

The Angry Negatives. This group is characterized by its low evaluation of just about every aspect of altering modal behavior and by the radically low intent of its members to alter their own transportation behavior.

Illustrative Characteristics of the Four Segments for Modal Change

Table 11-1 provides a quick introduction to the differentiating characteristics of the four market segments analyzed in this chapter. All data in this table have been taken from the full Phase 2 survey of 501 respondents. In the text that follows, some of the data have been taken from a sample of 380 of those respondents who also answered the Phase 1 survey. Each of the bolded numbers in Table 11-1 is an example of where the given market segment (row) has the highest scaling for the relevant variable (column). For the Angry Negative group, however, an example of extremely *low* scaling is shown.

Some Demographics

In terms of age, the Transit Loyalists are the youngest group, but the group does have some participation from the over-50 category. The Environmental Mode Changers are the oldest group, with good representation by people over 50, who may be empty nesters. In terms of the two negative groups, the Angry Negatives are somewhat older, with the Happy Drivers appearing disproportionately in both their 20s and their 40s. Age characteristics are shown in Table 11-2; the age-groups with the highest proportion for each market segment are shown in bold.

There are only minor differentiations in the income level of the four groups; the Transit Loyalists have lower household incomes, but their household sizes are smaller. The Transit Loyalists are disproportionately male, while the Environmental Mode Changers are disproportionately female.

The Structure of the Survey

As discussed in earlier chapters, the Phase 2 survey instrument was constructed with three clearly definable phases. First, a "pre-intervention" application of the full TPB was undertaken concerning one's intention to change personal transportation patterns. Second, an "intervention" was undertaken, in which the respondents were first exposed to different messages and then to seven separate potential strategies/services that might improve the marketability of the alternative transportation mode. For example, the respondents were asked to consider the implications of a modified cell phone that would (*a*) tell the user when the next bus would arrive, (*b*) tell the user how to make a transit trip home from any location if he or she were lost, and (*c*) have a "911" button that could be used to report the user's exact location to the police. Finally, another application of the TPB was undertaken to allow the documentation of any shift that might have occurred due to the messages or the alternatives.

At the commencement of the survey, the Transit Loyalists displayed the highest level of intent to change their transportation behavior to become more reliant on transit and walking. After the intervention was completed, the Environmental Mode Changers had shifted their level of intent to the

Table 11-1. Market segment characteristics.

Four Segments for Mode Change	Number of Cases	Initial Measure of Intent	Final Measure of Intent	Transit to Work (%)	For me to reduce pollution by using my car less would be IMPORTANT	For me to walk and take public transportation more would be DESIRABLE
Transit Loyalists	68	5.2	5.5	**65.6**	5.5	5.5
Environmental Mode Changers	150	4.0	5.4	20.1	**6.4**	5.1
Happy Drivers	132	3.7	4.3	26.8	5.2	4.3
Angry Negatives	151	2.3	2.9	16.9	4.3	**2.9**
Total	501	3.6	4.4	27.1	5.3	4.3

Numbers in bold are examples where the given market segment (row) has the highest scaling for the relevant variable (column), except for Angry Negatives, where an example of an extremely low scaling is shown.

Table 11-2. Market segments for mode change by age.

	Percentage by Age, for Each Segment				
	Under 30 years old	30–39 years old	40–49 years old	50-Plus years old	Total
Transit Loyalists	**29.4**	29.4	14.7	26.5	100.0
Environmental Mode Changers	23.3	22.7	23.3	**30.7**	100.0
Happy Drivers	27.3	26.5	**27.3**	18.9	100.0
Angry Negatives	19.2	**32.5**	20.5	27.8	100.0
All Respondents	24.0	27.5	22.4	26.1	100.0

Age-groups with the highest proportion for each market segment are shown in bold.

point where their stated intent was about as strong as that of Transit Loyalists.

The first part of this chapter will document the nature of the four market segments. The second part of this chapter will document the nature of the change in ratings between the initial and final applications of the TPB. The final part will review the role of the four segments in response to the two alternative messages presented to the survey participants.

Understanding the Two Most Likely Groups to Change Modal Behavior

The two most promising market segments are characterized by radically different motivations for changing their behavior. The first group appears pleased with the role of public transportation services in their lives and is positive about having additional services to create a better version of their existing experience. The second group is motivated by external considerations (their belief in the logic of improving the environment) and is quite unsatisfied with many aspects of the products and services currently offered. It was the second group that most increased its reported level of intent in response to strategies to deal with the perceived unsatisfactory conditions. The scale of the difference between the Transit Loyalists and the other groups in terms of present modal behavior is shown in Table 11-3. The numbers in bold indicate the market segments with the highest mode share for walking, driving, and taking public transit.

Transit Loyalists

The Transit Loyalists use transit to work at a rate more than three times that for the other positive group, the Environmental Mode Changers. For that reason, they already understand

Table 11-3. Primary mode choice for work by market segment.

	Which ONE of the following is YOUR PRIMARY means of getting to work?				
	Walking (%)	Bicycle (%)	Car (%)	Public transit (e.g., bus, train, trolley) (%)	Other (%)
Transit Loyalists (*n* = 61)	**14.8**		15.2	**65.6**	4.4
Environmental Mode Changers (*n*= 139)	2.9	0.7	74.3	20.1	2.0
Happy Drivers (*n* = 123)	4.1	0.8	67.5	26.8	0.8
Angry Negatives (*n* = 130)	1.5		**81.6**	16.9	
All Respondents (*n* = 453)	4.4	0.4	66.7	27.1	1.4

Numbers in bold indicate market segments with the highest mode share for walking, driving, and taking public transit

the limitations of this modal behavior, and they have learned to deal with them. They thus report the lowest concern about needing a car to make spur-of –the-moment trips or trips that involve carrying heavy things. More than any other group, their destination is downtown, which is the traditional destination for transit services. They have less of a need for a car to get where they want to go than any other segment.

The Transit Loyalists tend to understand the conditions that are associated with the use of public transportation services and to accept those conditions. As such, they are not particularly susceptible to strategies designed to deal with ameliorating those conditions. Compared with all other groups, the Transit Loyalists are less worried about crime while they are riding a transit vehicle or while they are walking, about being stranded if they miss the bus, or about dealing with fare payments. They are less concerned with the idea of traveling with those they do not know, and they are more accepting of being dependent upon others to get them to their destination on time.

On the other hand, they have the highest propensity to believe that if they used transit more, it would be *easier* to get to local destinations, to downtown, or to the rest of the region.

As will be discussed below, the Transit Loyalists are less optimistic about new services/products designed to deal with the perceived negative attributes of the transit lifestyle. Compared with the Environmental Mode Changers, the Transit Loyalists are less likely to say that new services would make paying the fare simpler, would make it easy to know when the bus would arrive, or would make them feel safer from crime or less fearful of being stranded.

In comparison with the Happy Drivers (the other market segment with overrepresentation by those under 30 years of age), the Transit Loyalists are much more likely to increase their walking and use of transit.

Environmental Mode Changers

The Environmental Mode Changers' positive disposition toward increased use of transit and walking is associated more with their belief in the potential for improvement than with their own day-to-day commitment to transit as it exists today.

In terms of values, this group has the highest propensity of any to place a positive value on reducing pollution by driving less, improving their health, meeting more neighbors, and reducing the time spent driving. A review of variables only included in the Phase 1 survey reveals that this group is nearly always more concerned than the other three groups about environmental issues.

This group has a greater propensity to see the environmental improvements from their proposed acts. They feel, more than any other group, that using transit more and walking more would reduce pollution, reduce the time spent driving, help them to meet more neighbors, and improve their health. They think that higher levels of transit use would save them money.

At the same time, this group needs a car for a variety of reasons; more than any other group, they say they need a car to make spur-of-the-moment trips and to carry heavy things. Their need for a car to get them where they need to go is second only to the Angry Negative group.

The Environmental Mode Changers currently view public transportation with some trepidation and caution. Compared with the Transit Loyalists, the Environmental Mode Changers are more worried about crime, being stranded, and paying the fare. They think, more than all but the most negative group, that increased reliance on transit would make it *more* difficult to get to local, downtown, and regional destinations.

Given their largely negative assessment of using public transportation, this group has the highest potential to believe that various strategies could indeed improve those conditions. Once this group experienced the intervention of comparing and prioritizing possible strategies for an improved transit-reliant lifestyle, the Environmental Mode Changers emerged as the most optimistic in responding to nearly every question that assumed that all new services and strategies would be available for use. Among the positive responses, they thought they would: save money, improve their health, reduce pollution, reduce the time spent driving, and find the new services dependable. The Environmental Mode Changers have the highest propensity to say that the new services and products would make it easier to pay the fare, easier to know when a train would be arriving, and make them less fearful of crime or of being abandoned.

(In this world of assumed new products and services, it is still the Transit Loyalists who report the highest level of belief that it would be easier to get to destinations, to overcome the problem of carrying heavy things, and to accommodate spur-of-the-moment trips. The Environmental Mode Changers have less personal experience with actual use of transit and more concerns about it.)

In comparison with the Angry Negatives (the other older market segment), the Environmental Mode Changers are much more likely to increase their walking and use of transit.

Understanding the Behavior of the Two Least Likely Groups to Change Modal Behavior

Happy Drivers

The Happy Drivers group is characterized by the propensity to be less likely than average to change modal behavior, but the group should not be seen as a carbon copy of the Angry Negatives. From the questions in the Phase 2 survey, this group does not produce either the highest or lowest score on any major

variable. For the purposes of this study, the group can be categorized having a low rate of hostility toward the concepts associated with a change of mode; for example, the group has a slightly higher than average response to the survey question, "For me to walk and take public transportation more would be desirable." However, this pattern of near-average support of concepts never translates into active support on any key variable.

A review of questions asked in the Phase 1 survey shows those members of this group who responded to both surveys had the highest propensity to say that they liked to drive, with high scorings on the freedom and independence that comes from owning several cars.

The Happy Drivers are the least likely of the two younger segments to change mode.

Angry Negatives

In the Phase 2 survey, the Angry Negative group places lowest on ratings of almost every variable associated with support of a change in modal behavior. This group emphasizes its auto dependency, with the highest propensity of any group to say they need a car to get where they need to go. In the scenario in which there is more reliance on transit and walking, this group has the lowest propensity to say they would reduce time spent driving.

Two of the few exceptions to the most negative role came in response to questions concerning worry about crime. This group reports less worry than some other groups about crime while using transit or while walking; perhaps they do not worry about it because they do not think about it, having no intention to use either mode. In addition, the group has the second highest belief that lowering the cost of transportation would be desirable.

In general, the Angry Negative group places the lowest rating on virtually all aspects of a transit-reliant life. From the responses of those who took both surveys (Phase 1 and Phase 2), a generally negative mood in such responses is noted, as not making new friends and not getting more exercise. This group tends to assign negative ratings even to "neutral" concepts, including the importance of street lighting or places to ride a bike. They seem to be suggesting that they just want to be left alone. They have the highest feeling of freedom and independence that comes from owning several cars, and the highest need to control the things that they do.

Of the two older groups, the Angry Negatives are the least likely to change mode.

What Groups Shifted and Why?

In this section, the concerned is with the shifts in answers from the initial set of TPB questions to the final set of questions, after the respondents were presented with the messages and the descriptions of alternative services. Table 11-4 shows the extent of shift in the direct measures of intent, ATT, SCF, and SN. Table 11-5 shows the data from which each of the values in Table 11-4 were derived.

Table 11-4. Shifts in answers from initial to final TPB questions.

Four Market Segments for More Walking and Transit	Shift in Intent	Shift in Attitude	Shift in Self-Confidence	Shift in Subjective Norm (from four beliefs)†
Transit Loyalists	0.26	0.17	0.11	**1.38***
Environmental Mode Changers	**1.42***	0.28	**0.96***	**2.34***
Happy Drivers	**0.58***	0.17	**0.39***	**1.49***
Angry Negatives	**0.61***	0.01	**0.42***	**1.30***
Full Sample (N = 501)	**0.80***	0.16	**0.53***	**1.67***
Interpretation: The Environmental Mode Changers provide the highest rating increase in every category. The current Transit Loyalists have a very small shift for self-confidence: they already know how to walk and ride transit and do not show much increase in self-confidence as the result of our improved strategies and products.				

* Significant change at the $p < .05$ level

†Note that the average of the *normative beliefs* is substituted for *subjective norm* since there was only one measure of subjective norm in the final set of TPB questions. The magnitude of change is thus not directly comparable with the change for the other direct measures. However, looking only at the change in the one direct measure of subjective norm, the change is still larger than for the other measures (see Table 10-23).

Table 11-5. Shift in direct measures of the TPB by market segment.

Four Market Segments for More Walking and Transit	Initial Intent	Final Intent	Shift in Intent	Initial Attitude	Final Attitude	Shift in Attitude	Initial Self-Confidence	Final Self-Confidence	Shift in Self-Confidence	Initial Subjective Norm from Four Beliefs	Final Subjective Norm from Four Beliefs	Shift in Subjective Norm
Transit Loyalists	5.19	5.45	*0.26*	5.25	5.42	*0.17*	5.38	5.49	*0.11*	3.10	4.48	*1.38*
Environmental Mode Changers	4.02	5.44	*1.42*	4.93	5.21	*0.28*	3.88	4.84	*0.96*	2.66	5.01	*2.34*
Happy Drivers	3.71	4.30	*0.58*	4.20	4.37	*0.17*	3.84	4.23	*0.39*	2.53	4.02	*1.49*
Angry Negatives	2.26	2.87	*0.61*	2.93	2.95	*0.01*	2.28	2.70	*0.42*	1.44	2.74	*1.30*
Full Sample (501)	3.57	4.36	*0.80*	4.18	4.34	*0.16*	3.59	4.12	*0.53*	2.32	3.99	*1.67*

The Transit Loyalists showed the smallest level of increase in intent of any of the four segments—smaller even than that of the Angry Negative group. By contrast, the Environmental Mode Changers showed by far the highest level of shift in intent. The Environmental Mode Changers showed the greatest increase in all categories.

The Shift in Attitude

For the sample as a whole and for each of the market segments, the increase in the scores for direct measure of attitude was not significant. This suggests that the seven services tended to increase the belief that one could make the change in behavior, and that one's immediate social network would be supportive of the change in behavior, to a greater extent than the belief that the proposed behavior was desirable, pleasurable, or interesting.

The Shift in Self-Confidence

The TPB suggests that the extent to which behavior actually follows from intent is constrained (negatively) by the reapplication of the factor of SCF after intent has been formed and is being translated into behavior. Thus, it is worthwhile to review the content of Table 11-5 with respect to final SCF.

The final SCF of the Transit Loyalists remains stronger than the final SCF of the Environmental Mode Changers, even as the level of intent increases for the environmental group. In short, the SCF for the Transit Loyalists was strong before the intervention and remained strong after the intervention. Looking both at shift in attitude and shift in SCF, the Transit Loyalists do not expect that the strategies offered to them would allow them to increase their use of green modes. In essence, they already are high users of green modes and don't have much room to further increase mode share.

By comparison, the Environmental Mode Changers increased their ratings for attitude and SCF more than any of the other segments. Because the SCF for the Transit Loyalists is still stronger than the SCF for the environmental group, the TPB suggests that the Environmental Mode Changers will be more constrained (negatively) in the path from intent to behavior than will the Transit Loyalists.

Table 11-5 also provides some insight about the difference between the Happy Drivers and the Angry Negatives. With the final TPB questions, the Happy Drivers show a SCF that is somewhat above the average for the sample as a whole, while the Angry Negatives reveal a SCF that is vastly lower than average. The Happy Drivers have some belief that they could alter their behavior, if they wanted to. Their final intent is somewhat lower than the sample average, reflecting only a lukewarm interest in actually wanting to change the behavior.

The Shift in Subjective Norm

A significant shift, however, occurred for all market segments in the change of ratings of the SN, which looks at the impact of one's personal social network in one's formation of intent to change behavior. This pattern is most dominant for the Environmental Mode Changers segment.

To better understand what might have caused the improvement in SN, correlations between the final SN for all respondents and each of the other rating statements were examined as well as correlations between the change in SN and each rating statement. The top correlations with either final SN or the change in SN are shown in Table 11-6, ranked by final SN. As can be seen, the statement with the greatest correlation with final SN was "With the new services available, I

Table 11-6. Statements with greatest correlation with final subjective norm (full sample).

Statement	Correlations with Final SN	Correlations with Change in SN
With the new services available, I would have less concern about being lost or stranded by missing the bus or train	0.49	0.28
I would rely on alternative transportation and walking to get me to my destination in a timely way	0.45	0.27
If I were to use the new services, I would feel safer from crime and other disturbing behavior	0.45	0.22
I would improve my health by walking more to public transportation	0.44	0.27
I would improve my health by walking more	0.41	0.27

would have less concern about being lost or stranded by missing the bus or train." This statement was also the most highly correlated with the change in SN. Also in the top group of statements were "I would rely on alternative transportation and walking to get me to my destination in a timely way" and "If I were to use the new services, I would feel safer from crime and other disturbing behavior."

There are differences when the correlations are developed for the two positive market sectors, as shown in Table 11-7. The correlation between final SN and "being lost or stranded" is greatest for the Environmental Mode Changers. For this group, the second ranked correlation is for "feel safer from crime and other disturbing behavior." This is very different from the response for the Transit Loyalists, where the highest correlation is with "I would rely on alternative transportation and walking to get me to my destination in a timely way." The correlation for being stranded was also significant, but was the lowest of the top five statements. Correlations do not imply cause, but do provide hypotheses for what might cause an improvement in SN.

Desired Attributes for a Change in Modal Behavior

This project explored the unmet desires and requirements of future transit riders in several ways. First, the question of desired attributes was explored through an *unconstrained* method, by asking the respondent to rate each alternative on a scale of one to seven, and second with a method that required trade-offs between a limited number of options, denying the respondent the ability to give high ratings to all options. In this section, the attitudes of the full sample and the four market segments for modal change toward the *attributes and functionalities* they would like to see addressed by specific products and strategies first will be reviewed. Then the rankings assigned to *specific products* that could be produced by the public transportation manager will be reviewed.

Ranking the Desired Attributes for a Change in Modal Behavior

After the completion of the initial TPB exercise in the Phase 2 research, the respondents were asked to think about an imaginary neighborhood that already had good sidewalks and good walking destinations. A stated requirement of that imaginary neighborhood was living with fewer cars than at present. The survey question was posed as follows:

> Thinking about this imaginary neighborhood, which transportation options would you need to live with fewer cars in your household?

Table 11-8 presents the results of this set of questions, presenting the rank order (left to right) of the attributes offered for the full sample and the mean ratings given by each market segment. The respondents gave the highest rating to "I would want to know exactly when the bus or train would arrive." The second most desired function was

Table 11-7. Statements correlating with final subjective norm by the positive market segments.

	Correlation with Final Subjective Norm	
Statement	**Transit Loyalist (n = 68)**	**Environmental Mode Changers (n = 150)**
With the new services available, I would have less concern about being lost or stranded by missing the bus or train	0.37	0.43
I would rely on alternative transportation and walking to get me to my destination in a timely way	0.52	0.16
If I were to use the new services, I would feel safer from crime and other disturbing behavior	0.41	0.37
I would improve my health by walking more to public transportation	0.40	0.11
I would improve my health by walking more	0.43	0.14

Table 11-8. Mean ranking of desired attributes and functionalities.

Four Segments to change in Modal Behavior	I would want to know exactly when the bus or train would arrive	I would want a transit pass so that I never had to worry about having cash	I would want to be able to walk to a nearby store or coffee shop	I would want a transit service that connects me with the rest of the region	I would want to be sure that a taxi would come at any hour	I would want a shuttle service to take me to the community center and other activities within the neighborhood	I would want frequent transit service (rail or express bus) to the downtown	I would want a car on my block that I could rent by the hour (car-sharing)
Transit Loyalists	6.01	6.28	6.29	6.22	5.35	5.57	**5.97**	4.00
Environmental Mode Changers	**6.56**	**6.55**	**6.58**	**6.48**	**5.95**	**6.07**	5.95	**5.22**
Happy Drivers	5.69	5.60	5.61	5.55	5.01	5.08	5.08	4.39
Angry Negatives	5.86	5.74	5.54	5.57	5.13	4.83	4.48	3.84
Total	6.05	6.02	5.97	5.92	5.37	5.37	5.28	4.42
Attribute's Rank	**1 (Highest)**	**2**	**3**	**4**	**5**	**6**	**7**	**8 (Lowest)**

"I would want a transit pass so that I never had to worry about having cash." Ranking third among the list of desired attributes was "would want to be able to walk to a nearby store or coffee shop." The least desired service concept was that for car sharing.

Looking at the bolded numbers in Table 11-8, it is clear that the most enthusiastic segment for most of these concepts was the Environmental Mode Changers, who even gave the lowly rated car-sharing option a scaling above 5. Only the Transit Loyalists rated any option higher than the Environmental Mode Changers—they rated "good transit to downtown" higher than all other market segments.

This survey method produces an unconstrained description of what services/attributes are desired by the survey respondents. Purposefully omitted from this method is any question of cost or trade-off. A different method to see how customers would react to descriptions of products was applied, based on whatever understanding they had concerning that product, through a prioritization process that forced trade-offs among products. Table 11-9 shows the rank ordering of services by market segment. The bolded cells indicate where any market segment ranks services differently from the sample as a whole.

Ranking the Specific Products and Services

When forced to prioritize over seven described products/services, respondents' rankings changed. The Transit Loyalists assigned the highest value to transit service to downtown. By contrast, neither the Happy Drivers nor the Angry Negatives gave highest ranking to service to downtown. For all segments, the smart card payment mechanism gets a higher ranking than either the community shuttle bus or the community door-to-door service. The smart phone and car sharing ended up in the lowest levels of the ranking scheme.

The rankings of the Transit Loyalists showed a variation from the sample norm, placing a number-two priority on the smart card, ranking it higher than the highly ranked regional transit service. Less importantly, the Angry Negatives also liked the smart card. The Transit Loyalists actually ranked the community door-to-door service somewhat lower than the smart phone; perhaps the idea of sharing a small vehicle is not particularly valued by those with wide experience in fixed-route and scheduled services.

Comparison with Other Research

The application of a program of market segmentation to augment the analysis undertaken for the full sample has proven productive. The use of post hoc categories significantly increases the ability to identify groups on the basis of the commonality of their attitudes and beliefs. And, as has been seen in this chapter, the TPB provides a structure with which to organize a wide variety of attitudes and beliefs in a consistent, interpretable format. A brief review of the conclusions of two other recent segmentation studies suggests some consistency of findings, while identifying some areas for further research.

Given the complexity of the study design, (designed to track changes between the two applications of the TPB), only four market segments were selected for the analysis. The clustering process assigned 43% of the full sample to the two groups most likely to increase use of transit and walking. Most studies reviewed tended to create five or more segments in this process.

The use of market segmentation in the analysis of increase in transit share is examined in *TCRP Report 36: A Handbook—*

Table 11-9. Products tanked by MaxDiff exercise, highest to lowest.

Four Segments to Change in Modal Behavior	Transit to Downtown	Regional Transit	Smart Card	Community Shuttle	Community Door to Door	Smart Phone	Car Sharing
Transit Loyalists	Highest Rank	**3**	**2**	4	**6**	**5**	Lowest
Environmental Mode Changers	Highest Rank	2	3	4	5	6	Lowest
Happy Drivers	**2**	**Highest Rank**	3	4	5	6	Lowest
Angry Negatives	**2**	**3**	**Highest Rank**	4	5	6	Lowest
Product's Rank (Full Sample)	1 (Highest)	2	3	4	5	6	7 (Lowest)

Bolded cells highlight where any segment has a ranking different from the sample average

Using Market Segmentation to Increase Transit Ridership (*49*). That study concluded with the creation of five workable market segments for potential change of modal behavior. They concluded that two segments were positive, and that three were less promising. Their analysis resulted in 37% of the sample population being assigned to the two positive groups and 63% being assigned to the negative groups. Note that the surveys in *TCRP Report 36* were of a randomized variety in specific transit districts, so the percentages of positive groups is more reflective of the broader population in a transit district than this study, which is purposely enriched with transit users.

Although a detailed comparison of the groups is not supportable because of the difference in methods used, some "high level" observations can be made.

TCRP Report 36 found that one positive group was disproportionately male and had the greatest use of transit in their lives. They were young, unmarried, and disproportionately students. This group bears a clear resemblance to our Transit Loyalists. Among their salient attributes were the following:

- They are the most likely segment to find the idea of using transit appealing—notably for commute travel.
- They see the least gaps between what is important in the mode choice decision and transit's ability to deliver.
- They have transit service available from where they live to where they work or go to school. They are the most likely to work in a central city or downtown area.
- They place low value on security, sense of belonging, and being well respected.
- They are mostly single; if married, their spouses often work.
- They moved or changed jobs in the past several years. (*49*, *p. 129*)

In all of these anecdotal areas, the *Report 36* transit-oriented group was similar to the this project's Transit Loyalists.

TCRP Report 36 found that the second most positive group for mode change was disproportionately female, similar to the Environmental Mode Changers. The group was analyzed in terms of the higher standards they want satisfied before proceeding with a positive change of modal behavior. *Report 36* describes their second positive group as follows:

- They feel transit is high risk and are unsure of transit's ability to perform as they require.
- While not particularly demanding in terms of benefits they seek in the mode choice decision, they see gaps in transit's ability to perform as required.
- If they are married, they are the most likely segment to have children at home. (*49*, *p. 128*)

On other issues, comparability is more difficult, as that study went into psychographic issues concerning optimism and outlook on life not emphasized in the present study. The report described three other groups with varying reasons for their car dependency.

Another chance to cross check the logic of our results of the segmentation comes in the paper, "'Complacent Car Addicts' or 'Aspiring Environmentalists'? Identifying Travel Behaviour Segments Using Attitude Theory," by Jillian Anable, which undertook a market segmentation procedure for change in modal behavior based on the construct of the TPB, as expanded (*52*). In her segmentation, she found some 25% of the sample could be described as the most likely to use alternative modes to visit historic sites; this was a combination of transit-dependent persons (no cars) and environmental activists with cars. At the other end of the spectrum, two strongly negative groups were identified, one of which seems directly hostile, while the other simply sees no reason to change. In the middle, roughly one-third of the sample is assigned to a group characterized by high commitment to environmental change, but holding the belief that they cannot pull it off. Anable writes, "This suggests that although they could be willing to reduce car use for altruistic motives and to avoid congestion, they are held back by weak perceptions of behavioral control." Of the market segments reviewed in this research, her group is most similar to the Conflicted/Contented group, one of the five segments described in the discussion in Chapter 7 concerning propensity to change neighborhoods.

In sum, it was found that the combination of market segmentation methods and the overarching construct of the TPB could play a significant role in the analysis of transportation issues, such as the propensity to increase walking and transit.

Anable summed up her conclusions on this combination in this way:

> Altogether, the possibility of explaining travel behaviour by attitudinal factors, with the use of market segmentation was confirmed. Segmentation provided a way of finding naturally occurring coherent and meaningful groups and left preconceptions aside. More specifically, the utilisation of an expanded version of an established theory of behaviour (TPB) has provided a practical, theoretical and useful basis to explain the mode choice decision. . . .
>
> Interpretable in the context of the TPB, the attitudinal segments help us to identify the factors underlying a decision to perform or not to perform a given behaviour. They essentially provide an indication of how hard people are willing to try to

leave the car at home for day trip travel and under what circumstances. Most significantly, each of the six groups identified represented a unique combination of each type of belief, proving that different groups need to be served in different ways to optimize the chance of realising changes in behaviour. The evidence clearly shows *that the same behaviour can take place for different reasons* and that the same attitudes (e.g. positive attitudes to the environment) can lead to different behaviour (e.g. a reduction or no reduction in car use). (*52*)

Addendum: Fifty-Six Variables Correlated with Final Intent

The variables used in the Chapter 11 market segmentation are shown in the table below, along with a measure of the correlation. The table also indicates a number of variables that have been reworded and recoded so that the correlations are positive.

Fifty-Six Variables Correlated with Final Intent (Rank Ordered)

Variable Name	**Correlation with Final Measure of Intent ***	**Changed to Make a Positive Correlation ****	**Significance Level †**
I would rely on alternative transportation and walking to get me to my destination in a timely way	**0.543**		*0.000*
I would reduce pollution	**0.454**		*0.000*
I'd save money (WITH ALL NEW SERVICES AVAILABLE)	**0.448**		*0.000*
I would improve my health by walking more to public transportation	**0.444**		*0.000*
For me to reduce pollution by using my car less would be IMPORTANT	**0.443**		*0.000*
With the new services available, I would have less concern about being lost or stranded by missing the bus or train	**0.441**		*0.000*
I would improve my health by walking more	**0.439**		*0.000*
I would reduce the amount of time I spend driving	**0.421**		*0.000*
I would improve my health by walking more	**0.402**		*0.000*
IN THE IMAGINARY NEIGHBORHOOD, I could live with fewer cars (OR ALREADY DO)	**0.397**		*0.000*
I'd save money (IF I TOOK TRANSIT MORE)	**0.391**		*0.000*
I would rely on public transportation and walking to get me to my destination in a timely way	**0.380**		*0.000*
I would reduce pollution	**0.379**		*0.000*
If I took more transit, my household could get by with fewer cars (OR ALREADY DOES)	**0.377**		*0.000*
I would improve my health by walking more to public transportation	**0.376**		*0.000*
With the new services, my household could own fewer cars (OR ALREADY DOES)	**0.371**		*0.000*
For my household to own fewer cars would be DESIRABLE (OR ALREADY DOES)	**0.357**		*0.000*
I would meet more of my neighbors	**0.351**		*0.000*
If I were to use the new services, I would feel safer from crime and other disturbing behavior	**0.345**		*0.000*
I would reduce the amount of time I spend driving	**0.339**		*0.000*
For me to be able to leave the driving to someone else would be DESIRABLE	**0.330**		*0.000*
If I were to use the new services, it would be easy to know when the bus or would be easy to know when the bus or train would arrive	**0.328**	**	*0.000*
For me to ride with people I don't know while traveling would be DESIRABLE	**0.327**		*0.000*
I *DO NOT* need a car to get where I need to go	**0.323**	**	*0.000*
If I were to walk and take public transportation more it would be *EASY* to make local trips to reach destinations such as the library, post office, restaurant, or coffee shop	**0.294**	**	*0.000*
For me to improve my health by walking more would be IMPORTANT	**0.291**		*0.000*
If I were to use the new services, paying the fare would be simple	**0.287**		*0.000*
I would be able to leave the driving to someone else	**0.285**		*0.000*

Fifty-Six Variables Correlated with Final Intent (Rank Ordered)			
Variable Name	**Correlation with Final Measure of Intent ***	**Changed to Make a Positive Correlation ****	**Significance Level †**
If I were to use the new services, it would be *EASIER* to make local trips to reach destinations such as the library, post office, restaurant, or coffee shop	**0.275**	**	*0.000*
It would be easier to take public transportation more if I knew when the bus or train would arrive	**0.274**		*0.000*
If I were to walk or take public transportation more it would be *EASIER* for me to make spur of the moment trips	**0.274**	**	*0.000*
For me to meet my neighbors while walking is DESIRABLE	**0.260**		*0.000*
If I were to use the new services, it would be *EASIER* for me to make spur of the moment trips	**0.259**	**	*0.000*
If I were to use the new services, it would be *EASIER* for me to get to other parts of the region	**0.255**	**	*0.000*
If I were to use the new services it would be *EASIER* for me to get to downtown	**0.253**	**	*0.000*
I need to travel downtown	**0.245**		*0.000*
It would be easier to take public transportation more if it were simple to pay the fare	**0.242**		*0.000*
It would be EASY for me to get downtown if I were to walk and take public transportation more	**0.225**		*0.000*
For me to be dependent on someone else to get me to my destination on time would be DESIRABLE	**0.222**		*0.000*
If I were to walk and take public transportation more it would be *EASY* forme to get to other parts of the region	**0.210**	**	*0.000*
For me to reduce the amount of time I spend driving would be IMPORTANT	**0.192**		*0.000*
If I were to use the new services, it would be EASIER for me when I have to carry heavy things	**0.187**		*0.000*
I *DO NOT* need access to a car to make spur of the moment trips	**0.183**	**	*0.000*
I *DO NOT* worry about crime or other disturbing behavior on public transportation	**0.179**	**	*0.000*
I would ride more with people I don't know	**0.171**		*0.000*
I *DO NOT* find that dealing with the fare for public transportation is a bother	**0.158**	**	*0.000*
I need to travel to other parts of the region	**0.157**		*0.000*
I *DO NOT* worry ABOUT encountering crime or other disturbing behavior when walking	**0.142**	**	*0.001*
It would be easier for me to walk or take public transportation more if I was sure of not being lost or stranded by missing the bus or train	**0.129**		*0.004*
I would be dependent upon someone else to get me to my destination on time	**0.128**		*0.004*
For me to reduce the cost of my daily transportation would be DESIRABLE	**0.128**		*0.004*
I *DO NOT* worry about being stranded if I rely on public transportation and miss the bus or train	**0.125**	**	*0.005*
I need to make local trips to reach destinations such as the library, post office, restaurant, or coffee shop	**0.125**		*0.005*
If I were to walk or take public transportation more it would be *EASIER* for me to carry heavy things	**0.109**	**	*0.015*
I *DO NOT* find that waiting for the bus or train and not knowing when it is coming is a bother	**0.103**	**	*0.022*

* Correlations are rank ordered by their absolute value.
** Variable with negative correlation from original phrasing. Variable recoded & name rephrased as positive.
† Correlations with significance less than 0.05 have been excluded from this table. $N = 501$ for all variables.

CHAPTER 12

Use of the TPB to Understand Mode Choice

Overview of the Chapter

This chapter explores the components of TPB for what the model can tell about what affects individuals' intentions to increase the use of environmentally friendly modes, such as walking and transit. The Internet panel survey in Phase 2 of the project included two sets of questions for the TPB, and these provide the data to allow examination of the relationship between intent and ATT, SN, and SCF about mode change. Further, the two sets of questions provide data to allow examination of beliefs that affect ATT, SN, and SCF.

The two sets of questions are referred to as the initial TPB set and the final TPB set. In the initial set, respondents were asked to give their opinions about making more trips by walking and public transportation and reducing trips by private automobile. In the final set, they were asked to give opinions about how a series of transportation options might allow them to increase their use of alternatives to the private automobile. The transportation options included good transit service to downtown, good transit service to the rest of the region, a shuttle bus to the local center, a shared ride service that is less expensive than a taxi, car sharing, a smart card that could pay for all services, and a smart phone that provided real-time information on schedules and a 911 emergency communication capability.

In between these two sets of questions, the respondents were exposed to some messages that communicated the value of public transportation. Around one-third of the respondents received a message on saving money, one-third received a message about reducing pollution and improving public health, and one-third received no message. The objective in this set of exercises was to test whether *intent* would change given the messages and service options, and also to see if variables associated with this change could be isolated.

This chapter summarizes statistical analyses of the hypothesized relationships for the TPB. Regression analysis is used to examine the relationship between the intent and direct measures of ATT, SN, and SCF. It was examined whether respondents' answers regarding their final intent are related to their initial intent or whether they are, as the TPB implies, related to their final ATT, SN, and SCF.

Following the analyses of intent, the relationship between behavioral beliefs and ATT was examined. Respondents provided direct measures of the desirability or importance of each behavioral belief as variables called *outcome evaluations*. A second measure of the importance of the behavioral beliefs was obtained by regressing final behavioral beliefs on final attitude. The coefficients from the regression are a statistically derived set of importance weights for the behavioral beliefs. Changes in attitude may be explained by changes in the behavioral beliefs that are important contributors to attitude. Following the analysis for ATT, similar analyses are shown for the normative beliefs and SCF. The results of these analyses indicate the types of changes that may have the most potential for improving the use of transit and walking.

Can Respondents' Ratings Be Trusted?

One problem with the study design is that the respondents may have anticipated what the researchers would like to find and may have answered in a way to please the researchers. Because respondents were asked to consider how they might use transit and walk more and drive less, they may well have indicated more interest in transit and walking than they actually would have felt.

There are several ways to try to overcome this problem. The first is to remind respondents of the disadvantages, as well as the advantages, of using transit and walking. As respondents consider the negative aspects of changing modes, they may be less inclined to exaggerate their attitude and intent to walk and use transit more.

Another way to combat the tendency to exaggerate a positive response is to examine the change when respondents

were exposed to different messages and different alternatives. Since it is likely that a tendency to exaggerate will show up from the beginning, when we examine a change in intent or other variables, much of the effect of exaggeration should be eliminated, providing that it is similar in each case.

Relationships of the Directly Measured TPB Variables

Table 12-1 summarizes the change in ratings for the directly measured TPB variables with regard to increasing use of alternative modes and decreasing use of the private automobile. *Intent* is measured by the respondents' agreement on three statements regarding (*a*) their plans to walk and take public transportation more, (*b*) their intent to walk and take public transit more, and (*c*) whether they will make an effort to walk and use public transportation more. ATT was the degree to which the respondent thought that walking and using public transportation more would be (*a*) more pleasant, (*b*) more interesting, and (*c*) desirable. SN was what was "expected of me." SCF was measured by (*a*) the respondents' confidence in being able to walk and take public transportation more, (*b*) their ease of doing so, and (*c*) the extent to which they thought it was possible.

Intent increased significantly from the initial to the final set of TPB statements. The increase was on the order of 0.8 units on a rating scale between one and seven. The ATT did not increase significantly. The lack of change in attitude toward the behavior is one indication that the respondents were not simply answering all questions in a manner to please the researchers.

Referring again to Table 12-1, there were significant changes in SN between the two TPB exercises. The rating of "it is expected of me" increased by nearly a point on the seven-point scale. There were also changes in the SCF of the respondents between the two TPB exercises. Respondents indicated significantly greater confidence that they could walk and take transit more with the alternatives than without them.

Table 12-1. Differences in direct measures for the theory of planned behavior.

TPB Measure	Differences
Intent	**0.80***
Attitude (average of three measures).	0.16
Subjective Norm (one measure: "it is expected of me")	**0.88***
Substitute Measure of Subjective Norm (average of four normative beliefs)	**1.67***
Self-Confidence (average of three measures)	**0.53***

*Difference is significant at $p < .05$

So while there was not a significant change in the respondents' own attitudes toward increasing their use of walking and taking transit, they did think that with the seven alternative transportation options available, walking and taking transit more would be more acceptable to others. In other words, there would be a normative expectation that the respondent would walk and use transit more. The results also indicated respondents were more confident in being able to walk and take public transportation more, that it would be easier to do so, and that it was more likely possible.

Regression was used to examine the relationship between the direct measure of intent (to walk and use public transportation more and reduce trips by automobile) and direct measures of ATT, SN, and SCF. Regressions were run separately for both of the sets of questions about intent—one set of questions before the messages and another set after the messages and with respondents told to assume they had access to the seven alternative transportation options. Table 12-2 and Table 12-3 show these regressions. To be consistent between the initial set of TPB questions and the final set, one variable, "It is expected of me," was used to measure SN.

Table 12-2 shows the results for the initial set of questions. Table 12-3 shows the results for the final set. All of the inde-

Table 12-2. Regression of initial intent to walk and take transit more.

Dependent Variable: Initial Intent			
Independent Variable	**Coefficient**	***t*-Statistic**	**Probability**
Constant	-0.37	-3.6	.0004
Initial Attitude	**0.47***	16.3	.0001
Initial Subjective Norm	**0.28***	11.0	$\leq .0001$
Initial Self-Confidence	**0.33***	12.1	$\leq .0001$

* indicates a significant coefficient at $p < .05$
$R^2 = 80\%$, 501 observations.

Table 12-3. Regression for final intent to walk and take transit more.

Dependent Variable: Final Intent			
Independent Variable	**Coefficient**	***t*-Statistic**	**Probability**
Constant	0.11	1.23	.2203
Final Attitude	**0.55***	17.6	≤ .0001
Final Subjective Norm	**0.25***	11.3	≤ .0001
Final Self-Confidence	**0.23***	8.09	≤ .0001

* indicates a significant coefficient at $p < .05$
$R^2 = 85\%$, 501 observations.

pendent variables are highly significant. As can be seen in each of the tables, attitude has the largest coefficient. The coefficients for subjective norm and self-confidence are similar in magnitude to each other and less than that for attitude.

One question regarding this set of equations is whether the respondents rated their intentions the same as they had previously, or whether they were consciously thinking about the use of the transportation alternatives. To look at this question, the final regression in Table 12-3 was redone to include the directly measured intent from the prior TPB exercise as another independent variable. If there had been no change in the way respondents answered the rating questions, then it would be expected to see a larger and highly significant coefficient for the initial intent measure. Also, there is confidence that final intent is corresponding with the final ATT, SN, and SCF, following the theory of planned behavior.

Table 12-4 shows the result of that regression. The initial intent measure is not significant at $p < .05$, and the coefficients of the other variables remain significant and similar to the prior regression. Thus there is some confidence that the respondents are evaluating their intent to use walking and public transportation differently with and without the alternative transportation services. Also, there is confidence that final intent is corresponding with the final ATT, SN, and SCF following the theory of planned behavior.

Relationship Between Behavioral Beliefs and Attitude

Since attitude is the most critical driver of intent, it is important to understand what factors drive ATT. There also is interest in determining if those factors change when respondents are asked to consider the effect of additional services.

Recall that the formal TPB model says that ATT is influenced by a linear combination of behavioral beliefs weighted by outcome evaluations. Table 12-5 shows the set of outcome evaluations that pair with the final behavioral beliefs. The outcome evaluations are shown in order of their average ratings for the sample of 501 respondents.

According to Table 12-5, having reliable transportation is rated the highest of the outcome evaluations, and the variation among respondents is less for this than for all others. Saving money and improving health by walking more follow in order. The least desirable outcomes were to have fewer cars in the household and to be dependent on someone else for travel.

In addition to the self-stated outcome evaluations, regression can be used to measure how respondents weight their behavioral beliefs in forming their attitude for increasing their use of walking and public transportation. The regression coefficients provide a statistical measure of weights similar to the outcome evaluations.

Table 12-6 shows a regression of the six final behavioral beliefs on final attitude (see Table 10-16. for a description

Table 12-4. Alternative regression for final intent to walk and take transit more.

Dependent Variable: Final Intent			
Independent Variable	**Coefficient**	***t*-Statistic**	**Probability**
Constant	0.09	1.04	0.2985
Final Attitude	**0.54***	16.3	≤ 0.0001
Final Subjective Norm	**0.25***	11.1	≤ 0.0001
Final Self-Confidence	**0.21***	7.4	≤ 0.0001
Initial Intent (without services and message)	0.04	1.53	0.1256

* indicates a significant coefficient at $p < .05$
$R^2 = 85\%$, 501 observations.

Table 12-5. Outcome evaluations that pair with final behavioral beliefs.

Statement, Rated on a Seven-Point Scale	Mean (SD)
For me to have a reliable type of transportation to take to my destination would be: (extremely unimportant to extremely important)	6.5 (1.0)
For me to reduce the cost of my daily transportation would be: (extremely undesirable to extremely desirable)	5.9 (1.4)
For me to improve my health by walking more would be: (extremely unimportant to extremely important)	5.8 (1.3)
For me to reduce pollution by using my car less would be: (extremely unimportant to extremely important)	5.3 (1.7)
For me to reduce the time I spend driving would be: (extremely unimportant to extremely important)	5.3 (1.7)
For my household to own fewer cars would be: (extremely undesirable to extremely desirable)	3.1 (1.9)
For me to be dependent on someone else to get me to my destination on time would be: (extremely undesirable to extremely desirable)	2.8 (1.8)

Table 12-6. Regression for final attitude with seven alternative services available.

Dependent Variable: Final Attitude			
Independent Variable: Final Behavioral Beliefs	**Coefficient**	***t*-Statistic**	**Probability**
Constant	**1.02***	3.06	.0023
I would rely on alternative transportation and walking	**0.29***	4.88	≤ .0001
I would improve health and reduce pollution	**0.27***	3.86	.0001
I'd save money	**0.13***	2.68	.0077
I would reduce the amount of time I spend driving	0.07	1.39	.1642
My household could get by with fewer cars	0.05	1.51	.1323
I would be dependent on someone else	**-0.17***	-3.58	.0004

*indicates a significant coefficient at $p < .05$
$R^2 = 32.2\%$ 460 observations.

of the wording of the beliefs). Because the measures about health and reducing pollution were highly correlated, an average value was substituted for the three individual measures.

Although not directly comparable with Table 12-5, the order of the coefficients is similar. The largest coefficient is for "I would rely on alternative transportation," followed closely by the coefficient for improving health and reducing pollution. "I would save money" is also significant and positive, although its magnitude is around half of the top two. The only other significant coefficient is for "I would be dependent," which is negative.

The results shown in Table 12-6 may indicate why respondents' ratings for attitude did not change significantly from the initial to the final TPB exercise. Recall that respondents rated their ability to "rely on alternative transportation" higher in the final exercise, and they also rated "I would save money" higher. However, they rated their ability to "improve health and reduce pollution" lower. Although it is not clear why respondents rated the "improve health and reduce pollution" lower when the seven transportation alternatives were available, the respondents' insignificant change in attitude is consistent with the lowered rating for the behavioral belief that they would "improve health and reduce pollution."

Relationship Between Normative Beliefs and Subjective Norm

In the TPB, SN is influenced by the opinions of other people (the *normative beliefs*) and the extent to which the respondent cares about the opinions of others (the *motivation to comply*). Depending upon the characteristics of the respondent and the type of issue being examined, SN can vary in influence. As shown in Table 12-2 and Table 12-3, SN has less influence on intent (to walk and use public transportation more) than ATT. Subjective norm and SCF are similar in influence.

Table 10-5 showed the values of the motivation to comply with the desires of family, friends, neighbors, and coworkers. These are summarized again in Table 12-7. As can be seen, family has the most influence, followed by friends, coworkers, and then neighbors, according to the self-stated measures.

Another method for looking at the influence of others on the respondents' SN is to use regression to examine the relationship between the normative beliefs and the subjective norm. The regression coefficients provide statistical measures of the impact of each normative belief on the subjective norm. Table 12-8 shows such a regression for the final subjective norm after the messages and description of alternative transportation options. The importance of family's expectations is shown again in this table. Only family opinion appears to be significantly related to the final SN.

The results in Table 12-8 may indicate why respondents' ratings for SN increased significantly from the initial TPB to the final TPB exercise. Referring back to Table 10-21, there was a significant gain in the normative belief regarding family opinion, and this appears to have a significant influence on the SN.

Table 12-7. Mean ratings for final motivation to comply.

Motivation to Comply with:	Mean (SD)
My family	5.1 (2.0)
My friends	4.2 (1.9)
My coworkers	2.8 (1.6)
My neighbors	2.5 (1.6)

Relationship Between the Power of Control and Self-Confidence

Self-confidence is the third component influencing intent in the TPB. Its influence, as shown in Table 12-2 and Table 12-3, is similar in magnitude to the subjective norm. As shown in Table 12-1, there were significant increases in the average value of self-confidence after respondents were shown pro-transit messages and the seven alternative transportation options. Because self-confidence does have a significant effect on intent, and because our survey panel survey results indicate self-confidence can be improved, it is worthwhile to try to understand the factors that affect self-confidence.

Table 12-8. Regression for final subjective norm with seven alternative services available.

Dependent Variable: Final Subjective Norm			
Independent Variable: Final Normative Beliefs (with the new services available,	**Coefficient**	***t*-Statistic**	**Probability**
Constant	**0.97***	5.1	≤ .0001
my family would be more supportive of my walking more and taking public transportation more.	**0.54***	5.1	≤ .0001
my friends would be more supportive of my walking more and taking public transportation more.	0.04	0.3	.7334
my neighbors would be more supportive of my walking more and taking public transportation more.	-0.02	-0.2	.8393
my co-workers would be more supportive of my walking more and taking public transportation more.	0.09	1.0	.3252

* indicates significant coefficients at $p < .05$
$R^2 = 34\%$, 501 observations.

Table 12-9. Mean ratings for final control beliefs.

Belief (Rated on a Seven-Point Scale)	Mean (SD)
I need to make local trips (to reach destinations such as the library, post office, restaurant, or coffee shop). (not very often to very often)	5.5 (1.6)
I need access to a car to make spur of the moment trips. (not very often to very often)	5.1 (1.9)
I need access to a car to carry heavy things (not very often to very often)	5.1 (1.8)
I find waiting for the bus or train and not knowing when it is coming is a bother. (strongly disagree to strongly agree)	5.1 (1.9)
I worry about being stranded if I rely on public transportation and miss the bus or train. (strongly disagree to strongly agree)	4.7 (2.0)
I worry about crime or other disturbing behavior on public transportation. (strongly disagree to strongly agree)	4.1 (2.0)
I need to travel to other parts of the region. (not very often to very often)	4.1 (2.1)
I find dealing with the fare for public transportation is a bother. (strongly disagree to strongly agree)	3.9 (2.0)
I worry encountering crime or other disturbing behavior when walking. (strongly disagree to strongly agree)	3.8 (2.0)
I need to travel downtown (not very often to very often)	3.4 (2.3)

In the TPB, SN is influenced by the control beliefs and the power of each of those beliefs. Table 10-7 in Chapter 10 showed the mean control beliefs; these are shown again in Table 12-9. As can be seen, the highest rated item had to do with the need to make local trips. This was followed by three items rated second in magnitude: (*a*) the need for access to a car to make spur-of-the-moment trips, (*b*) the need for access to a car to carry heavy things, and (*c*) the bother of waiting for transit and not knowing when it was coming. Concern about being stranded was rated above neutral, at 4.7. The lowest rated beliefs were concern about getting downtown, encountering crime while walking, and dealing with the fare payment system.

Regression analysis was used as an alternative method for judging the influence of the control beliefs. Table 12-10 shows a regression using the power of control variables and SCF from the final TPB exercise. The order of the coefficients shown in Table 12-10 is very different from the order of the control beliefs shown in Table 12-9. As can be seen in the regression results, there are only two significant coefficients, with "I worry about being stranded" having the largest magnitude. Those that said they would have less concern about being stranded also had a higher rating for SCF.

The second significant variable had to do with making trips downtown. The negative coefficient says that respondents who agreed that it would be more difficult to get downtown tended to have lower self-confidence. Although, on the whole, respondents rated their need to get downtown the lowest of all of the control beliefs, their belief in their ability to travel downtown with the seven transportation options was significantly associated with their confidence in their ability to walk and take public transportation more. On the other hand, although they rated the control belief "I need to make local trips" highest, their belief in their ability to make local trips with the seven transportation options did not appear associated with their confidence that they could increase walking and public transportation use.

The R^2 for the regression shown in Table 12-10 is the lowest for the regressions shown in this chapter and indicates that there are many other factors underlying SCF than identified in this research.

Summary

This chapter examined the relationships between the direct measures of the TPB and also between the direct measures and the indirect measures, using the data from the Phase 2 Internet panel survey. The statistical technique of regression analysis was used to analyze the relationships between variables.

As shown in prior chapters, SN, SCF, and intent increased significantly between the initial TPB exercise and the final exercise, but ATT did not increase significantly. Regression analysis was used to examine the relationship between the respondents' intentions to increase their use of public transportation and walking and their ATT, SN, and SCF. In both the initial and final TPB exercise, intent to increase the use of

Table 12-10. Regression for final self-confidence with seven alternative services available.

Dependent Variable: Perceived Behavioral Control (SCF)			
Independent Variable: Final Power of Control	**Coefficient**	***t*-Statistic**	**Probability**
Constant	3.13*	8.33	≤ .0001
Have less concern about being stranded	**0.30***	**4.52**	**≤ .0001**
Feel safer from crime and other disturbing behavior	0.09	1.47	.1425
Paying the fare would be simple	0.09	1.16	.2459
Easy to know the schedule	0.06	0.78	.4384
More difficult to get to the region	0.03	0.53	.5942
Harder to make spur of the moment trips	-0.07	-1.28	.2025
Harder to carry heavy things	-0.09	-1.57	.1163
More difficult to make local trips	-0.05	-0.69	.4882
More difficult to get downtown	**-0.18***	**-2.71**	**.0069**

* indicates significant coefficient at $p < .05$
$R^2 = 23\%$, 501 observations

public transportation and walking was most closely related to a respondent's attitude. Intent was also related to SN and SCF; these were of similar influence to each other, but smaller influence than attitude.

Regression analysis was used to examine whether the behavioral beliefs measured in the final TPB exercise were significantly related to the respondent's attitude. The most important belief was found to be that with the new services available, "I would rely on public transportation and walking to get me to my destination in a timely way." The next most important belief was a composite of beliefs about improving health and reducing pollution. While respondents increased their rating of their ability to rely on public transportation and walking, they decreased their rating of improving health and reducing pollution. This result may explain why attitude did not change significantly.

Regression analysis was also used to examine the relationship between the normative beliefs and the final SN. The most important belief was found to be that "with the new services available, my family would be more supportive of my walking more and taking public transportation more." The significant increase in this normative belief corresponds with the positive change in the SN.

Finally, regression analysis was used to examine the relationship between the power of control ratings and SCF. The most important power of control statement was "With the new services available, I would have less concern about being lost or stranded by missing the bus or train."

The overall message of this exercise seems to be that to increase transit use and walking requires the following:

- The perceived reliability of the system must be improved.
- The positive health and environmental impact of walking more and taking public transportation more must be more convincing.
- Customers must be convinced that they will not be left stranded.
- Families must approve of increased transit use and walking.

CHAPTER 13

Practical Implications of the Research

The primary objectives of this research were twofold—namely, to understand how people make travel and location decisions and to derive practical implications and policy guidance for encouraging more use of public transportation and walking. An underlying assumption is that growing urban congestion and impaired mobility can be mitigated by encouraging people to substitute public transportation and walking for individual automobile use. A practical challenge, is, of course, how to promote this kind of behavior in enough instances to have a measurable, beneficial effect on travel conditions. The premise of this research is that by gaining a better understanding of the links between individuals' attitudes, intentions, and behaviors with regard to travel alternatives to the automobile, strategies can be better configured and targeted to help achieve the desired outcomes.

Some Research Limitations

When considering the practical or policy implications from this research, it is important to keep in mind some inherent limitations of the research design. The use of an Internet panel brings some bias to the sample, as respondents are those with access to the Internet who are willing to respond to such surveys. The sample was limited to larger metropolitan areas with good transit. Age-groups of interest were oversampled, and respondents were limited to those who had recently moved or were contemplating moving. Indeed, this research was not intended to give results that could be projected quantitatively to a larger population. Its purpose was to increase understanding of the motivations of certain individuals who are of major interest to policymakers trying to promote smart growth and environmentally friendly travel modes. Future research will be needed to determine the overall incidence rate of market segments described in this study.

Another limitation relates to the specification of the models of relationships tested in the study. Using the TPB, prior research, and findings from focus group discussions as a guide, this study identified a set of independent variables that are used to explain differences or variation in ATT, SN, and SCF, as well as intent. Although the regressions show significant results, as is often the case with individual attitudinal data sets, they typically explain relatively small percentages of the total variation in the ATT, SN, and SCF. This means that it is possible that other important factors have been left out of these models. Hence, the practical implications that can be derived are thereby somewhat limited or tentative. The study acknowledges the need for additional research to help further our understanding of these effects. Notwithstanding these limitations, however, the research design provides an appropriate way to infer practical implications for how to frame and deliver strategies for encouraging the desired outcome behaviors that have been explored in this study.

Implications from Phase 1 Research

The first phase of the research used focus groups and survey research to better understand individual attitudes and values as they relate to the stated *intent* to move to a CN. The focus was primarily on understanding factors that affect the choice of residential neighborhood, but also on factors associated with greater use of walking and transit. The research assessed attributes of a CN that either attract or repel individuals. It defined several market segments in terms of their attitudes towards urban living and a lifestyle that emphasizes more use of transit and walking. The research also examined the association between individual values, urban form, and auto availability with mode share for transit and walking. While a number of factors were shown to be related to a desire or willingness to move to a CN, it is clear that many other factors unmeasured in this research model will be relevant, and additional research will be needed to identify these.

Although this research was experimental in nature, there are some findings that provide practical advice to practitioners in the transit field.

Practical Implications from the Phase 1 Research

Findings from Phase 1 that have practical implications include the following:

- Some features of a CN were of greater importance to this sample of respondents than other features. The most important belief was that it would be easier to get to stores, restaurants, libraries, and other activities if one were living in a CN. *Developers of compact neighborhoods should ensure that they are located near interesting destinations, such as stores, restaurants, and other activity centers.*
- Making new friends with close neighbors emerged as an important factor influencing the decision to move to a CN, along with needing fewer cars and having public transportation readily available for the places you want to go. *Marketing campaigns intended to promote the values of living in CNs should emphasize these kinds of attributes and benefits.*
- Individuals who believed that such a residential move would result in more street noise or less living space had a more negative attitude toward the move. *Practical efforts to promote living in compact neighborhoods would need to try to counter these perceived negative attributes and emphasize the positive attributes.*
- Individuals are more likely to feel they could move to a CN if they could find affordable housing. This was the most important perceived barrier to such a move, over others that included having to get by with fewer cars, having less living space, or losing touch with current friends. *Public policy that seeks to ensure the availability of affordable housing in CNs would be indicated by this finding.*
- Respondents who expressed a more positive attitude toward living in a CN are the best initial candidates for promotional efforts. *It would make most sense to approach those with the highest probability of receptiveness to campaigns to encourage transit use, walking, and living in CN. For example, those who say that owning fewer cars is a good thing would fall into this positive group, as would those who value a clean environment.*
- If family and friends are supportive or encouraging of a move to a CN and communicate that riding transit and walking reflect appropriate values, then an individual is more likely to be motivated to do those things. *Promotional efforts could be directed toward families, rather than just toward individuals, to help build a foundation of support for the value of living in CNs and using public transportation. In the longer term, seeking to influence community normative values with respect to these behaviors could have positive effects on an even larger segment of the population.*
- From a practical policy standpoint, perhaps the biggest impediment to marketing CN living and use of transit is the pervasive reluctance to give up personal automobiles. This research showed that the average number of automobiles per person in a household is more predictive of the propensity to walk and use transit than the type of residential neighborhood or set of urban/environmental values held by the individual. *Policies such as reducing the zoning requirement for parking in CNs, providing mortgages that recognize savings from reduced car use or ownership, and employer incentive programs for transit use and ridesharing could help in this regard. Policy to create new infrastructure to facilitate walking and transit will be more successful if it is coupled with efforts to support and encourage values associated with those outcomes.*
- Prior research on the propensity to change modes suggests that people are creatures of habit. Individuals who have never used public transportation or who use it rarely tend not to consider public transportation as a viable alternative for meeting their transportation needs. The times when these individuals are most likely to consider such a change in transportation mode is when they are making life-cycle changes, such as a change in residence or a change in employment. *Thus, practical strategies that seek to induce a mode change should recognize that individuals may be more receptive during these periods of change in their lives.*

Implications from Phase 2 Research

The second phase of this research project used another Internet panel survey to further explore the determinants of mode choice and how selected intervention measures could encourage more transit use and walking behaviors. The focus in this phase was primarily on understanding factors that affect the choice of mode of travel. Respondents were asked to imagine living in a CN and were then asked to respond to various transportation options. Phase 2 also explored how the respondents' attitudes and intent to change behaviors were affected both by the availability of a set of services supportive of using public transportation and by several different marketing messages designed to encourage transit use and walking behaviors.

Practical Implications from the Phase 2 Research

Findings from Phase 2 that have practical implications include the following:

- Although most respondents (70%) indicated that transit service was within walking distance, normative support for increased walking and use of public transit was low. These individuals said they wanted reliable transportation at low cost, and they didn't want to spend any additional time commuting, nor did they want to be dependent on someone else for their transportation. They believed that transit would not only take more time, but also give them less control over the timeliness of their arrival. They also expressed a need to use a car for short or spur-of-the-moment trips or to carry heavy things. *These attitudes present a challenge for policymakers seeking to encourage more transit ridership. Replacing the car will take a suite of services to meet requirements for both speed and flexibility.*
- When respondents were asked to consider traditional marketing messages and a suite of transit-supportive services (including good downtown transit service, regional transit service, smart cards, shuttle service, smart phone, and car sharing), their beliefs about transit changed. However the changes were apparently due to the suite of services and not to the marketing messages. *The practical implication is that it will be difficult to significantly change beliefs about riding transit with public policy messages alone. More emphasis will need to be placed on supplementing messages with a suite of services that enhance the overall transit-riding experience.*
- Being able to depend on transit to "get me to my destination in a timely way" was a key driver of attitude. Providing information to customers on transit schedules and improving the reliability of the service appear to be key strategies.
- Although those respondents who were concerned about reducing pollution and improving health had a more positive attitude toward walking and taking transit, respondents were not convinced that the suite of transit supportive services would reduce pollution and improve health. A message about the positive health and environmental impacts of transit use also was not convincing. *There is a need to more convincingly communicate the positive health and environmental effects of walking and transit.*
- Respondents' attitudes toward transit riding and walking are the most critical drivers of intentions to increase use of these modes, but their self-confidence in using transit and walking and their perception of others' opinions also affected their intentions. In this research, respondents' attitudes did not change despite the messages and transit-supportive services. But their self-confidence that they could take transit increased when additional transit-supportive services were considered. They also believed that their families would be more supportive of their taking transit and walking more. *This would suggest that a practical policy approach would be to seek to provide and market a set of ancillary services intended to make transit riding more simple and attractive (a higher status activity) for those who otherwise are inherently reluctant to use transit.*
- Respondents' concerns about being stranded when using transit appeared to be the most critical driver of their self-confidence in being able to take transit, as well as in the approval of friends and family. This was especially true of the environmentally oriented market segment, which was willing to change modes if the conditions associated with transit riding were improved. *The practical policy implication is to focus on providing this group, in particular, with ancillary services that can help them overcome these kinds of concerns. If the transit system is believed to be safer and more attractive, family and friends are likely to feel more positive about transit, which will further motivate the members of this group to translate their expressed intent into actual transit-riding behavior.*
- Prior research has shown that an impediment to using public transportation is that the behavior is unfamiliar to many people and hence is not actively considered as an option. This research verified the importance of respondents' self-confidence in using public transportation. *Many communities and employers offer incentives for people to try out transit, including free passes and employee discounts on transit and charges for parking personal cars at work, especially single-occupant vehicles. These actions will help transit to become more familiar and will increase users' self-confidence in taking it.*

Summary of Practical Implications

Figure 13-1 highlights some of the practical strategies that may be undertaken in an effort to promote living in CNs and to encourage more transit use and walking, as suggested by the research findings from this study. Practical implications of this research all derive from three component strategies that involve encouraging individuals to move to a CN and encouraging them to increase their use of transit and walking instead of driving. These component strategies are as follows:

- Encourage policies that lead to the creation of an urban form that is highly conducive to transit use and walking. Attributes of CNs include ease of walking to stores, restaurants, and other activities; easy access to public transportation; ability to have fewer automobiles in the household; and opportunity to interact with neighbors. Work through employers and community policymakers to provide incentives for transit use.
- Provide a set of services that complement and support using public transportation, particularly for the market segments with the most potential to increase transit use. These include providing real-time information about

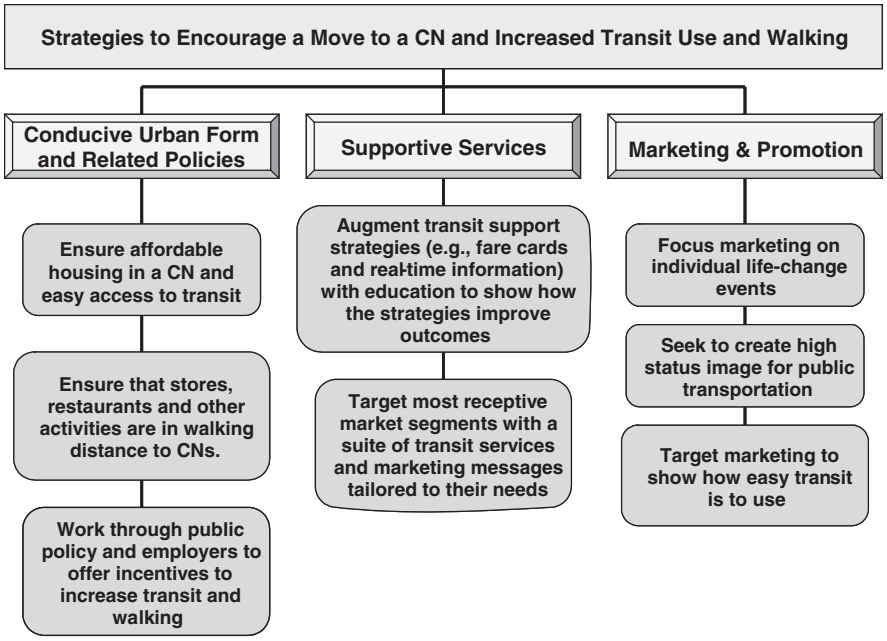


Figure 13-1. Practical policy approaches.

transit arrival/departure times, as well as other services that make people feel safer and more confident about using transit.

- Educate and market the use of public transportation to the public, focusing first on segments of the population that are known to be more receptive. Focus marketing and policies on increasing the status of transit and making it simpler to use.

There are many challenges to accomplishing the desirable practical outcomes discussed in the Summary of this report. It is also clear that additional research will be needed to more fully understand the factors that link attitudes and values with the outcome behaviors. The positive market sectors identified in this research represented 30% to 45% of the sample, and the practical strategies noted above should target these segments first. The promotional messages directed to these individuals will need to be tailored to their needs and matched with their attitudes and values. No one approach is, however, likely to be highly successful on its own; rather, a variety of approaches must be applied simultaneously, including creating a conducive urban form, providing supportive public services, and coordinating the services with targeted marketing and promotion. In addition, a suite of incentives and disincentives should be added, resulting in structural, social, and economic forces that may be expected to have a reasonable chance of changing human behavior in ways favorable to use of public transportation and walking.

References

1. Stanley, Robert, et al. *TCRP Report 97: Emerging New Paradigms. A Guide to Fundamental Change in Local Public Transportation Organizations*. Transportation Research Board of the National Academies, Washington DC, 2003.
2. Lucy, W., and D. Phillips. *Confronting Suburban Decline: Strategic Planning for Metropolitan Renewal*. Island Press, Washington DC, 2000.
3. Cervero, R. *The Transit Metropolis: A Global Inquiry*. Island Press, Washington DC, 1998.
4. Myers, D., and E. Gearin. Current Preferences and Future Demand for Denser Residential Environments. *Housing Policy Debate*, Vol. 12, No. 4, 2001, pp. 633–660.
5. Hobbs F., and N. Stoops. *Demographic Trends in the 20th Century: Census 2000 Special Reports*. U.S. Census Bureau, Washington DC, 2002.
6. National Association of Realtors. *Smart Growth: A Resource for Realtors—The Issues, the Economics, and the Debate*. Chicago IL, 2000.
7. American Public Transit Association. Historical Ridership Trends. Washington DC. http://www.apta.com/research/stats/ridershp/ridetrnd.cfm. Accessed May 25, 2006.
8. Bureau of Transportation Statistics. *National Transportation Statistics 2003*. Washington DC. http://www.bts.gov/publications/national_transportation_statistics/2003/index.html.
9. U.S. Department of Housing and Urban Development. *American Housing Survey*. Washington, DC, various years.
10. Coogan, M. *Why Care about Walking?* U.S. Department of Transportation, Washington, DC. http://nhts.ornl.gov/2001/presentations/walking/walking.ppt. Accessed August 5, 2006.
11. Crane, R. The Influence of Urban Form on Travel: An Interpretive Review. *Journal of Planning Literature*, Vol. 15, No. 1, 2000, pp. 3–23.
12. Ewing, R., and R. Cervero. Travel and the Built Environment—A Synthesis. In *Transportation Research Record: Journal of the Transportation Research Board, No. 1780,* TRB: National Research Council, Washington, DC, 2001.
13. Cervero, R., C. Ferrell, and S. Murphy. *Transit-Oriented Development and Joint Development in the United States: A Literature Review.* Research Results Digest No. 52. TRB: National Research Council, Washington, DC, October 2002.
14. Handy, S. Smart Growth and the Transportation–Land Use Connection: What Does the Research Tell Us? *International Regional Science Review,* Vol. 28, No. 2, 2005, pp. 146–167.
15. J. R. Kuzmyak, R. H. Pratt, and G. B. Douglas. *TCRP Report 95: Traveler Response to Transportation System Changes, Chapter 15—Land Use and Site Design*. TRB, National Research Council, Washington, DC, 2003.
16. Frank, L., T. Schmid, J. Sallis, J. Chapman, and B. Saelens. Linking Objectively Measured Physical Activity with Objectively Measured Urban Form: Findings from SMARTRAQ. *American Journal of Preventive Medicine,* Vol. 28 (2S2), 2005, pp. 117–125.
17. Kitamura, R, P. Mokhtarian, and L. Laidet. A Micro-Analysis of Land Use And Travel in Five Neighborhoods in the San Francisco Bay Area. *Transportation*, Vol. 24, Issue 2, 1997, pp. 125–158.
18. Bagley, M., and P. Mokhtarian. The Impact of Residential Neighborhood Type on Travel Behaviour: a Structural Equations Modeling Approach. *Annals of Regional Science*, Vol. 36, No. 2, 2002, pp. 279–297.
19. Bhat, C., and J. Guo. A Comprehensive Analysis of Built Environment Characteristics on Household Residential Choice and Auto Ownership Levels. Presented at the TRB Annual Meeting, Paper # 06-0990, Washington DC, 2006.
20. National Association of Realtors. *1999 National Association of Realtors Profile of Home Buyers and Sellers.* Chicago IL, 2000.
21. Malizia, E., and S. Exline. Consumer Preferences for Residential Development Alternatives. Working Paper 2000-02. University of North Carolina at Chapel Hill, Center for Urban and Regional Studies, Chapel Hill NC, 2000.
22. Decision Data Inc. Seattle Planning Department Residential Preference Study. Seattle WA, December 1993.
23. Naess, P. Residential Location Influences Travel—But How and Why? Paper for the Traffic Days at Aalborg University, Aalborg University, Denmark, 2002.
24. Weisbrod, G., M. Ben-Akiva, and S. Lerman. Tradeoffs in Residential Location Decisions: Transportation versus Other Factors. *Transportation Policy and Decision-Making,* Vol. 1, No. 1, 1980. Earlier version also available at http://www.edrgroup.com/edr1/library/lib_trans_general/index.shtml.
25. Lerman, S. Location, Housing, Automobile Ownership, and the Mode to Work: A Joint Choice Model. In *Transportation Research Record 610.* TRB, National Research Council, Washington DC, 1977, pp. 6–11.
26. Srour I., K. Kockelman, and T. Dunn. Accessibility Indices, Connection to Residential Land Prices and Location Choices. In *Transportation Research Record, Journal of the Transportation Research Board, No. 1805*. Transportation Research Board of the National Academies, Washington DC, 2003, pp. 25–34.
27. Waddell, P., and F. Nourzad. Incorporating Nonmotorized Mode and Neighborhood Accessibility in an Integrated Land Use and

Transportation Model System. In *Transportation Research Record, Journal of the Transportation Research Board, No. 1805*. Transportation Research Board of the National Academies, Washington DC, 2003, pp. 119–127.
28. Krizek, K., and P Waddell. Analysis of Lifestyles Choices: Neighborhood Type, Travel Patterns, and Activity Participation. In *Transportation Research Record, Journal of the Transportation Research Board, No. 1807*. Transportation Research Board of the National Academies, Washington DC, 2003, pp. 119–128.
29. Ajzen, I. The Theory of Planned Behavior. *Organizational Behavior and Human Decision Processes*, Vol. 50, 1991, pp. 179–211.
30. Fishbein, M., and I. Ajzen. *Belief, Attitude, Intention, and Behavior: An Introduction to Theory and Research*. Addison Wesley, Reading, MA, 1975.
31. Ajzen, I., and M. Fishbein. *Understanding Attitudes and Predicting Social Behavior.* Prentice Hall, Englewood Cliffs, NJ, 1980.
32. Bandura, A. Self-Efficacy: Toward a Unifying Theory of Behavioral Change. *Psychological Review*, Vol. 84, 1977, pp. 191–215.
33. Bandura, A. Self-Efficacy Mechanism in Human Agency. *American Psychologist*, Vol. 37, 1982, pp. 122–147.
34. Bandura, A., N. Adams, A. Hardy, and G. Howells. Tests of the Generality of Self-Efficacy Theory. *Cognitive Therapy and Research*, Vol. 4, 1980, pp. 39–66.
35. Armitage C.J., and M. Conner. Efficacy of the Theory of Planned Behaviour: a Meta-Analytic Review. *British Journal of Social Psychology,* Vol. 40, 2001, pp. 471–499.
36. Godin, G., and G. Kok. The Theory of Planned Behavior: a Review of its Applications to Health-Related Behaviors. *American Journal of Health Promotion*, Vol. 5, No. 11, Nov-Dec, 1996, pp. 87–98.
37. Bamberg S., I. Ajzen, and P. Schmidt. Choice of Travel Mode in the Theory of Planned Behavior: The Roles of Past Behavior, Habit, and Reasoned Action. *Basic and Applied Social Psychology*, Vol. 25, No. 3, 2003, pp. 175–187.
38. UK Department for Transport. A Review of the Effectiveness of Personalized Journey Planning Techniques. http://www.dft.gov.uk/stellent/groups/dft_susttravel/documents/page/dft_susttravel_504131.hcsp. Accessed August 6, 2006.
39. Forward, S. *Short Journeys—Why Do We Choose the Way We Do?* A VTI report from the Swedish National Road Transport Research Institute. www.vti.se/info/rapporter/edetalj.asp?recID=731. Accessed 2003.
40. Aarts, H., B. Verplanken, and A. van Knippenberg. Habit and Information Use in Travel Mode Choices. *Acta Psychologica*, Vol. 96, 1997, pp. 1–14.
41. Gärling, T., A. Gärling, and P. Loukopoulos. Forecasting Psychological Consequences of Car Use Reduction: A Challenge to an Environmental Psychology of Transportation. *Applied Psychology*, Vol. 51, January 2002, p. 90.
42. Verplanken, B., H. Aarts, A. van Knippenberg, and A. Moonen. Habit versus Planned Behavior: A Field Experiment. *British Journal of Social Psychology,* Vol. 37, 1998, pp. 111–128.
43. Harms, S. From Routine Choice to Rational Decision Making Between Mobility Alternatives. Centre for Innovation Research in the Utility Sector. Conference Paper STRC 2003. 3rd Swiss Transport Research Conference, March 19-21, 2003.
44. Kaiser, F., S. Wolfing, and U. Fuhrer. Environmental Attitude and Ecological Behavior. *Journal of Environmental Psychology*, Vol. 19, 1999, pp. 1–19.
45. Swensen, M., and W. Wells. Useful Correlates of Pro-Environmental Behavior. In *Social Marketing: Theoretical and Practical Perspectives*. M. Goldbert, M. Fishbein, S. Middlestadt, eds. Lawrence Erlbaum Associates, Mahwah NJ, 1997, pp. 3–19.
46. Ajzen, I. http://www-unix.oit.umass.edu/~Ajzen/tpb.html, University of Massachusetts, Amherst, MA. Accessed 2006.
47. Adler, T., L. Rimmer, and D. Carpenter. Use Of Internet-Based Household Travel Diary Survey Instrument. In *Transportation Research Record, Journal of the Transportation Researc Board, No. 1804.* Transportation Research Board of the National Academies, Washington DC, 2002, pp. 134–143.
48. Tierney, J. The Autonomist Manifesto (Or, How I Learned to Stop Worrying and Love the Road). *New York Times Magazine*, September 26, 2004.
49. Yalch, R. *TCRP Report 36: A Handbook. Using Market Segmentation to Increase Transit Ridership.* TRB, National Research Council, Washington DC, 1998.
50. Stradling, S. G. *Changing Individual Travel Behaviour: From Policy to Perceived Behavioural Control*. Transport Research Institute, Napier University, UK, 2003.
51. Cohen, S., and B. Orme. What's Your Preference? Asking Survey Respondents About Their Preferences Creates New Scaling Decisions. *Journal of Marketing Research*, Summer 2004, pp. 33–37.
52. Anable, J. 'Complacent Car Addicts' or 'Aspiring Environmentalists'? Identifying Travel Behaviour Segments Using Attitude Theory. *Transport Policy,* Vol. 12, No. 1, 2005, pp. 65–78.

Abbreviations

ATT—attitude toward the behavior
CFI—comparative fit index
CN—compact neighborhood
GIS—geographic information systems
LRT—light rail transit
MSA—metropolitan statistical area
MC—motivation to comply
NFI—normed fit index
OE—outcome evaluation
PC—power of control
PBC—perceived behavioral control
PMT—person miles traveled
RMSEA—root mean squared error of approximation
SCF—self-confidence
SEM—structural equation modeling
SMSA—standards metropolitan statistical area
SN—subjective norm
TPB—theory of planned behavior
TJD—transit joint development
TOC—transit-oriented development
VHT—vehicle hours traveled
VMT—vehicle miles traveled

APPENDIXES

Appendixes to the contractor's final report for TCRP Project H-31, "Understanding How Individuals Make Travel and Location Decisions: Implications for Public Transportation," are available on the TRB website at http://trb.org/news/blurb_detail.asp?id=8661. The appendixes are the following:

Appendix A: Interview with Experts
Appendix B: The Interview Questionnaires
Appendix C: SPSS and Excel Files of Survey Results

Abbreviations and acronyms used without definitions in TRB publications:

AAAE	American Association of Airport Executives
AASHO	American Association of State Highway Officials
AASHTO	American Association of State Highway and Transportation Officials
ACI–NA	Airports Council International–North America
ACRP	Airport Cooperative Research Program
ADA	Americans with Disabilities Act
APTA	American Public Transportation Association
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ATA	Air Transport Association
ATA	American Trucking Associations
CTAA	Community Transportation Association of America
CTBSSP	Commercial Truck and Bus Safety Synthesis Program
DHS	Department of Homeland Security
DOE	Department of Energy
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
FHWA	Federal Highway Administration
FMCSA	Federal Motor Carrier Safety Administration
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
IEEE	Institute of Electrical and Electronics Engineers
ISTEA	Intermodal Surface Transportation Efficiency Act of 1991
ITE	Institute of Transportation Engineers
NASA	National Aeronautics and Space Administration
NASAO	National Association of State Aviation Officials
NCFRP	National Cooperative Freight Research Program
NCHRP	National Cooperative Highway Research Program
NHTSA	National Highway Traffic Safety Administration
NTSB	National Transportation Safety Board
SAE	Society of Automotive Engineers
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (2005)
TCRP	Transit Cooperative Research Program
TEA-21	Transportation Equity Act for the 21st Century (1998)
TRB	Transportation Research Board
TSA	Transportation Security Administration
U.S.DOT	United States Department of Transportation