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The Effects of Teleshopping on Travel Behavior and Urban Form

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Abstract

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This dissertation employs structural equation modeling (SEM) techniques to explore the tradeoffs people make when engaging in teleshopping activities from home. Using the Bay Area Travel Survey (BATS) 2000 this dissertation performs an activities analysis to investigate these relationships. Time use variables are included that predict the amount of time each individual spends during the day on work, maintenance, discretionary, and shopping activities, both in and outside of the home. These activities are used to predict the amount of shopping travel each person undertook. Results suggest that people substitute home teleshopping time for shopping travel time, and teleshoppers take fewer shopping trips and travel shorter total distances for shopping purposes. However, these effects are mainly "indirect" and appear to be mediated through two time-use variables – In-Home Maintenance and In-Home Discretionary activities. Home teleshoppers tended to spend more time on In-Home Maintenance and less on In-Home Discretionary activities than non-home teleshoppers.

Variables constructed to represent the degree to which people are "time-starved" from the demands of their work and maintenance activities revealed that female heads of

households tend to home teleshop more, make more shopping trips and shopping trip chains, shop out-of-home more, and shop travel for longer periods than the rest of the survey population. A variable constructed to measure each survey participant household's accessibility to shopping opportunities suggests that people who live in high retail accessibility areas tend to home teleshop slightly (but statistically significantly) more, take more shop trips, make more shop trip chains, and travel shorter total distances for shopping purposes than those who live in lower accessibility neighborhoods.

These results suggest that home teleshopping is primarily used as a tool to restructure a person's daily activities participation, which in turn, restructures a person's shop travel behavior. The degree to which someone is time-starved – particularly, female head of households – appears to play a role in determining the propensity to home teleshop as does a person's relative accessibility to retail opportunities. While confirmatory analysis is necessary, these results suggest that activity-based travel demand models would benefit from the inclusion of home teleshopping, time-starved, and retail accessibility variables.

DEDICATION

To my family,

Elisabeth, Sophie, Aidan,
Dad, Mom, Mike,
John, Diana,
and Isabelle.

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INTRODUCTION

During the 1990's the Internet was a central player among a cast of technological characters that seemed to be changing our world. The proliferation of Internet startups and their meteoric rise in stock market value appeared to be a financial reflection of the growing importance of life online. Prominent among the services offered in this new virtual world was online shopping. User-friendly, multimedia interfaces for the online shopper were thought to provide something close to a full-sensory experience, allowing online retailers to overcome some of the obstacles associated with virtual shoppers being unable to "kick-the-tires" during product selection. It was widely assumed that online retailers could supply the same products offered at traditional retail venues, at a competitive price, and with the added convenience of home delivery. Many assumed there would also be a host of changes in everyday life that would be wrought by the switch to life online.

More recent events have called these optimistic assessments into question. First, the failure of many dot-com firms – and online retailers in particular – has moderated the unbridled optimism of the late 1990s for the online revolution. High-profile failures such as Webvan, Etoys, Pets.com and other former "giants" of online shopping seemed to cast some doubt on the ability of online retailers to survive, let alone earn a profit. Second, the growth in online sales over the last few years has been significantly slower than once assumed. While some thought that online retail activity would grow to take a significant chunk of traditional retail sales, this has not proven to be the case as yet. As of the first quarter of 2005, online retail sales were 2.3 percent of total retail sales – only four-tenths of one percent greater than the previous year's first quarter share of total sales.[1]

But the revolution was assumed to go well beyond the world of mere business transactions and corporate scorekeeping. Many assumed there would also be a host of changes in everyday life wrought by the switch to online life. In particular, technological theorists such as Mitchell (1999) have drawn a direct causal link between the conveniences offered by online services – including online shopping – and the behaviors of individuals and our society in general. In the case of online shopping, some have assumed that it would become a functional substitute for traditional retail shopping (Negroponte 1998), thereby reducing physical shopping trips and vehicle miles traveled. Taken a step further, it seems reasonable to assume that to the degree online shopping is a viable substitute for traditional shopping and physical travel, online patrons will use this technology as a means to further physically separate their residences from retail centers, increasing urban dispersal and decreasing the attraction of cities for residents and employers (Janelle 1995; Horan, Chinitz et al. 1996). A counter-argument exists, and gains its argumentative strength by pointing to the interplay between travel behavior, urban form, and past telecommunications advances. Here, it can be argued that advances in telecommunications technologies serve as both a force towards urban dispersal and urban agglomeration; both as a means to substitute for physical travel and as an enticement for more (Graham and Marvin 1996; Graham 1997; Moss 1998; Shen 2000). In this argument, there is an assumption that urban form affects and is affected by

[1] Unadjusted Quarterly Retail E-Commerce Sales, United States Census Bureau,

telecommunications innovations. However, a critical element that is often overlooked in these arguments is the individual. Simply stated, the means and outcomes of the adoption of technologies are likely to differ between individuals, depending largely on the differences in their lifestyles. To the extent that online shopping provides a useful tool or a source of enjoyable entertainment that fits people's lifestyle choices, we can expect to see individuals changing their purchasing behaviors, travel behaviors, resulting in societal shifts in transportation and land use patterns.

The introduction of online shopping, in combination with telephone (catalog and television) shopping modalities (all referred to hereafter as teleshopping), provides an example of how telecommunications-based technologies are being adopted, how people's lifestyles and location affect adoption, and how the two might interact to alter travel and urban location choice for residences and businesses. Studying the introduction and the degree of acceptance of these technologies across urban space may provide insights into the potential for online shopping tele-substitution, the implications of its acceptance on travel behavior and urban form, and insights into the nature of technological adoption and substitution in general.

Problem Statement

People incorporate technologies into their everyday lives if they offer added convenience or utility over pre-existing modalities, or if they offer a substantially novel experience or service that did not previously exist. The extent to which teleshopping is widely adopted

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http://www.census.gov/mrts/www/data/html/05Q1.html will be determined by its success at offering a sufficiently more convenient or novel shopping experience to the user when compared to traditional shopping modalities. Within the urban context, urban form, transportation infrastructure, residential location, and levels of transportation system congestion (among others) primarily determine shopping convenience. Understanding the degree to which teleshopping may substitute for shopping trips and influence future urban morphology is therefore dependent – to some degree – on the pre-existing urban form and transportation system context. Furthermore, the degree to which shopping opportunities are perceived as being convenient by each individual will differ according to a combination of each person's needs and preferences – a factor we can best describe as his or her "lifestyle."

This dissertation measures how the propensity to teleshop is translated into teleshopping activities that substitute for traditional, trip-based retail shopping trips. A critical element of this effort is the measurement of how this propensity is influenced by urban form and personal lifestyle. From these observations and measurements, the implications of teleshopping on the future of urban form will be drawn as well.

There are several areas of investigation in this arena that must be addressed if we are to understand the interplay between teleshopping, travel behavior and urban form: First, it is as yet unclear if teleshopping is being used as a substitute for or a compliment (i.e., encouraging more) to traditional retail shopping trips. Second, it is similarly unclear to what extent urban form is affecting or being affected by teleshopping. If teleshopping is

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http://www.census.gov/mrts/www/data/html/05Q1.html being affected by urban form, then we would expect the propensity to purchase online to be influenced by how attractive and convenient traditional retail purchases are in comparison. If you live in a mixed-use neighborhood with ample retail opportunities at your disposal, would you be less likely to shop online than if you live in a suburban neighborhood within a few minutes drive to a large mall?

Furthermore, if you can substitute online shopping for traditional shopping trips, are you likely to move further away from the urban centers, stretching out the boundaries of suburbia and expanding the thin film of exurban development in our rural areas? Based on these issues, a series of research questions can be stated to ground the study within a general framework for analytical investigation.

Research Questions

This dissertation will focus on the travel behaviors of individuals and how they are influenced by the relative attractiveness of teleshopping and traditional (trip-based) retail opportunities. There are several, interrelated questions that will be analyzed in this exploratory study:

1) The substitution hypothesis: As discussed earlier, this question has two components: A) a travel component that focuses on whether teleshopping activities substitute for traditional shopping trips; and B) a shopping component, which focuses on whether teleshopping activities replace traditional shopping activities. Fundamentally, the question being asked here is: Are teleshoppers doing less traditional retail shopping and shopping travel? In contrast, we may

find that there are no changes in traditional retail shopping, indicating there is no substitution, and that teleshopping is an "add-on" activity to the people's pre-existing traditional shopping trips. Finally, in the extreme, we may find that teleshopping trips have a "complementary" influence on traditional shopping trips, where teleshopping sessions lead to an increased desire, ability, or need to engage in more traditional shopping trips than the non-teleshopper.

2) The substitution hypothesis and urban geography: While there may be no measurable substitutive or complementary effects for a population drawn from an entire metropolitan area, people living in different urban environments with different lifestyles may use teleshopping differently. For people living in neighborhoods with poor accessibility to retail services, teleshopping may offer a tempting opportunity to substitute for traditional shopping trips. Therefore, is there a geographical distribution of teleshoppers? Are there a higher proportion of teleshoppers in suburban or exurban areas with poor accessibility to retail shopping opportunities than the metropolitan population as a whole? Is the propensity to substitute teleshopping for shopping travel influenced by urban geography?

3) Lifestyle, teleshopping, and the substitution hypothesis: As discussed earlier, there may be variations in the propensity to teleshop as a substitute for traditional shopping trips depending on the lifestyle of the person in question. Therefore, by ranking people by the degree to which they are "time-starved" in their everyday lives, we can measure the degree to which these people are likely to teleshop and if they are more likely to do so as a substitute for traditional shopping travel.

Since it seems reasonable to assume that time-starved people are also more likely to chain their shopping trips together with work, entertainment, or other activity travel purposes, we can expect to find a more trip-chaining in time-starved people as well. This leads to the question: Can we find a measurable difference in the propensity for time-starved people to teleshop when compared to the larger population? Furthermore, are people who feel "time-starved" (those who suffer from a lack of discretionary time due to an over-abundance of work and maintenance responsibilities) and have low levels of retail shopping accessibility from home and work (and therefore, fewer opportunities to regularly trip-chain shopping trips with commute trips) more likely to teleshop? How do the opportunities for chaining shopping trips within the work trip affect the propensity to shop?

Methodology

The research questions listed above are investigated using a combination of data sources in a person-level quantitative analysis of reported activities (including home teleshopping) and their associated travel behaviors. An analysis of activities data collected in the San Francisco Bay Area by the Metropolitan Transportation Commission (MTC) from February 2000 through March 2001. Trip records from this dataset are combined with regional MTC travel demand model data describing the total distances traveled between reported trip start and end points to determine total person miles traveled for each trip. Accessibility measures—both to retail opportunities and total employment—for each survey participant's home travel analysis zone (TAZ) are calculated based on zone-to-zone travel times obtained from the regional travel demand model and total employment for each TAZ, broken out by employment categories.

These data are analyzed in two ways. First, descriptive statistics are developed and compared for home teleshoppers and non-home teleshoppers. Second, the data are analyzed using a nonrecursive structural equation model (SEM) that measures and controls for the potential endogeneity effects between the various activities and travel data variables. Additional exogenous variables, such as the household income and number of children are included as well. Specific lifestyle variables are developed from socio-economic data included with the BATS 2000 data set to reflect the degree to which survey participants are "time-starved" and may be more likely to engage in home teleshopping activities to find relief.

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LITERATURE REIVEW

A review of existing theories and research on teleshopping, general shopping behavior, telecommunications adoption and substitution, and travel behavior provides the context for this dissertation. These fields and their associated research set the stage for questions such as: Why and where do people shop, what modes of travel do they use to do it, and under what conditions do they adopt new patterns of shopping that may have implications for urban travel and form?

Telecommunications Adoption and Substitution

Research on the adoption of telecommunications technologies (also referred to as "ICT" or Information and Communications Technologies) can be traced back to the introduction of the telephone and the associated changes in behavior. Salomon (1986), an early theoretician on the interactions between telecommunications use and travel behavior, developed a theoretical template for understanding these relationships. This typology has since been updated and modified in subsequent works (Mokhtarian 1990; Casas, Johanna et al. 2001; Hjorthol 2002):

1) Substitution: where the expanded availability of telecommunications technologies and applications substitute for other functions and behaviors. A straightforward example is the substitution of online shopping transactions for traditional/physical shopping trips;
2) Modification: where a shift is made in the routing, the timing of trips, or the chaining of trips upon adoption of a telecommunications technology;

3) Complementarity: where the introduction or adoption of a telecommunications technology serves to encourage additional, pre-existing activities and behaviors. Again, using the example of telecommunications and travel, the increased use of a telephone may expand a person's social world, increasing the opportunities for that person to travel for social purposes. This is an example of an "enhancement" or "complementary" relationship, where increased use of a telecommunications application leads to increased physical travel. A second form of complementary relationship is an efficiency gain, where telecommunications applications provide new and useful information that can be used by individuals or businesses to engage in traditional functions and behaviors with increased efficiency; and
4) Neutrality/Add-On: where telecommunications use has no measurable influence on travel behavior.

Particularly over the last decade, several researchers have studied these phenomena, trying to identify the key variables that affect our behavioral responses to new technological conveniences. Mokhtarian and Meenakshisundaram (1999) conducted a longitudinal diary survey to measure the use of various telecommunications technologies (phone, fax, and e-mail) and information object transfers (in-house documents, mail, express mail, etc.) on personal meetings and travel. They found both complementary and substitutive effects of different communications modes on each other. In other words, the use of one communications mode such as a fax machine during the first study time period seemed to be associated with increased (or decreased, depending on the modes in question) use of another mode such as e-mail. However, model results for the relationships between telecommunications modes and personal meetings and trips were not statistically significant, indicating no complementary or substitutive relationships between dissimilar modes. While the authors did not consider it explicitly, these results indicate that telecommunications devices and services may be primarily used in an "add-on" fashion to personal meetings and trips.

Handy and Yantis (1997) performed an exploratory study on how people used telecommunications technologies, looking for cases when people would substitute in-home use of telecommunications services for out-of-home activities. They found that a large percentage of telephone banking sessions substitute for physical banking trips, while a small minority of shopping trips (20%) are substituted by in-home teleshopping activities. However, overall they found that the majority of in-home activities were added on or complementary to their out-of-home counterparts. Perhaps most interestingly, they found evidence that as the quality of in-home services improve, the amount of substitution of in-home for out-of-home services tends to increase. In the case of banking services, the researchers asked participants to consider what they would have done if telephone banking service was not working the last time they used it. Roughly 46 percent of the respondents who reported using their telephone banking services would have made a special trip to the bank or an ATM, while 36 percent would have waited until their next trip to the bank or ATM. In this case, it appears that a large percentage of telephone banking sessions substitute for physical banking trips, while a substantial minority of teleshopping banking sessions are induced by the complementary effects of telephone banking on banking activities. These findings of significant home banking substitution for out-of-home banking sessions may reflect a high level of quality of online and telephone banking services.

Differences between information technologies and the context of their use (i.e., at home, in the workplace, or mobile) appear to play an important role in determining the influence of ICT use on travel behavior. In a study of Internet users in the Puget Sound region, Viswanathan and Goulias (2001) found that home and work Internet users tend to have shorter travel times than non-Internet users, but did not have any measurably different pattern of activities. They also found that computer usage at work and school tends to increase the amount of time spent at those activities, but did not have a statistically significant effect on travel durations. Mobile technology users (e.g., cell phones and laptop computers) tend to have significantly longer travel times, suggesting people may be using mobile technologies to provide additional flexibility in planning their daily activities, thereby increasing their travel demands, or because increased travel is leading to a greater dependence on mobile technologies.

Similar conclusions are drawn by Senbil and Kitamura (2003) in a study of how the use of telecommunications devices affects participation in activities in Osaka, Japan. Regression analysis results indicate that cellular phone use has a complementary effect on work duration and the frequency of joint activities (those undertaken with another person). A structural equation model developed using the same activities data also found that increased use of a home telephone tends to have a complementary effect on discretionary activities.

Additional links between ICT usage and activity durations were found by Douma, Wells et al. (2004). In a study of ICT users in the Twin Cities area of Minnesota, they found that professionals, technical employees and managers tend to use ICT to stay connected with their offices while leaving from or traveling to work at a time later than the typical peak commute periods. They conclude that these workers are using ICT as a means of increasing the flexibility of their work schedule demands. They also found that while using broadband Internet connections from home as a substitute for commuting to work (i.e., telecommuting) was a rare occurrence in their data set, those who did telecommute typically had broadband connections.

Srinivasan and Athuru (2004) used the 2000 Bay Area Transportation Survey (BATS 2000) to evaluate the influences of ICT on travel behavior. They found that Internet use for maintenance activities, particularly by workers, tends to generate an increased number of trips of shorter duration than the average survey participant. They qualify these results by stating that the degree to which Internet use generates additional trips is dependent on the relative supply of activity opportunities (i.e., level of accessibility) as well as the availability of time and resources (e.g., vehicles) to pursue these activities.

Teleshopping and General Shopping Behavior

Any discussion teleshopping research should begin by reviewing the work of Salomon and Koppelman (1988). In this early work (well before the invention and growth of online shopping), these authors constructed an analytical framework for understanding teleshopping and the implications for its future growth and importance. While we may casually think of shopping as the act of purchasing goods, Salomon and Koppelman began by breaking down the shopping process into five sequential steps, several of which could be supplanted or enhanced by the adoption of teleshopping:

1) Entry into the market;
2) The choice among alternative shopping modes;
3) Information gathering;
4) The evaluation of information; and
5) The choice of consequent actions.

The choices people make about which of these five stages they choose to replace with teleshopping—and any mode of shopping for that matter—are determined by the capabilities of each mode's transmission (or, using the terms of the personal computer era, the characteristics of the shopping mode's "user interface"), the characteristics of the product in question and its market profile, and the characteristics of the user. These steps and the determining factors that govern people's choices of a shopping mode provide us with a framework for understanding how and why people might adopt teleshopping.

Tacken (1990) provides additional insight into the choice of shopping modes. Shopping is done for a number of reasons, each of which may have a distinct set of preferred modes and means to achieve these ends. Tacken divides shopping trips into two general categories:

1) Functional shopping: where the shopper seeks to fulfill personal or household needs; and

2) Recreational shopping: where the shopper engages in shopping activity as a means to interact with others socially or for the experience of shopping and consuming itself.

Graham and Marvin (1996) believe that teleshopping complements rather than replaces traditional retail. People will still want to have the experience of traditional shopping and will likely use teleshopping services as an enhancement to the traditional shopping experience. Shoppers will increasingly use online services to search for information, make product comparisons, and search for bargains, while still engaging in traditional retail shopping behavior to "kick the tires" and enjoy the shopping experience. Mitchell (1999) sees a similar convergence of electronic and traditional shopping, where "…small look-and-order showrooms in high-traffic locations such as airports" will replace traditional retail outlets.

To test for substitution in the case of catalog shopping, Handy and Yantis (1997) asked survey respondents to consider what they would have done the last time they made a catalog purchase if they had not found the item they wanted. In response, 31.5 percent of the participants reported that they would not have bought the item at all. This suggests that roughly a third of the catalog purchases would not have been made if not by catalog (i.e., they are add-on with respect to shopping travel), and that they were most likely, recreational shopping sessions. Another 40 percent of survey participants indicated they would have looked for the item on their next trip to a store, but would not have made a special trip for it. Handy and Yantis surmise that these catalog purchases may have replaced in-store purchases, but since they would have made the trip anyways, these catalog purchases did not replace a trip to the store. The remaining 20 percent of survey respondents indicated that they would have made a special trip to get the item if they could not find it in a catalog, suggesting that these purchases actually substituted for a shopping trip. Handy and Yantis conclude that roughly 20 percent of catalog purchases may replace traditional (i.e., physical) shopping trips, and it seems fair to conclude further that these shopping sessions were most likely "functional" in nature.

In line with Tacken's (1990) second factor, several researchers have proposed that the propensity to teleshop may be driven – at least in part – by the amount of spare time the shopper has (Gould, Golob et al. 1997; Kilpala, Seneviratne et al. 1999). The less discretionary time a person has, the more likely they are to shop online. Presumably, accessibility to retail opportunities is related to time availability since longer travel times for shopping will increase a person's sense of being "time-starved". The combined effects of a person's constrained schedule (i.e., the degree to which shoppers feel "time-starved") and their relative accessibility to traditional shopping outlets are of particular importance for this dissertation.

Gould (1998) echoes Tacken's emphasis on the available time the shopper has and the relative convenience of traditional shopping, but broadens her focus to include the possibility that the activity of traditional shopping and its associated travel may offer the user some intrinsic value. For Gould, the key questions to consider when analyzing the tradeoffs between traditional and teleshopping are:

1) Does e-shopping save travel time (or time in general)?; and

2) Does shopping travel have intrinsic value (i.e., social or psychological)? For example, Gould hypothesizes that there may be some intrinsic value of normal shopping for a person who is teleworking and feels isolated in the home. Shopping may provide an excuse to get out of the house and the opportunity for social interaction.

Graham and Marvin (1996) also note the trend towards shopping as a leisure activity, citing this as another reason for the continued importance of the traditional shopping experience in our lives. Thus, the characteristics of shoppers themselves and their attitudes towards the shopping experience are of critical importance. Theoretical speculation concerning the characteristics of shoppers and their propensity to teleshop are described below.

Teleshopping Adoption and Substitution

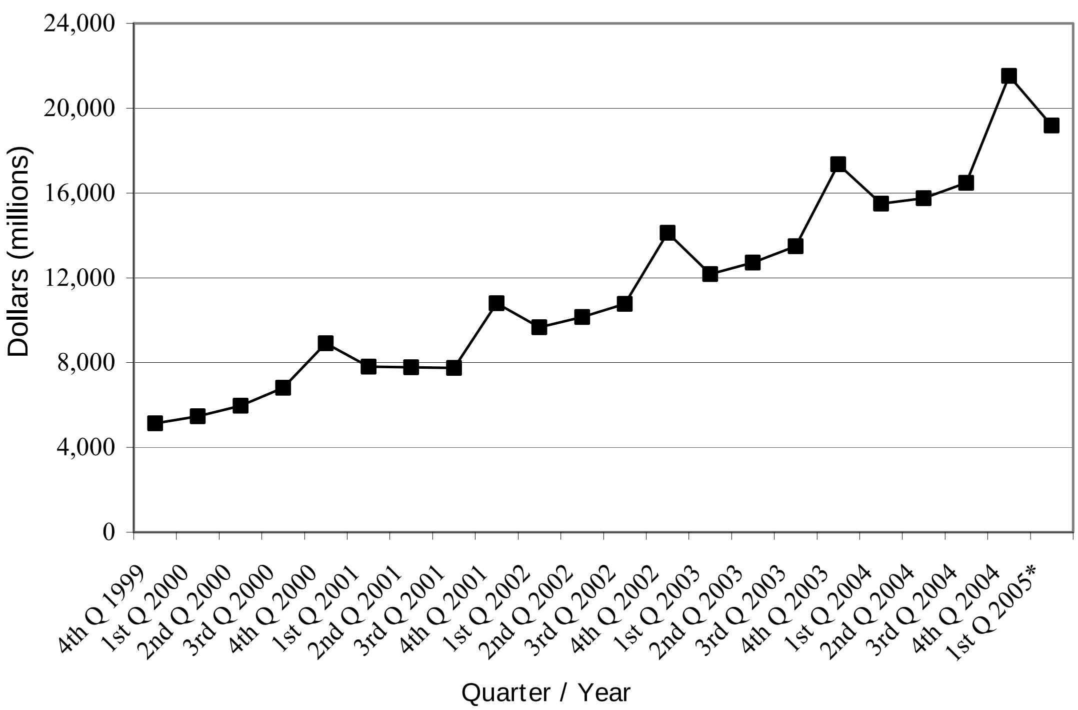
The degree to which substitution actually takes place will govern the positive (or negative) impacts of teleshopping on our society and environment. Gould, Golob et al. (1997) suggest that since travel time is a significant share of a traditional shopping activity, teleshopping substitution will take place if it provides significant time savings over trip-based shopping. Since it eliminates the need for the customer to physically travel, teleshopping should offer significant time advantages over single-purpose, single-destination shopping trips. However, Gould and Golob (1998) suggest that the chances for significant substitution of teleshopping sessions for traditional shopping trips are slim. The limited research performed to-date tends to support this assertion (Giglierano and Roldan 2001; Ferrell 2004).

Nevertheless, as the demands of daily life change according to the time of day, day of the week, and season, we should expect the relative attractiveness of teleshopping to vary as well. In particular, the daily demands of social and economic life can change dramatically during the holiday season. Figure 1 shows the growth of e-commerce sales since 1999. Since the introduction of the Internet to the world of retail sales, online retail sales have grown in bursts of volume that correspond to the winter holiday seasons. Every year since 1999 – even during the dot-com "bust" years since 2000 – sales via the Internet have grown substantially. During the other (non-holiday) periods of the year since 1999, online sales have been flat or grown slowly. These data suggest that the conveniences offered by online retailers are most attractive to people during the more time-stressed periods of the holidays – a time when consumers are generally more time-starved and may be looking for a more convenient way to meet their holiday gift-giving obligations.

Another holiday season pattern is discernable from the data displayed in Figure 1. In the months following the winter holiday season (the first quarter of each following year), online sales drop below their holiday season heights, but never fall to or below their pre-holiday season levels. It would seem that with each holiday season, new consumers test online retail services. We can surmise that every year, a share of them finds that they like these services and continue to use them in the following months. In other words, each year, a cadre of new online shoppers tests these services and become new converts. The question is: Are these new converts increasing their online purchases in addition to their traditional retail purchases (an add-on relationship), are their traditional retail purchases further stimulated by their online purchases (a complementary relationship), or are online purchases substituting for their traditional retail purchases?

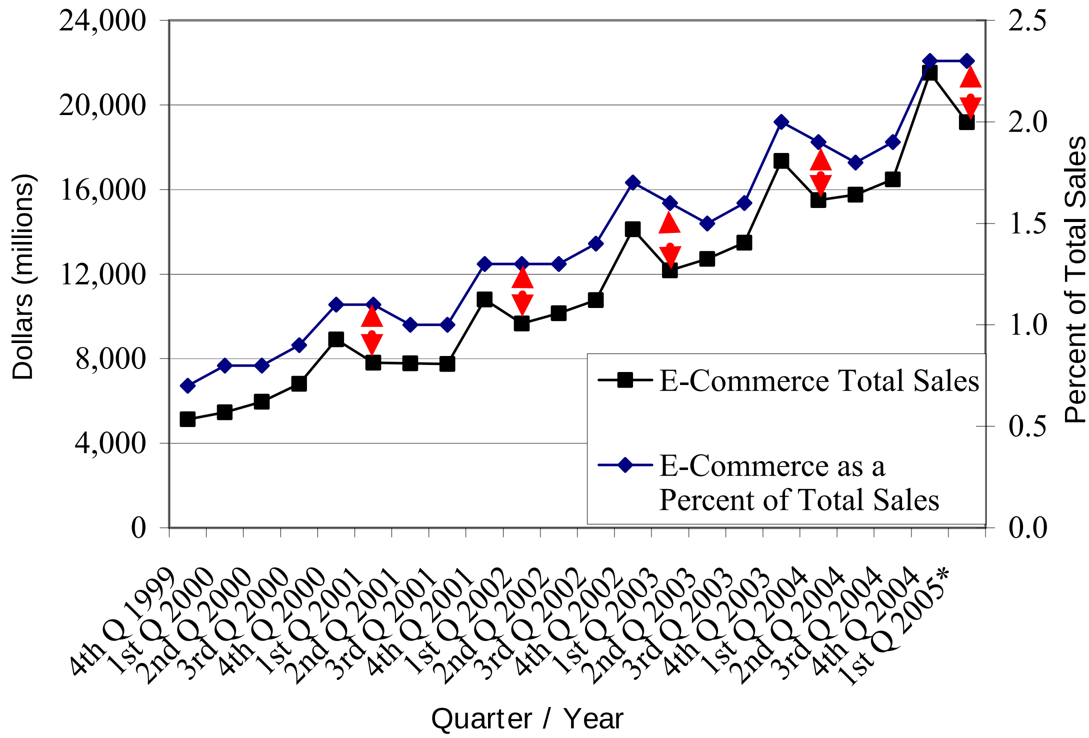
Additional retail sales data displayed in Figure 2 suggest that the relationship between online and traditional retail sales is either substitutive or complementary. Here, the seasonal pattern of total online (E-Commerce) retail sales is compared to the pattern of changes in the share of online sales as a percent of total retail sales.

FIGURE 1: ESTIMATED QUARTERLY U.S. RETAIL E-COMMERCE SALES



* - Preliminary estimate.
Source: Unadjusted Quarterly Retail E-Commerce Sales, United States Census Bureau, http://www.census.gov/mrts/www/data/html/05Q1.html

FIGURE 2: THE EFFECTS OF SEASON ON U.S. RETAIL E-COMMERCE SALES AND ADOPTION



* - Preliminary estimate.
Source: Unadjusted Quarterly Retail E-Commerce Sales, United States Census Bureau, http://www.census.gov/mrts/www/data/html/05Q1.html

First, online sales as a percentage of total retail sales have grown consistently from year to year over the past four years from less than one to more than two percent. This suggests that over time, consumers are increasing their share of online purchases. Again a pattern of holiday seasonal spikes can be seen where the share of total sales by online modes grows quickly during the holiday months and then falls again (though not below their pre-holiday levels) in the following months. However, while total online sales fall during the first quarter of each year, online retailers' share of total retail sales tend to remain flat or fall off less dramatically than total sales online, usually falling somewhat during the third quarter (though not to or below pre-holiday levels). This suggests that the convenience and attractiveness of online and traditional retail vary according to seasonal conditions, where online retailers tend to fare better than traditional retailers during the first quarter of each year. It further suggests that if teleshopping (online) modalities encourage traditional retail purchases during the holiday months, the effect is not completely translated to the post-holiday season and that during this period online purchases either substitute for or are unrelated to traditional retail purchasing behavior.

While seasonal context appears to be one possible factor that can affect the propensity of people to use teleshopping as a substitute for traditional shopping trips, additional research suggests that other contextual factors may play a role as well. Kim and Goulias (2004) investigated the effects of telecommunications adoption on time use and travel using the Puget Sound Transportation Panel longitudinal survey. Employing activities-based, simultaneous techniques, they found that the effects of ICT adoption and use depended on the context of its use. When people used computers and the Internet at work, they tended to increase their participation in subsistence activities and to decrease their participation in leisure activities and travel behavior. However, when people used computers and the Internet at home, they tended to increase their leisure and travel activities and decrease their subsistence activities. Therefore, the location of one's daily activities patterns, including teleshopping, may play an important role in determining to what degree one activity substitutes for another.

Several teleshopping researchers agree that so called, "time-starved" people are the group most likely to be attracted to teleshopping as a way to reduce the time burdens of shopping (Tacken 1990; Gould, Golob et al. 1997; Gould and Golob 1998; Kilpala, Seneviratne et al. 1999). Kilpala, Seneviratne et al. (1999) emphasize that high income shoppers will be most attracted to teleshopping since they presumably value time more than lower income groups. Tacken (1990) adds the mobility impaired to the list of potential teleshoppers, since this mode offers a new method for shopping without the burden of personal travel. Gould, Golob et al. (1997) note that women may be more likely to shop online since they are more time pressured with the duties of work, home, and childcare. As evidence, they claim that women make up 80 percent of all Peapod users (an online grocery service) (Gould, Golob et al. 1997). They back this assertion up with further empirical evidence, showing from a study of Portland, Oregon and Southern Washington State residents that female workers, if given more time, choose to engage in more maintenance activities. They interpret these results to mean that female workers have a latent demand for out-of-home, maintenance activities. Thus, more time gained from at-home shopping may result in more shopping.

Teleshopping and Trip Chaining

According to Gould, Golob et al. (1997), travel time is a significant share of a traditional shopping trip. Since it eliminates the need for the customer to physically travel, teleshopping should offer significant time advantages over single-purpose, single-destination shopping trips. But while convenience and timesavings are often cited as reasons why teleshopping is attractive, these assessments often do not account for the efficiencies of how people work shopping activities into their everyday lives through trip chaining. Trip chaining offers a higher level of transportation efficiency than single-purpose trips since it reduces the number of outbound and inbound trips that must be taken to and from the home. By combining trips to multiple locations for multiple purposes, people can make traditional shopping efficient and attractive (Gould and Golob 1998). Trip-chaining research tells us that shopping trips are often embedded within chained trips (Marker and Goulias 2000), are the most likely type of trip to be chained with other trips (Goulias, Pendyala et al. 1990; Misra and Bhat 2000), and the most convenient trip to combine them with is a commute trip (Kim, Sen et al. 1994). Thus, while teleshopping may be convenient when compared to a single-purpose shopping trip where the entire travel time is associated with the purchase, it may not be attractive when compared to a chained trip where the travel associated with the shopping link within that chain is minor.

Estimation of the effectiveness of teleshopping for reducing trips and vehicle miles of travel is not simple. If we hypothesize that trips once undertaken through physical presence (traditional shopping) are replaced with tele-purchases and consequent home deliveries, we must include the relative efficiencies of trip chaining when considering the travel benefits of teleshopping. When shopping trips are replaced by deliveries, we can expect a net reduction of travel since a personal shopping outing requires two trips (one to the store, one home again) and a delivery only requires one trip within a circuit of chained deliveries (Marker and Goulias 2000). However, this scenario assumes that shopping trips are made in isolation and not within trip chains.

To the extent that teleshopping is not being used as a substitute for traditional shopping, we may find an explanation in its inability to compete with the convenience of automobile-enabled, traditional shopping and the efficiencies and convenience of chained trips. Therefore, an important question is: How do the opportunities to chain shopping trips with other necessary travel affect the propensity to teleshop and substitute? We can assume that more opportunities to conveniently stop by a store on the way to or from work can eliminate the utility of teleshopping as a means to reduce the burdens of maintenance shopping activities. However, the relative attractiveness of trip chaining (and teleshopping) depends on part on the type of shopping trip undertaken – certain shopping trips are more compatible with trip chaining than others. Therefore, the net travel benefits of teleshopping may very well depend on the type of traditional shopping activity and the associated travel patterns it replaces.

If primarily maintenance shopping trips are undertaken within a set of chained trips, and if these maintenance activities are also the most likely to be replaced by teleshopping (as in the case of groceries), then we may expect few travel reduction benefits since these trips were already so efficient. This hypothesis is supported by Gould, Golob et al. (1997). They found that people who worked at home had longer shopping trips (in terms of distance traveled) than out-of-home workers. While 53 percent of out-of-home workers' shopping trips were linked to work trips, 49 percent of the shopping trips of those who split time between working at home and out-of-home were linked to work trips. Gould *et al.* ascribed this difference to the ability of out-of-home workers to chain shopping trips with their work commutes, thereby reducing total and shopping trip VMT. On the other hand, to the extent that teleshopping is an attractive alternative to more discretionary shopping trips, and if we assume these trips are less likely to be chained trips, then we might see significant travel reduction benefits. Any future analyses of teleshopping, substitution, and trip chaining will need to control for the effects of the other work, maintenance, and discretionary activities each study participant engages in to fully account for the tradeoffs people potentially make between these various activities, teleshopping, and out-of-home shopping travel.

The Potential for Trip and VMT Reduction

The quality and cost of the service will also affect the propensity of people to use it, and by extension, the amount of travel generated or reduced. There are several ways in which teleshopping could generate more travel instead of reducing it. In the aggregate, teleshopping may very well prove more efficient than traditional (trip-based) shopping modalities, but may offer the user more free time and lead to the generation of travel for other purposes.

Home Delivery Issues and Shop Travel Reduction

While the online purchase portion of the transaction may provide a low cost alternative to traditional shopping modalities, substantial questions remain about the viability of product delivery methods. If the industry continues on its current path, we can assume that the great majority of goods bought online will be physical in nature, requiring delivery to the consumer's home. Here, Gould and Golob (1998) point out a fundamental paradox for the teleshopping/online industry. Since the people most likely to be attracted to online purchasing can best be described as "time-starved"— people looking for ways to cut the costs (time and monetary) of retail transactions—we can also assume that this group will be the least likely to be home enough to actually receive the goods being delivered. Having to take time out of your busy schedule to stay home and wait for delivery defeats the purpose of shopping online in the first place.

Several means to cope with this dilemma have been proposed. Marker and Goulias (2000) suggest that a new form of delivery may evolve called household replenishment. Focused mainly on the grocery market, household replenishment would involve the construction of delivery receptacles on the exterior of houses that could be opened by the delivery person. The delivery items could be left there, secured from theft, waiting for the customer to come home and move the purchased items into the home. If groceries were involved, this might require the construction of refrigerated delivery receptacles to keep perishables from spoiling. There are significant obstacles associated with this method, with full implementation requiring all participating homes to be retrofitted with a large and expensive receptacle. Delivery could also be made directly into a person's house. Issues of security for the homeowner have been addressed through bonding of the delivery company and its employees, should any damage or thefts occur as a result of delivery activities.

A third potential solution to the delivery paradox is centralized neighborhood delivery. Instead of delivering to each customer's home, the delivery company would leave the customer's package at a designated delivery center in the customer's neighborhood. It would then be the customer's responsibility to pick up the package and take it home. While this method has the advantage of allowing the customer to pick up the package at will, it also creates an additional set of vehicle trips (assuming the package is too large to carry by foot) that may further degrade the travel reduction potential of teleshopping (Marker and Goulias 2000).

Another obstacle to the home delivery scenario resides within the delivery industry itself. According to Kilpala, Seneviratne et al. (1999), at the time of their study, "...only about 20% of United Parcel Service's (UPS) deliveries are to residential customers, and they are just covering costs.". Presumably, teleshopping deliveries need to reach a critical mass, where enough deliveries are made in each area of delivery coverage to increase the marginal profit of each drop-off. However, until this threshold is reached, and without substantial profits for the carriers, we can assume that the costs to the user for deliveries will remain high, dampening the growth of teleshopping.

Other home delivery factors potentially limit the success of teleshopping. Time-starved people looking for ways to reduce the demands of shopping and travel on their schedules are one of the most likely groups that would be attracted to teleshopping (Kilpala, Seneviratne et al. 1999). Specifically, people with high incomes may be more attracted to teleshopping as a way of saving on purchase time and shopping related travel.

However these people are also the most likely to require deliveries on weekends or evenings when they would be home to receive them. This presents a problem to the delivery service provider, who must find means to work around these potential delivery bottlenecks (Kilpala, Seneviratne et al. 1999).

Substitution and the Boomerang: Does Teleshopping Generate More Travel?

It is frequently assumed that teleshopping will be more convenient to use than traditional shopping. This added convenience is often seen as an unquestionable benefit to the shopper and society as a whole. However, there are a number of ways in which teleshopping might be too convenient and generate more travel.

If too convenient or if the monetary costs of transactions and delivery are substantially smaller than the transaction and travel costs associated with its brick-and-mortar competitors, teleshopping may also encourage customers to order deliveries more often, thereby increasing the number trips and VMT. On the other hand, if teleshopping delivery is too expensive, customers may combine what would have been multiple orders into single delivery, thereby reducing VMT (Marker and Goulias 2000).

Additional issues surrounding the potential travel benefits of teleshopping revolve around the question of how people value their free time. If we assume that teleshopping successfully substitutes for traditional shopping travel, the question becomes: What will people do with the free time created? Marker and Goulias (2000) and Kilpala, Seneviratne et al. (1999) point out that the act of traveling – often viewed in purely utilitarian terms as a derived demand – may have value in and of itself. If true, then travel reductions gained from teleshopping substitution may encourage travel for other purposes. In this case, most substitution benefits of teleshopping could be lost to a constant, inelastic demand for travel. A similar argument can be made based on Gould's (1998) position that there is an intrinsic value to the shopping experience.

This line of thinking can be expanded to the realm of home workers and their shopping behavior. To the extent that increased teleworking translates into more people working at home, and if we further assume that many chained shopping trips are undertaken by people on their way to and from work, we might expect some effects of teleworking on shopping behavior as well. Clearly, the location of a person's daily activities, the travel routes they use to get there, and the relative access one has at any of these locations to retail opportunities can affect the amount of shop trip chaining, shop trip travel, and teleshopping one does.

Accessibility to Retail and Teleshopping

A number of researchers have hypothesized that the propensity to teleshop may also be driven in part by the relative accessibility a shopper has to retail opportunities. Tacken (1990) identifies several factors that may be important to people as they make a decision to teleshop, including urban form and transportation system performance, which he hypothesizes play an important role in the decision to teleshop. The three factors are:

1) Accessibility to shopping;
2) Available time; and

3) How and when ordered items can be received.

In effect, one's relative accessibility to retail shopping opportunities directly affects the amount of available time a person has to engage in shopping activities. The greater one's accessibility, the less time spent in transport to reach those outlets, and the more one's available time can be spent on shopping as opposed to travel. Consequently, several researchers have proposed that the propensity to teleshop may also be driven—at least in part—by the amount of spare time the shopper has (Gould, Golob et al. 1997; Kilpala, Seneviratne et al. 1999). The less time a person has, the more likely they are to shop online. The combined effects of available time (i.e., the degree to which shoppers feel "time-starved") and their relative accessibility to traditional shopping outlets are of particular importance for this dissertation.

However, in a study of Dutch online shoppers Farag, Dijst et al. (2003) found that the tendency to shop online is not significantly affected by the degree to which they are "time-starved" but is affected by their residential environment. People living in the mid-sized and core cities as well as the suburbs of the Randstad (the heavily urbanized western part of The Netherlands) tend to shop online more often than those living in the urban areas outside the Randstad, a finding directly opposite to that proposed above where those with poor accessibility would shop online more often as a substitute for long trips to shop. However Farag, Dijst et al. (2003) propose that these differences may still be the result of different lifestyles and characteristics of people living outside versus inside the Randstad. They indicate that further study with improved measures of accessibility and lifestyle is needed to determine the relative influences of these factors on teleshopping and shopping travel.

Consequently, the means we employ to measure accessibility are of critical importance. Recent research suggests that our distance and time-based measures accessibility may be too simplistic for today's complex interplay between human behavior, telecommunications advances, and our increasingly dispersed and fractured urban forms (Weber 2003). Weber (2003) specifically asserts that the increasingly complex nature of urban space as it relates to people's activities and their use of telecommunications need to be reflected in our use of accessibility measures. By using more sophisticated Geographic Information System (GIS) capabilities and data sources, he suggests that urban research can move beyond travel time as the centerpiece of typical accessibility measures to include more nuanced effects such as mixed-use and urban design. Comparing the results of two studies illustrates this point.

Gould and Golob (1998) found that people living in higher density and mixed-use neighborhoods in Portland, Oregon were less likely to engage in a shop-trip chain during their work trips, presumably because single-purpose shop trips from home were so easy and travel efficient. These findings lead them to suggest that the benefits of online shopping and delivery could be used to increase the efficiency of travel for people who live in low-density neighborhoods by creating local drop-off and pick-up points for online purchases where residents can pick-up their goods ordered online earlier that same day (i.e., chained trips).

Somewhat contrary to Gould and Golob's (2002) findings, Ferrell (2004) found that households in the San Francisco Bay Area with high accessibility to retail opportunities tended to make more shopping trip chains. The differences between these two studies may be due in part to differing definitions of accessibility, which was defined by Gould and Golob as high density, mixed-use neighborhoods and by Ferrell using a travel-time (gravity model) based measure of retail opportunities. Both of these studies could be correct since each measures a different aspect of accessibility and resulting travel behavior responses. Therefore, one possible reason for these contradictory findings is the different nature of the accessibility measure used in these two studies. Furthermore, there may be significant differences between work and shopping trip chains – Ferrell's analysis focused on shopping trip chains while Gould and Golob's focused on work trip chains. These findings suggest that in the absence of the detailed land use and urban design data or budgetary abundance, accessibility research design requires a clear theoretical nexus between the behavior being studied and the type of accessibility measure employed.

Nevertheless, there is common ground between these two papers. Based on his findings, Ferrell (2004) hypothesized that – similar to the conclusions of Gould and Golob (2002) – home teleshopping and trip chaining are a pair of travel-efficiency tools that can be used in tandem. Based on this hypothesis, it is not difficult to further suggest that home teleshopping and trip chaining have complementary effects on shopping and shopping trips. The insignificant findings for the model used by Ferrell (2004) to predict shopping trip travel distances as well as the significant findings that home teleshoppers tend to make more shopping trips and more shop trip chains implies that the efficiencies of trip chaining and home teleshopping are not being used to travel more but to shop more (i.e., to take more shop trips of shorter lengths). Ferrell suggested that further research was needed that would specifically identify and measure the interchanges and tradeoffs between how people utilized their time and teleshopping to determine how teleshopping affects shopping time, shopping travel time, as well as shopping related travel and other time use categories. To do so, a more robust and flexible modeling technique is required needed to simultaneously measure the interrelationships between these variables. This dissertation serves in part to document the results of this continuing effort.

Personal Lifestyle, Teleshopping and Substitution

There may also be variations in the propensity to teleshop as a substitute for traditional shopping trips depending on the lifestyle of the person in question. Since it seems reasonable to assume that time-starved people are also more likely to chain their shopping trips together with work, entertainment, or other activity travel purposes, we can expect to find a more trip-chaining by time-starved people as well. This leads to the question: Is there a measurable difference in the propensity for time-starved people to teleshop when compared to the larger population? Verhoef and Langerak (2001) studied the effects of these variables on the propensity for people to grocery shop online in the Netherlands. They found that respondents who felt they were the most "time-starved" responded that they would consider adopting online grocery shopping as a way to avoid the time demands of traditional grocery shopping. Their results suggest that convenience is a primary characteristic in the potential attractiveness of online grocery shopping in comparison to traditional shopping modes.

The results from Tacken (1990) support this finding with a survey of patrons of a Dutch grocery teleshopping service. The two highest rated advantages of this service were the ability to avoid having to haul purchased goods home after shopping (75% of respondents) and the time savings of teleshopping (47%). The high rankings of these two factors indicate that the perceived convenience of teleshopping provides its distinct advantage over traditional shopping, and may provide the motivation for time-starved shoppers to choose it over traditional (trip-based) shopping modes.

The patterns of teleshopping for travel substitution may differ by socio-economic factors as well. For example, working females today are often the most "time-starved." It seems reasonable to expect that these working women are a likely group of potential teleshoppers; allowing them to substitute teleshopping sessions for routine maintenance shopping trips. The patterns of catalog sales seem to support this notion which appear not to be influenced by a lack of transportation access to traditional retail, but rather mostly by the degree to which someone is time-starved (Gould and Golob 1998).

Similarly, Koppelman, Salomon et al. (1991) found that a person's relative level of accessibility to traditional retail outlets, and the ease of return for purchased items that were no longer wanted or were defective, had no significant impact on mode choice—i.e., those with poor retail outlet accessibility were just as likely to purchase through teleshopping modalities as those with good accessibility. Additional support is found from Tacken (1990) who found that there were no clear differences in the propensity to teleshop in relation based on the relative accessibility of the shopper to retail shopping establishments.

However, according to Gould, Golob et al. (1997), if time-starved female workers were given more time, they would likely use that time to do more maintenance activities, and potentially, generate more shopping trips. This notion is supported by Handy and Yantis (1997) who found that shoppers who used mail order catalogs frequented stores as often as non-users. Therefore, the daily demands of social and economic life may play a decisive role in determining the fate of teleshopping and the degree to which it substitutes for or complements traditional shopping trips.

Lohse and Johnson (1999) provide additional insights into the nature of the relationships between teleshopping and time-starvation. Based on a longitudinal panel survey of Internet users in the United States, they found that the time-starved lifestyle – as measured by the number of hours worked during the survey period – was one of the most powerful determinants of online shopping of the variables included in their models.

In addition to finding no significant substitution or complementary relationships between online and traditional shopping travel, Casas, Johanna et al. (2001) found that online shoppers tend to have high incomes and are younger in age than the typical survey participant. Based on these findings, they hypothesize that online shoppers may tend to have a more “active” lifestyle than non-online shoppers. Since people who lead “active” lifestyles are also likely to feet time-starved, this hypothesis is consistent with the ideas proposed above.

More recently, Farag, Dijst et al. (2003) found somewhat contradictory results. In their study of Dutch online shoppers, they found no significant relationship between those socio-economic indicators they identified as related to a time-starved lifestyle – variables such as number of workers and children per household – and the tendency to shop online. They hypothesize that these somewhat unexpected results may be caused by differing interactions between the time-starved lifestyle and shopping for groceries versus non-groceries respectively. Specifically, they propose that time-starved people may be more likely to shop online for groceries than for non-grocery purchases since groceries are of more importance for time-pressured households. Although not specifically discussed by Farang *et al.*, this assertion can be expanded upon to further hypothesize that online shopping is most likely a substitute for required, maintenance shopping activities (such as groceries) for time-starved people.

Implications for Urban Form

In addition to the potential effects on travel behavior, teleshopping also presents the potential for changing urban physical form. There are three areas where the widespread acceptance of teleshopping by consumers may affect urban form. First, to the extent that teleshopping creates fewer reasons for people to live near shopping areas, it could be a further impetus for urban dispersal. Second, if we assume that teleshopping will replace certain market segments of traditional retail shopping, these traditional retail establishments may be forced out of business. This could radically change urban land uses, and further degrade the importance of cities as centers of consumption. Finally, if the neighborhood delivery center concept takes off, we might see a reversal of trends in retail consolidation. While retail stores have been tending to consolidate into malls, and the success of "big box" retail has further eroded the viability of neighborhood retail districts, a neighborhood delivery center could potentially refocus consumption patterns to the neighborhood scale. Not only would people pick up their goods at a neighborhood distribution center, but also they would very likely engage in additional purchasing at these distribution sites or adjacent to them. Either impulse buying or pre-planed, chained retail trips could be brought back to the neighborhood scale.

While Graham and Marvin (1996) develop a strong theoretical set of arguments for the continued strong role of cities in the telecommunications/information age, they also point out that there is an important role for teleshopping and other new forms of electronically mediated activities to cause continued urban dispersal. Specifically, they assert that there will be degradation of the need for proximity to customers as required for traditional retail as teleshopping gains acceptance.

While there are no clear trends yet indicating where teleshopping business facilities will locate, it seems likely that they will be compelled to seek locations with access to the maximum number of customers. Evans (1999) predicts that teleshopping businesses will locate their order fulfillment facilities close to transportation facilities, allowing rapid delivery. Mitchell (1999) specifically identifies teleshopping businesses that deal in perishable or urgently needed goods as likely candidates to locate in urban areas since these goods require rapid delivery. Therefore, we can reasonably assume that to the extent that urban areas continue to provide access to large markets and provide high quality transportation networks, many of these teleshopping businesses will locate there.

However, the fate of traditional retail businesses and their associated land uses are far from clear. Assuming that teleshopping presents a competitive challenge to traditional retail establishments, there are three possible responses by retailers to home delivery competition. They can: 1) abandon retail stores and become electronic businesses by delivering from warehouses, 2) abandon large retail stores and move up the value chain by adopting a boutique strategy, and 3) maintain large retail stores and compete with teleshopping outlets on the basis of price (Marker and Goulias 2000).

If traditional retail establishments switch to become teleshopping/electronic businesses, then any assumptions about the likely locations of teleshopping facilities would apply to virtually the entire retail sector. If, however, they choose to abandon large retail stores and become boutique outlets, we can assume that they will seek unique locations with more character than suburban beltways and big box, tilt-up buildings. These new boutique stores may reinvigorate our urban downtowns and shopping districts. Finally, if we assume that they continue to compete on the basis of price, it seems likely that the flight of retail to the suburbs and exurbs will continue, further fueling urban dispersal in general.

Ironically, while the technology of teleshopping may prove to be a tool for society to propel its cities towards further urban dispersal, this technology may simultaneously provide a means to bind these large, sprawling metropolitan areas together. As indicated by theories of industrial location, our most valued and technologically advanced firms find themselves drawn to suffer the diseconomies of scale in large urban areas to capture the benefits of technological spillovers and the innovative milieu. To the extent that technologies such as teleshopping allow the benefits of living in urban areas to be stretched out further away from traditional central cities, we can expect that people will seek to live in the more affordable suburbs and exurbs, while commuting long distances to reach these centers of technological dynamism.

RESEARCH DESIGN AND METHODOLOGY

While teleshopping research to-date has begun to flesh out the behavioral responses of people to these new technologies, many questions remain. Several studies have looked at the question of substitution using hypothetical, using “what if” questions and answers to respondents about how they might have acted in the past if things were different (Tacken 1990; Handy and Yantis 1997; Verhoef and Langerak 2001). Only in the past few years have published studies begun to appear that combine records of teleshopping and travel behavior as discrete activities (Farag, Dijst et al. 2003; Douma, Wells et al. 2004; Ferrell 2004) as is typically done in contemporary travel and activity surveys by transportation planning agencies in the United States.

Similarly, until recently (Farag, Dijst et al. 2003; Ferrell 2004) there have been no systematic spatial analyses have been conducted that look at the variations in teleshopping and travel behavior as they interact over geographic space. As discussed earlier, the following three question areas are the focus of this dissertation research:

1) Does teleshopping substitute for traditional shopping trips or shopping activities?
2) Does urban geography affect the propensity to teleshop and to substitute teleshopping for traditional shopping trips or activities?
3) Does lifestyle affect the propensity to teleshop and to substitute teleshopping for traditional shopping trips or activities?

This research consists of four steps:

1) Data Collection and Preparation;

2) Preliminary Data Analysis: A Teleshopper Profile

3) Model Construction and Activities Analysis; and

4) Presentation of Results and Analysis.

Data Collection and Preparation

This dissertation links the shopping and travel behaviors of individuals with data describing variations in urban form and accessibility. In searching for a primary data source for this research, priority was placed on obtaining data that reported the amount of each individual's activity and travel behavior as discrete records including traditional shopping and teleshopping activity events, detailed individual and household demographic information for survey participants, and geographically precise data on residential, employment, and other recorded activity information. After reviewing a number of potential data sources, the Metropolitan Transportation Commission's (MTC) Bay Area Travel Survey (BATS) 2000 was selected.

This dataset provides detailed activity diary records for 14,563 households, which represents roughly 0.6 percent of the 2,429,257 total households in 1998 in the San Francisco Bay Area. The surveyors utilized a geographically stratified sample, with the stratification based on counties and MTC's pre-defined traffic "superdistricts" within counties. To ensure a representative sample of the two counties with the lowest population densities – Napa and Marin – the surveyors chose to fix a minimum number of households for these counties at 600 each. The other seven counties were randomly sampled according to the stratification method mentioned above.

These data are used by MTC to calibrate the region's travel demand model. Since it contains detailed activity records for each individual – including travel purpose and mode choice – detailed geographical location information for each activity, as well as the use of home-based teleshopping services (referred to in BATS 2000 as a "Home Shopping" activity), can be combined with data on the distribution of retail outlets to establish the relative accessibility of each surveyed residence to retail shopping opportunities. Table 1 shows the BATS 2000 activity codes.

TABLE 1: BATS 2000 ACTIVITY CODE KEY

1 = DRIVING, RIDING, WALKING, BIKING, FLYING
2 = HOUSEHOLD CHORES and PERSONAL CARE
3 = MEALS (at home, take-out, restaurant, etc.)
4 = RECREATION/ENTERTAINMENT
5 = SLEEP
6 = WORK or WORK RELATED, (in or out of home)
7 = SCHOOL or SCHOOL RELATED (College/Day Care)
8 = SHOPPING (AT HOME), (by Internet, catalog, or television)
9 = SHOPPING (AWAY FROM HOME)
10 = PERSONAL SERVICES/BANK/GOV'T
11 = SOCIAL ACTIVITIES
12 = RELAXING/RESTING
13 = VOLUNTEER/CIVIC/RELIGIOUS SERVICES
14 = SICK or ILL/MEDICAL APPOINTMENT
15 = NON-WORK (NON-SHOPPING) INTERNET USE
16 = PICK-UP/DROP OFF PASSENGER
17 = CHANGED TYPE OF TRANSPORTATION
990 = OUT OF TOWN/MOVED OUT
996 = OTHER
998 = Don't know
999 = Refused

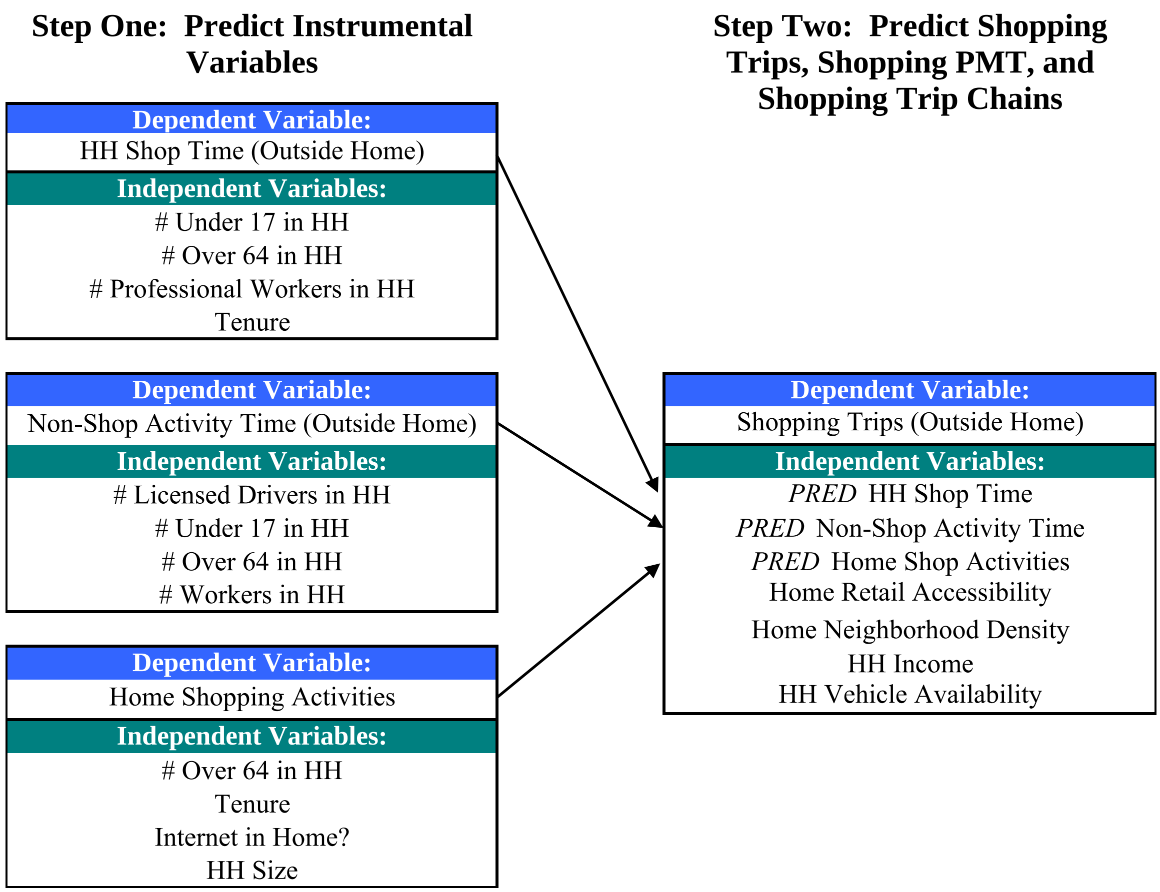
Source: MTC BATS 2000 Activity Survey File.

Preliminary Research Results

Prior to undertaking dissertation research project described here, a preliminary study was undertaken and published (as referenced and discussed previously, Ferrell (2004)) to test the effectiveness of using two-staged least square regression methods as the primary modeling method for this dissertation research. The findings of this research as published in Ferrell (2004) are summarized here and suggest there may be a complementary relationship between home teleshopping and shopping travel. This experience using two-stage regression models as a means to control for the potentially endogenous relationships between variables led to a search for a more robust and flexible modeling system that would not only control for, but allow the measurement and evaluation of these endogenous relationships.

The estimation of the models was taken in two-stages. The first stage models were constructed to predict independent variable inputs into the second stage models that predict the dependent/evaluation variables: the number of shopping trips, shop trip travel distance, and the number of shop trip chains. Figure 3 provides a graphic representation of the two-staged modeling process used for this preliminary research project as well as a list of the variables included in each step.

FIGURE 3: TWO-STAGED LEAST SQUARES REGRESSION MODEL DIAGRAM



First stage models were constructed to predict the demand for non-shopping and shopping activities were estimated using household demographic variables. These first step models generally included household size (number of persons), household income, number of household workers, a dummy variable indicating when a household had one or more vehicles per licensed driver, a dummy variable indicating the number of household members aged 65 and older, and a similar dummy variable indicating the number of household members 16 and under. The specific variables selected for each of these stage one models were determined through a combination of theoretical support, each variable's contribution to overall model fit, and its degree of multicollinearity with other model variables. Estimated values for work and shopping time were then used as independent variable inputs into subsequent stage two models that predict the amount of travel and trip chaining.

In addition to these shopping and other activity demand variables, stage two models included several geographical measures. The amount of shopping done by a household and the amount of travel its members engage in to access these activity locations is partially determined by their availability and relative ease of traveling to them.   To address this issue, each household's accessibility to retail opportunities was calculated using a gravity-based measure using the total number of retail employees as shown in the "Measuring Urban Geography: Constructing Accessibility Measures" section below. The stage-two model analysis results are summarized and discussed below.

The total shopping miles traveled per household model results are shown in Table 2. Total shopping miles traveled is strongly associated with the predicted total amount of time spent shopping and predicted total amount of time spent in non-shopping out of home activities (both calculated in stage-one models). While the positive relationship between shopping time and shopping travel distance is not surprising, the positive relationship between non-shop activities time and shopping travel distance is somewhat surprising. One would think that more time spent at work (for example) would reduce the amount of time available for shopping and its associated travel. However, since this model controls for the total amount of shopping activity time, the amount of shopping time is held constant. Additional reductions in shopping trip distances would be expected from the increased opportunities to chain shopping with work trips. The positive relationship may also indicate that working and other activities generate their own shopping trips to some extent – in other words, there may be a complementary relationship between working, maintenance and discretionary activities and shopping. Subsequent models may shed additional light on this issue by measuring these effects. The denser and more retail accessible a household's neighborhood is, the less its members tend to travel in terms of distance for shopping activities. As for the key variable of interest, the total number of home teleshopping activities was not significantly related to total shopping travel distance. The model R-Squared was low at 0.044.

TABLE 2: SHOPPING PERSON-MILES TRAVELED PER HOUSEHOLD MODELS RESULTS

	Shopping Person-Miles (1/100 Mile) Per Household			
Variables	Coefficient	*t* -statistic		Tolerance
(Constant)	8.86E+02	6.2330	***	
PRED_Non-Shopping Activity Time	1.97E-01	5.1960	***	0.656
PRED_Shopping Time	7.30E+00	6.9660	***	0.708
HH Accessibility to Retail	-1.00E-02	-6.3170	***	0.708
Home Teleshopping Activities	1.30E+01	0.2540		0.999
Neighborhood Population Density	-3.69E+00	-2.6110	***	0.671
HH Vehicle Availability	1.19E+02	2.3074	**	0.931
HH Income	1.65E-03	5.1223	***	0.850
R^2	0.044			
F	57.128			
F-Sig.	0.000			
N	8789.0			

* = significant at α = 0.10 level
** = significant at α = 0.05 level
*** = significant at α = 0.01 level
Tolerance (a measure of multicollinearity) = the proportion of the variable's variance not accounted for by the other independent variables in the equation.

TABLE 3: SHOPPING PERSON-TRIPS PER HOUSEHOLD MODEL RESULTS

	Shopping Trips Per Household			
Variables	Coefficient	*t* -statistic		Tolerance
(Constant)	-2.04E-02	-0.118	*	
PRED_Non-Shopping Activity Time	2.23E-04	4.826	***	0.656
PRED_Shopping Time	2.09E-02	16.419	***	0.708
HH Accessibility to Retail	1.92E-06	0.999		0.708
Home Teleshopping Activities	2.31E-01	3.712	***	0.999
Neighborhood Population Density	-3.65E-03	-2.124	**	0.671
HH Vehicle Availability	7.22E-02	1.151		0.931
HH Income in Dollars	1.88E-06	4.897	***	0.850
R^2	0.069			
F	93.667			
F-Sig.	0.000			
N	8789.0			

* = significant at α = 0.10 level
** = significant at α = 0.05 level
*** = significant at α = 0.01 level
Tolerance (a measure of multicollinearity) = the proportion of the variable's variance not accounted for by the other independent variables in the equation.

The total number of shopping trips per household model results are shown in Table 3 and, as found in the previous model, the dependent variable is strongly and positively associated with the predicted total amount of time spent shopping and the predicted total amount of time spent out of the home performing non-shopping activities. The positive association with non-shop activities time adds additional weight to the hypothesis that work, maintenance, and discretionary activities may generate their own shopping trips since they are associated with increases in both shopping distance traveled and shopping trips. Finally, the more home teleshopping activities a household engaged in, the more shopping trips they took. This suggests that the relationship between home shopping and out-of-home shopping trip making is complementary.

TABLE 4: SHOPPING TRIP CHAINS PER HOUSEHOLD MODEL RESULTS

	Shopping Trip Chains Per Household			
Variables	Coefficient	*t*-statistic		Tolerance
(Constant)	-4.21E-01	-2.8770	***	
PRED_Non-Shopping Activity Time	2.67E-04	6.8270	***	0.656
PRED_Shopping Time	1.26E-02	11.6690	***	0.708
HH Accessibility to Retail	4.30E-06	2.6390	***	0.708
Home Teleshopping Activities	2.07E-01	3.9260	***	0.999
Neighborhood Population Density	-2.18E-03	-1.4960		0.671
HH Vehicle Availability	4.94E-02	0.9290		0.931
HH Income in Dollars	1.46E-06	4.4730	***	0.850
R^2	0.052			
F	68.193			
F-Sig.	0.000			
N	8789.0			

* = significant at α = 0.10 level

** = significant at α = 0.05 level

*** = significant at α = 0.01 level

Tolerance (a measure of multicollinearity) = the proportion of the variable's variance not accounted for by the other independent variables in the equation.

The total number of shopping trip chains per household model results are shown in Table 4. As one would anticipate, the more time spent shopping as well as in other out-of-home activities, the more likely a shopping trip will be chained with other trips. While population density was not significantly related to the dependent variable, retail accessibility was positively and significantly related to the number of shopping trip chains. These findings indicate that households with high accessibility to retail opportunities are more likely to chain their shopping trips, potentially traveling less distance overall as a benefit from trip chaining. However, based on previous results, they appear to use the time benefits of chaining to make more shopping trips and visit more retail locations while traveling the same distances for shopping as non-home shoppers. Similarly, the more household members engaged in home teleshopping activities, the more they tended to chain shopping trips, indicating that home teleshopping may be influencing people to shop more, take more trips and chain these shop trips more than non-home shoppers. Thus, it is reasonable to assume that home shoppers' shopping trips may be more specialized, with more destinations and requiring more shopping trips. Overall R-Squared for this model was low (0.052) but had a good F-significance ($F < 0.000$).

Results of this preliminary analysis suggest that home teleshopping households engage in more shopping trips and chain more of their shopping trips. It is hypothesized that teleshopping has a complementary effect on out-of-home shopping, leading to more shopping trip making while the time for these additional trips and home teleshopping activities is enabled through efficiencies gained from increased trip chaining. Time saved through increased trip chaining and teleshopping may provide the additional time needed to shop more – both from within the home and outside the home.

While these models produced some interesting results, the process of developing and analyzing them revealed a number of shortcomings of the two-staged least squares regression method for this particular application. First, as reported above, it was difficult – and in the end, impossible – to develop stage-two models with R-Squared values greater than 0.069, suggesting that at best, these models could not explain 93 percent or more of variation found in the dependent variables. These difficulties were the main reason why this preliminary research was conducted at the household-level of analysis, which produced marginally higher R-Squared results than those conducted at the person-level of analysis, which is more theoretically sound.[2]

Second, while this modeling technique was capable of controlling for the endogenous relationships between variables, it does not allow these two-way relationships to be measured and analyzed. What results is only half a picture at best of the relationships between the variables included in the models. Third, there is a limit to the number of variables that can be adequately and efficiently predicted in the first step of this process. The sheer number of variables that should be included in these models – including disaggregated activities variables such as work, maintenance and discretionary activities variables – tended to overwhelm the two-staged least squares modeling process when included. Constructing each stage-one model to adequately predict a variable for insertion into the three, stage-two models would have required an enormous investment of time and effort in order to avoid multicollinearity problems and would have required a vast host of exogenous variables to predict the stage-one instrumental variables. Even with the limited set of instrumental (predicted) variables used as inputs into the stage-two models, the models were found to exhibit temperamental characteristics, with fluctuations in independent variable signs from one model run to the next, suggesting that despite best efforts, multicollinearity among the instrumental variables may not have been completely removed from the final models, calling into question the results they produced and the consequent analysis of the effects of home teleshopping on shop travel described above.

[2] This assumes that decisions about travel and activities are typically made by individuals, and not among household members.

The limitations encountered using these methods led to a search for a more robust and capable analysis method to analyze complex activities and travel behavior relationships.

Activities Analysis Methods

Transportation researchers have long considered travel to be primarily a *derived demand* (Muller 1995). Mitchell and Rapkin (1954) have been credited with one of the first published discussions of this hypothesis (Handy 1992). They placed particular importance on the relationships between activities and land use as means to understanding trip generation (Mitchell and Rapkin 1954). However, while travel and land use data were increasingly available for model forecasting and research work, there was a paucity of activities data – the critical factor that provides the conceptual link between travel behavior and land use. According to Golob (1996), the main impediment to advancing the methods and applications of activities analysis in travel demand research and forecasting is the lack of data that effectively links time-use data with travel behavior data. Traditionally, the travel research and forecasting community has collected travel diary survey data that links travel behaviors to trip purposes, but does not include detailed time and location information for the activities that took place between recorded trips. Additional impediments were encountered that had to do with the lack of familiarity in the research and forecasting communities with statistical modeling techniques that could gracefully and reliably handle the measurement of endogenous relationships between variables with data that are not normally distributed. Travel was primarily modeled and researched by separating trips into broad trip purpose categories (such as home-work, home-shop, and home-other trips) and modeled separately. In the specific arena of travel behavior research, research methods have seen a gradual process of evolution over the past decade. Increasingly, time-budget effects on travel behavior are being measured and controlled for. In the decades of the 1970s and 1980s, research began to investigate the idea of methodologically linking travel demand to activities (Golob and McNally 1997). In the 1990s increased attention was given to understanding and modeling demand for transportation within the context of the activities that people travel to reach and engage in. As a result, more transportation surveys began to widen their approach to include the collection of activities information, and increasing attention has been given to developing the methods of analysis to handle this new data.

Accounting for the endogenous relationships between travel and activities has been one of the most researched aspects of activities-based travel demand (e.g., demand for activities increases the demand for travel and the ease of travel may increase the demand for associated activities). Goulias, Pendyala et al. (1990) employed a two-staged least squares regression method to model trip chaining behavior. Ferrell (2004) used a similar method to measure the effects of home teleshopping on travel behavior. However, this method proved somewhat problematic since it required a separate model for each dependent variable (i.e., shop trips, trip lengths, trip chains) and was difficult to instrument (i.e., develop the first stage models).

Purvis, Iglesias et al. (1996) reported on their efforts to modify the San Francisco Bay Area's regional travel demand modeling process to include feedback relationships between activities and travel demand.

By the mid-1990's, activities analysis techniques were gaining attention and use. These methods typically include variables that measure the total amount of time spent by survey participants within categories of activities. Often these activities are divided into broad classifications such as work-related activities which generally cover activities that are undertaken specifically for paid employment, maintenance activities which include household chores, eating, sleeping, shopping and personal services (e.g., banking), and discretionary activities which includes recreation, social activities, relaxing and resting.

Recently, Structural Equations Models have become a favorite method for activities-based analysis. Golob (2001) found that by the end of the 1990s, there were over 50 published studies using Structural Equations Modeling (SEM) techniques, many of them focused on activities analysis. SEM models can handle a large number of endogenous and exogenous variables simultaneously, avoiding the cumbersome two-staged least squares regression process of developing instruments to cancel-out the effects of endogenous variables on one-another.

A number of recently published research studies have used SEM techniques to measure activities participation patterns in a manner similar to that being undertaken in this dissertation. Golob (1996) used an SEM structure to show the relationships between in-home and out-of-home activities participation on travel behavior. Mokhtarian and Meenakshisundaram (1999) used SEM techniques to study the longitudinal effects of newly adoption communications technologies on those already in use. Senbil and

Kitamura 2003 (2003) developed an SEM model to investigate the relationships between telecommunications technology use and activities participation. Kim and Goulias (2004) used SEM techniques to measure the relationships between activities, travel and telecommunications technologies. Farag, Schwanen et al. (2005) used SEM to study the influences of teleshopping on travel behavior in The Netherlands. Based on this author's previous difficulties fitting two-staged least squares regression models for the purposes of measuring home teleshopping and travel behavior (Ferrell 2004) and on the body of research amassed that has used SEM techniques for these purposes, this dissertation research will utilize an SEM model formulation.

SEM Model Formulation

SEM model variables are typically broken up into two functional categories: exogenous and endogenous. Exogenous variables are those that are presumed to have a one-way effect on other variables, but the collection of other variables within the model are not expected to have an effect on them. Endogenous variables are those that are presumed to have an effect on other variables and are likely to be affected by other variables in the model as well. At the beginning of the model's construction, each variable considered for inclusion must be classified and grouped into one of these categories. A critical question to consider here is the timeframe that is being modeled. A variable can be categorized within either group depending on the timeframe in question.

For example, a person's access to an automobile clearly plays an important role in their ability to travel to and work outside the home. However, the amount of time one spends working also affects one's income, and in turn, the ability to afford that automobile. Following this logic, all three variables – automobile availability, income, and time spent working – would all be reasonably classified as endogenous with two-way relationships between them. However, if the time period of the survey being used only covers a few days of personal activities participation (as is the case with the BATS 2000 dataset), the amount of time each survey participant spends over a two-day survey period engaged in work activities would not have any measurable effect on income or car ownership levels – the survey period may cover two days of vacation time, sick days, or the non-work days of a person with an irregular work schedule. In this case, we would reasonably classify most socio-economic and demographic variables as exogenous to the effects of other variables in the model. If the survey covered a month, a year, or more of activities time then we would have to consider including these as endogenous variables subject to the influences of each other.

For the purposes of this study and considering the time-period of activities covered by the BATS 2000 dataset, all socio-economic and demographic variables have been classified and treated as fixed, exogenous variables within the confines of the SEM model. Exogenous variables included in the model are shown in Table 5.

Endogenous variables, as described earlier, are those that might reasonably affect and be affected by other variables within the BATS 2000 dataset and the construct of the SEM model. Conceptually, these include any time-use activities engaged in over the two-day survey period and any travel behavior reported by the survey or inferred through supplementary analyses using other data sources (such as the MTC travel demand model travel distances and times). These variables can be grouped into household and person-level categories.

The SEM activities model used three groups of endogenous variables. The first group includes variables that describe daily activities participation by each adult in the survey. Activities are broken down into five categories: Work, Maintenance, Discretionary, Shopping, and Travel activities. These variables can be further grouped into three categories: those activities that took place at home, those activities that took place outside the home, and travel variables. The endogenous variables used in the model are shown and described in Table 6.

For this effort, a structural equation model (SEM) with observed variables was specified. A nonrecursive SEM analyzed the differences between the covariances found in the sample data and those predicted by the model. The model is fit by iteratively minimizing these differences. SEM allows for the inclusion of both observed and unobserved (latent variables) in the model. When included, the measurement component fits the latent components of the model using the observed variables in the model, while the structural component fits the exogenous and endogenous variables. While SEM is typically described as containing both observed and unobserved components, in practice the difficulties associated with estimating a full-scale SEM lead researchers to typically limit their models to include only observed variables (Golob 2001).

TABLE 5: SEM MODEL EXOGENOUS VARIABLES

Level	Exogenous Variable	Description
Household	AGE6_17HH	Number of children between 6 and 17 years old in household.
	ALWAYS	Dummy varialble for car availability in household (1 = number of cars equal to or greater than number of licensed drivers; 0 = number of cars less than number of licensed drivers).
	HHINC<35K	Houshold income below $35,000 per year.
	HHINC>85K	Household income above $85,000 per year.
	HM_TE_ACC	Home accessibility to all employment types.
	HM_RE_ACC	Home accessibility to retail employment.
	INTERNM2	Dummy variable for internet access in home (0 = no, 1 = yes).
	TENURE	Dummy variable for home ownership (0 = no, 1 = yes).
	UNDER6HH	Number of children in household under six years old.
Person	DISABLE	Dummy variable indicating if person is disabled or not (0 = no, 1 = yes).
	EMPLOYED	Dummy variable indicating if person is employed or not (0 = no, 1 = yes).
	PROFESSIONALS	First, factor analysis variable indicating if person is time-starved.
	FEM_HHH	Second factor analysis variable indicating if person is time-starved.
	LICDRIVE	Dummy variable indicating if person is licensesd to drive or not (0 = no, 1 = yes).
	OVER64	Dummy variable indicating if person is over 64 years of age or not (0 = no, 1 = yes).
	SCHOOL	Dummy variable indicating if person is enrolled in school or not (0 = no, 1 = yes).

TABLE 6: SEM MODEL ENDOGENOUS VARIABLES

Endogenous Variable			Unit	Description
Activity Variables	In Home	WIHTM	Minutes over 2 days	Total two-day time spent on Work activities done at home in minutes.
		MIHTM	Minutes over 2 days	Total two-day time spent on Maintenance activities done at home in minutes.
		DIHTM	Minutes over 2 days	Total two-day time spent on Discretionary activities done at home in minutes.
		HSTIM	Minutes over 2 days	Total two-day time spent on Shopping activities at the home in minutes.
	Out-of-Home	WOHTM	Minutes over 2 days	Total two-day time spent on Work activities done outside the home in minutes.
		MOHTM	Minutes over 2 days	Total two-day time spent on Maintenance activities done outside the home in minutes.
		DOHTM	Minutes over 2 days	Total two-day time spent on Discretionary activities done outside the home in minutes.
		SHTIM	Minutes over 2 days	Total two-day time spent on Shopping activities done outside the home in minutes.
		SHOPTT	Minutes over 2 days	Total two-day time spent on Shopping Travel done outside the home in minutes.
Travel Variables		AS_DIS	1/100 Mile over 2 days	Total distance (in 1/100th miles) traveled for shopping trips over two-day period.
		S_TRIP	Trips over 2 days	Total number of shopping trips over two-day period.
		SCHAIN	Trip Chains over 2 days	Total number of chained trips with shopping trips included over two day period.

Therefore, a structural model was specified using the following form:

$$\boldsymbol{y = By + \Gamma x + \zeta}$$

Where:

y = p x 1 vector of observed endogenous variables.

x = q x 1 vector of observed exogenous variables.

B = p x p matrix of coefficients of the y-variables.

Γ = p x q matrix of coefficients of the y-variables.

ζ = p x 1 vector of equation errors.

According to Golob (2001) Maximum Likelihood (ML) is the most commonly used SEM estimation method employed in transportation research since it is relatively robust in handling violations of multivariate normality that are typically encountered when using travel diary data. Since the BATS 2000 dataset is large, with over 20,000 usable person records, ML estimation was used for this study.

Assessing Model Goodness of Fit

When attempting to judge the goodness of fit for an SEM model, no single measure is appropriate since each measure reflects only one particular aspect of fit. The most commonly referenced measure is the Chi-Square (χ^2) statistic and its associated p-value of significance. A small χ^2 value and insignificant p-value is desirable since this indicates there is no significant difference between the model and its underlying data.

However, according to Kline (1998), a good χ^2 score may be unlikely with large sample sizes such as the sample employed for this study. For large sample sizes, the ratio of the χ^2 statistic to the degrees of freedom (χ^2/df) in the model can be calculated. χ^2/df values less than three are considered good for large sample sizes. Another category of fit indices measure the relative proportions of the observed covariances explained by the model – indices such as the Bentler-Bonett Normed Fit Index (NFI) and the Benteler Comparative Fit Index (CFI) should have values greater than 0.90 (Golob 2001). The Root Mean Square Error of Approximation (RMSEA) takes into account the level of model complexity employed by measuring the discrepancy from the population per degree of freedom. Typically, values less than 0.05 are considered to reflect a good model fit (Golob 2001).

Measuring Urban Geography: Constructing Accessibility Measures

To determine the influence of urban geography on the propensity to teleshop and the likelihood of using teleshopping as a substitute for traditional shopping trips, a measure of the relative accessibility to traditional retail establishments for each survey respondent in the BATS 2000 dataset was developed. These accessibility rankings were then used as an independent variable within the construct of the previously described models to determine how a person's residential accessibility to shopping opportunities affects his or her propensity to choose teleshopping as the mode of choice for shopping and purchases and as it affects the likelihood of substituting teleshopping for traditional shopping trips. Data on the geographical distribution of shopping opportunities were obtained from the

Association of Bay Area Governments (ABAG), which provides estimates of retail employees at the Travel Analysis Zone (TAZ) level for the Bay Area[3].

The amount of shopping done by a household and the amount of travel its members engage in to access these activity locations are partially determined by their availability and the relative ease of traveling to them. To address this issue, each household's accessibility to retail opportunities was calculated using a gravity-based measure based on the total number of retail employees as shown in the following formula:

$$A_i = \Sigma_j [Jobs_j * F_{ij}]$$

Where: $F_{ij} = Time_{ij}^{-v}$

$Jobs$ = # of jobs in tract

$Time$ = network travel times

i = residential zone

j = employment zone

$-v$ = an empirically calculated friction factor using BATS 2000 data

The propensity to participate in other, non-shopping activities outside the home is also driven in part by the relative accessibility of one's home to appropriate centers for these activities. To account for this dynamic, a more general accessibility measure was also

[3] Since these data only cover the nine county San Francisco Bay Area, retail and general employment locations outside the Bay Area but adjacent to it are necessarily missing from this analysis. Consequently, calculated accessibility values for some households located near the outer edges of the Bay Area may be lower than in reality. However, there are very few locations near the edges of the Bay Area where significant retail opportunities lie within a reasonable traveling distance and consequently, it was

constructed for non-shopping activities. For this measure, each survey household's relative accessibility to total employment (as compared to retail employment as calculated for the previous accessibility measure) was calculated using a gravity-based model.

While these gravity-based measures of accessibility do not address the full complexities of the interrelationships between telecommunications, travel, and urban land uses as discussed by Weber (2003), the alternatives require extensive Geographic Information System (GIS) land use and transportation system databases that are beyond the time and resource budgets of this research effort. Furthermore, since the primary hypotheses of this paper hinge on the time-savings offered by home teleshopping, these time-based measures of accessibility seem appropriate for this research application. Additional complexities based on individual differences (e.g.; gender or age) and telecommunications usage are accounted for in the model's variables that measure individual (survey participant) and household characteristics, as well as home teleshopping activities.

Lifestyle and Substitution: Time-Starved Factor Analysis

To determine the influence of lifestyle on the propensity to substitute teleshopping for traditional shopping activities, a review of these subjects in the activities, ICT and travel research was performed. As discussed earlier, Gould, Golob et al. (1997) among others have hypothesized that teleshopping may be attractive to those who are "time-starved".

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determined that, on whole, the calculated accessibility values for the region are reasonably accurate for the purposes of this study.

Verhoef and Langerak (2001) as well as Tacken (1990) provided confirmation for this idea when they found that their survey respondents who felt most time-starved were more likely to see online grocery shopping as a potential time savings tool.

Based on previous research, the degree to which one feels time-starved—and would therefore be more likely to shop online—is likely to be influenced by the demands of family and home. Casas, Johanna et al. (2001) found that income (high) and age (young) are correlated with the propensity to shop online, suggesting that households with young, professionally employed persons may find teleshopping to be an attractive time-saving device. It is also possible that the interactive effects of a professional career and a large family may have a disproportionate influence on the degree to which a person considers herself to be time-starved. In particular, female, working parents are often cited in our culture as bearing a heavy load of daily responsibilities with little time for themselves. While the extra duties for household maintenance that are placed on females are essentially a legacy of gender inequalities in our society at large, they are imposed by and respond to the needs of the family or household structure. Therefore, it seems reasonable to assume that a measure of time-starvation would be constructed from variables that specifically identify overworked females.

The pressures of life as a member of a multiple worker household are also frequently cited as a stress-inducing lifestyle that leaves little time for personal pursuits. With the growth of the professional working class and the associated disappearance of union-governed jobs with clear working hour boundaries, professional employers and employees alike find themselves working long, often uncompensated hours simply to keep up with the workload. Consequently, it seems reasonable to assume that a measure of time-starvation would also include variables that specifically identify people employed as professionals.

These two dynamics are not mutually exclusive. Indeed, a person may well find themselves under both forms of time-starvation. It has been hypothesized that time-starved people would be likely to teleshop as a means to save time and use it for more pressing tasks or for personal, discretionary activities.

While Verhoef and Langerak (2001) as well as Tacken (1990) utilized a direct, self-rated indicator variable of each survey participant's perceived level of time-starvation, the BATS 2000 dataset does not include a self-rated level of time-starvation. Therefore, time-starvation was treated as a latent variable, using a set of indicator (manifest) variables to classify each survey participant as to their relative levels of time-starvation. Additional hypotheses and research findings that have been developed in recent years provide the direction needed to develop a set of indicator variables for the time-starved lifestyle that can be used in a model of teleshopping and travel behavior.

Trip Chaining and Other Potential Factors

One of the most promising outcomes of teleshopping from a policy perspective would be a reduction in vehicle miles traveled and the associated negative externalities of automobile use such as road congestion, air pollution, and a reduction of greenhouse gas emissions. However, the degree to which substitution actually takes place will govern the positive (or negative) impacts of teleshopping (Hendrickson, Matthews et al. 2001). As discussed earlier, teleshopping's inability to compete with the convenience of automobile-enabled, traditional shopping may be due to the inherent efficiencies and convenience of chained trips. Opportunities for convenient shopping trips are not only home-based, but include those that can be "chained" with other trips that are necessary (such as commute trips). Therefore, an important question is: How do the opportunities to chain shopping trips with other necessary travel affect the propensity to teleshop and substitute? We can assume that the more opportunities one has to conveniently stop by a store on the way to or from work can eliminate the utility of teleshopping as a means to reduce the burdens of maintenance shopping activities.

If the propensity to substitute home-based shopping trips with teleshopping is determined, in part, by each person's residential accessibility – as hypothesized here – then the propensity to substitute teleshopping for chained shopping trips should be determined in part by the accessibility of a person's place of employment to retail opportunities. Therefore, to determine the extent to which people make trade-offs in their everyday lives between teleshopping and chained shopping trips, a variable was calculated that sums the total number of chained trips that included shopping activities for each person during each travel day captured in the BATS dataset. This variable was then inserted into the SEM model previously described to determine the degree to which the amount of shopping trip chaining reported by each respondent in BATS affects the propensity to teleshop and to substitute teleshopping activities for traditional shopping activities and trips. This variable also serves as a control to determine the potential effects of residential retail accessibility on the propensity to teleshop and substitute teleshopping for traditional retail shopping.

Potential Findings

While research to-date on the subject of teleshopping and travel substitution remains in its infancy, there is adequate evidence to expect that the results of this study will not find more than a small amount of travel substitution taking place. Most likely, those models that test for substitution without controls for lifestyle, accessibility, or trip chaining opportunities will find little or no substitution, while the more sophisticated models that include these control factors may begin to register some degree of substitution taking place. For example, we may find that it is convenient for single, working parents (i.e., time-starved) that live in suburban areas with poor accessibility to retail to substitute a teleshopping session for a trip to the store. While these exceptional cases may not represent a large enough minority of the population to significantly reduce VMT in the Bay Area, these new consumption patterns may indicate a continuation of the trend for people to use technological advances in communications and transportation technologies as a means to further separate their residences from their activity centers.

Furthermore, to the extent that these behaviors are found to be statistically significant, it may warrant the inclusion of teleshopping as a mode choice alternative in our transportation models. While the overall impact on regional VMT would be small, the addition of a teleshopping option, a measure of individual time-starvation, and a measure of accessibility to retail opportunities within transportation model mode choice equations may (depending on the findings of this and similar research efforts) improve the calibration and fit of these models to real-world conditions, and improve their predictive capabilities.

DATA PREPARATION AND PRELIMINARY ANALYSIS

Following the methods and using the datasets described in the previous section, data variables for accessibility and time-starved measures were constructed. Following these preparations, descriptive statistical analyses were performed to identify potentially significant and interesting variables for inclusion in the SEM model and potential relationships that could be studied in further detail.

Time-Starved Factor Analysis

Using a compilation of potential exogenous variables that help describe the time-starved condition, factor analysis was performed to distill the core descriptive component variables of the time-starved individual. Factor analysis was run using only individuals from the dataset that were identified as time-starved during the two-day survey period. Persons were identified as time-starved by selecting activities that were deemed mandatory or necessary for daily work or household maintenance (excluding any shopping activities) and summing the times spent on these activities for each person in the dataset. These activities are listed in Table 7.

TABLE 7: TIME-STARVED INDICATOR ACTIVITIES BATS 2000 CODE KEY

1 = DRIVING, RIDING, WALKING, BIKING, FLYING
2 = HOUSEHOLD CHORES and PERSONAL CARE
3 = MEALS (at home, take-out, restaurant, etc.)
6 = WORK or WORK RELATED, (in or out of home)
7 = SCHOOL or SCHOOL RELATED (College/Day Care)
10 = PERSONAL SERVICES/BANK/GOV'T
14 = SICK or ILL/MEDICAL APPOINTMENT
16 = PICK-UP/DROP OFF PASSENGER
17 = CHANGED TYPE OF TRANSPORTATION

Cases where the share of total time spent on these activities during the two-day survey period was greater than or equal to one standard deviation above the average time spent on these tasks for the entire survey population were identified and coded as being time-starved. These cases were then used as the sample population to fit the time-starved factor analysis model.

A series of factor analytic runs were performed to develop the best-fitting combination of variables, number of factor components, and rotation method. Comparison of results using Varimax and Quartimax factor rotation techniques were performed. Both techniques provide a method and criteria for selecting an optimal rotated factor component matrix. According to Schweizer (2001), the main difference between these techniques is that while Quartimax tends to select rotated factor matrices with large differences between the loadings of the same variable on different factors (i.e., it maximizes the differences between row wise variances of factor loadings), Varimax selects factor matrices where the factors account for a similar amount of variance over matrices where the factors account for very different amounts of variance. Therefore, the Quartimax technique will favor rotated matrix results with factors that offer the greatest amount of distinction between their factor loadings on each variable included in the analysis, while Varimax searches for a factor matrix where each factor accounts for a roughly equal amount of variance.

While Varimax is the more widely used technique, the best fitting results from this series of factor analytic runs were found using the Quartimax method. Using Principle

Component Analysis and Quartimax rotation techniques the following four variables produced factor loadings that described the greatest percentage of total variance in these variables: the number of professionally employed persons per household (PROFHH), a dummy variable identifying survey participants between the ages of 17 and 64 (Age 17 – 64), a dummy variable identifying survey participants who were listed as the head of their household (HEADHH), and a dummy variable identifying female survey participants (GENDER). Two factor variables describing the time-starved condition were produced and input as exogenous variables into the final SEM model. The resulting factor loadings (correlations between each input variable and each component) after rotation are shown in Table 8. The rotated factors describe just over 57 percent of the total variance in contributing variables. This result and the associated Eigenvalues for each step of the Principal Components and Quartimax rotation processes are shown in Table 9.

Factor loading results support the hypothesis stated in the previous section that there may be two statistically distinct types of time-starvation. The first factor utilized the number of employed professionals in each household and a dummy variable indicating whether a person was of a typical working age (between 17 and 64). This factor seems to best match the second cause of time starvation mentioned above where the pressures of having multiple persons in a household employed as professionals can reduce the amount of available for non-work activities. Hereafter, this time-starved factor variable will be referred to as the "PROFESSIONALS" factor.

TABLE 8: TIME-STARVED FACTOR ANALYSIS ROTATED COMPONENT MATRIX

Variable	Component 1	Component 2	Communalities
PROFHH	0.754	-0.184	0.603
HEADHH	0.013	0.812	0.659
GENDER	-0.062	0.600	0.364
Age 17-64	0.811	0.102	0.668

Extraction Method: Principal Component Analysis. Rotation Method: Quartimax with Kaiser Normalization. Only cases for which Time Starved Dummy = 1 are used in the analysis phase.

TABLE 9: TIME-STARVED FACTOR ANALYSIS EIGEN VALUE AND COMPONENT VARIANCE RESULTS

	Initial Values			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
Component	Total Eigenvalues	% of Variance	Cumulative %	Total Eigenvalues	% of Variance	Cumulative %	Total Eigenvalues	% of Variance	Cumulative %
1	1.26	31.60	31.60	1.26	31.60	31.60	1.23	30.75	30.75
2	1.03	25.75	57.35	1.03	25.75	57.35	1.06	26.60	57.35
3	0.97	24.14	81.48						
4	0.74	18.52	100.00						

Extraction Method: Principal Component Analysis.

Only cases for which Time Starved Dummy = 1 are used in the analysis phase.

The second factor utilized the Gender ("0" = male, "1" = female) and head of household variables. Interpretation of the signs accompanying the factor loadings suggests that female heads of household are more likely to be time-starved. This factor best matches the first cited cause of time-starvation where the pressures of running a household for females are particularly difficult. These women may be without a spouse to share the burdens and can increase the level of perceived time-starvation. Hereafter, this time-starved factor variable will be referred to as the "FEM_HHH" factor, standing for "female head of household."

Preliminary Data Analysis: A Home Teleshopper Profile

Preliminary analysis of the BATS 2000 dataset was performed by compiling average values for critical socio-demographic, time-use and travel variables and comparing them for Home Teleshoppers (people who reported shopping from inside their homes via the Internet (online), catalog or television shopping modes), Out-Of-Home Shoppers (people who reported shopping outside the home during the two-day BATS 2000 survey period, but who did not report Home Teleshopping) and the average values for the entire dataset population. To identify key variables that describe distinctive characteristics of Home Teleshoppers that could be used for further analysis in simultaneous modeling efforts (the SEM model), t-test techniques were utilized.

Teleshopper Demographic Profile

To effectively and accurately model the time use, travel, out-of-home and in-home shopping behaviors of BATS 2000 survey participants, a demographic profile of home teleshoppers was constructed. Key demographic and economic variables were identified through a review of previous, similar studies.

In their survey of Internet (online) shoppers, Cohen and Hamlin (1998) found that men were more likely to make purchases online than females, online purchasers tend to be aged 19 to 49, and have higher incomes than non-online shoppers. Online shoppers who did not make purchases (i.e., online browsers) tended to have a more even gender split, and were generally younger than online purchasers.

Using the 1999 household survey of residents of Sacramento, California, Casas, Johanna et al. (2001) found that online shoppers tended to be males between the ages of 34 and 64, with household incomes averaging $74,000 per year. Similarly, Farag, Schwanen et al. (2005) found that Dutch online shoppers were typically male, single, and young with high incomes while people who frequently shopped in stores were typically female, highly educated, and did not own a car.

Table 10 shows the average person-level demographic variables for all persons in the BATS 2000 dataset, all Home Teleshoppers, and all Out-Of-Home Shoppers (that did not engage in Home Teleshopping). T-tests were run to statistically compare the mean values of each variable for the Home Teleshopper and Out-Of-Home Shopper groups.

TABLE 10: PERSON-LEVEL DEMOGRAPHIC PROFILE

Person-Level Variables	All Persons	Home Teleshoppers	Out-Of-Home Shoppers	Home Teleshopper vs. Out-Of-Home Shopper T-Test Results	
				T-Test	**Sig.**
Average Age	40	46	43	***-3.75***	***0.000***
% Female	52%	62%	60%	-1.02	0.308
% HH Head	43%	57%	51%	***-3.13***	***0.002***
% Employed	69%	60%	61%	0.46	0.646
% Professional	88%	35%	32%	-1.37	0.172
% In School	28%	16%	22%	***3.61***	***0.000***
% Licensed Driver	76%	92%	93%	***-5.81***	***0.000***
% Disabled	3%	4%	2%	***-1.98***	***0.047***
N=	28,810	604	8,009	-	-

Note: Bold typeface indicates a relationship at the p = 0.10 level or better. Italic and Bold typeface indicates a relationship at the p = 0.05 level or better.

Results of person-level T-test are shown in Table 10. All variables tested but three had significantly different mean values for the Home Teleshopper and Out-Of-Home Shopper groups. Of those significant variables, all are significant at the p<0.05 level.

On average, Home Teleshopper survey participants are three years older than their Non-Home Teleshopper comparison group members. Home Teleshoppers were also more likely to identify themselves as the head of their household than Out-Of-Home Shoppers, with 57 percent of Home Teleshoppers identified as household heads and only 51 percent of Out-Of-Home Shoppers.

In general, the remaining statistically significant person-level variable means shown in Table 10 suggest that – as one might expect – Home Teleshoppers are more likely to spend time in the home than partaking in activities away from it. Only 16 percent of Home Teleshoppers compared to 22 percent of Out-Of-Home Shoppers were students (% In School). Home Teleshoppers were also less likely to have a driver's license (92% of

Home Teleshoppers versus 93% of Out-Of-Home Shoppers). Finally, Home Teleshoppers were more likely to be disabled, with four percent of indicating they were disabled in some way versus only two percent of the Out-Of-Home Shopper group.

Table 11 shows average values and T-test results for households with Home Teleshoppers and Out-Of-Home Shoppers.

TABLE 11: HOUSEHOLD-LEVEL DEMOGRAPHIC PROFILE

Household-Level Variables	All Households	Home Teleshopping HHs	Out-Of-Home Shopper HHs	*Home Teleshopper vs. Out-Of-Home Shopper HH T-Test Results*	
				T-Test	**Sig.**
Average HH Income	$86,123	$90,625	$89,006	-0.57	0.568
Average HH Size	2.30	2.53	2.50	-0.56	0.576
Workers Per HH	1.31	1.32	1.31	-0.18	0.861
Professionals Per HH	0.77	0.76	0.79	0.95	0.340
Average HH Vehicles	1.84	1.90	1.96	**1.71**	**0.088**
Licensed Drivers per HH	1.74	1.89	1.86	-1.13	0.259
HH Vehicles per Licensed Driver	0.86	0.84	0.87	***2.03***	***0.043***
Tenure (Own House)	31%	28%	26%	-0.74	0.460
Home Internet Access	74%	84%	76%	***-4.33***	***0.000***
N=	13,191	552	6,210	-	-

Note: Bold typeface indicates a relationship at the p = 0.10 level or better. Italic and Bold typeface indicates a relationship at the p = 0.05 level or better.

Household-level T-tests found that three variables included in Table 11 had significantly different mean values for the Home Teleshopper and Out-Of-Home Shopper households groups at the $p<0.10$ level (Average Household Vehicles, Household Vehicles Per Licensed Driver, and Home Internet Access) and of those, two are significant at the $p<0.05$ level.

T-tests found that (consistent with the finding that Home Teleshoppers are more likely to be licensed drivers themselves) Home Teleshoppers tend to live in households with more licensed drivers than Out-Of-Home Shoppers households (1.89 versus 1.86 licensed drivers per household). Interestingly, this slightly higher level of drivers per household does not translate into a higher level of automobile availability for Home Teleshopper households. Quite the opposite, t-test results found that Home Teleshoppers have significantly fewer automobiles per licensed driver in their homes than Out-Of-Home Shopper households. This suggests that Home Teleshopper households are teleshopping as a substitute for out-of-home shopping, thereby avoiding the need to purchase additional vehicles.

Finally, as would be expected, Home Teleshoppers are more likely to have Internet access in their homes than Out-Of-Home Shoppers (84% versus 76%). There were no statistically significant differences found between Home Teleshopper and Out-Of-Home Shoppers' households in terms of the number of workers per household, the number of professional workers per household, the number of vehicles per household, the number of vehicles per licensed driver in the household, or the rates of home ownership.

Overall, t-test results suggest that Home Teleshoppers tend to be older, the head of a household and are less likely to be enrolled in school. Home Teleshoppers are more likely to have a driver's license and to be disabled but have fewer automobiles per licensed driver than Out-Of-Home Shoppers. Perhaps as a substitute for automobile availability, Home Teleshopper households tend to have Internet connections in their homes more often than the Out-Of-Home Shopper group.

Several of these findings are in contrast to the findings of previous studies. Specifically, while several of the previously cited studies found that online shoppers are more likely to be male, the t-test run for gender found no statistically significant difference between Home and Out-Of-Home Shopper groups. Interestingly, though not significant, 62 percent of Home Teleshoppers were female as opposed to 60 percent of Out-Of-Home Shoppers, suggesting that Home Teleshoppers may be more likely to be female compared to Out-Of-Home Shoppers. Cohen and Hamlin (1998) suggest that males may be more comfortable making online purchases than females and found that, indeed, females were more likely to be online browsers than purchasers. This gender difference may reflect a mistrust of Internet payment technologies on the part of females. If true, this may help explain why more females were Home Teleshoppers than males, since the BATS 2000 Home Teleshopper included those people who reported catalog and television shopping in addition to Internet/Online shopping – two Home Shopping modalities that may engender a significantly higher level of trust among females. Similarly, both Farag, Dijst et al. (2004) and Casas, Johanna et al. (2001) found that online shoppers generally had higher household incomes than non-online shoppers, Table 11 shows that BATS 2000 survey participants that reported Home Teleshopping households had slightly lower average household incomes than Out-Of-Home Shopper households. These differences may also reflect a somewhat different demographic profile for Internet shoppers and Home Teleshoppers.

Teleshopper Time-Use (Activities) Profile

The amount of time each person spends on daily activities reflects their demographic characteristics, the roles they play in their work and home lives, and their personal priorities. Home Teleshoppers may also exhibit differences in their daily activity patterns when compared to Out-Of-Home Shoppers.

Table 12 shows the average number of minutes BATS 2000 participants reported for each activity category over the two day survey period, for all persons in the BATS 2000 dataset, all Home Teleshoppers, and all Out-Of-Home Shoppers. T-tests were run to statistically compare the mean values of each time-use variable for the Home Teleshopper and Out-Of-Home Shopper groups.

TABLE 12: TWO-DAY ACTIVITIES PROFILE (MINUTES)

Variables	All Persons	Home Teleshoppers	Out-Of-Home Teleshoppers	Home Teleshopper vs. Out-Of-Home Teleshopper T-Test Results	
				T-Test	Sig.
Out-Of-Home Work	269	194	205	1.00	0.317
In-Home Work	157	124	99	***-2.90***	***0.004***
Out-Of-Home Maintenance	153	108	135	***3.62***	***0.000***
In-Home Maintenance	916	1,029	980	***-2.06***	***0.039***
Out-Of-Home Discretionary	77	47	83	***6.44***	***0.000***
In-Home Discretionary	181	221	199	**-1.83**	**0.067**
Out-Of-Home Shopping	23	63	82	***5.37***	***0.000***
In-Home Teleshopping	6	288	0	-	-
N=	34,680	697	9,280	-	-

Note: Bold typeface indicates a relationship at the p = 0.10 level or better. Italic and Bold typeface indicates a relationship at the p = 0.05 level or better.

T-tests found that six of the seven activities variables tested and shown in Table 12 had significantly different mean values for the Home Teleshopper and Out-Of-Home Shoppers groups at the p<0.10 level (all but Out-Of-Home Work). Of that group, five were significant at the p<0.05 level (In-Home Work, Out-Of-Home Maintenance, In-

Home Maintenance, Out-Of-Home Discretionary, In-Home Discretionary, and Out-Of-Home Shopping).

Not surprisingly, t-test results indicate that Home Teleshoppers generally spend less time doing activities away from home (and more time on In-Home activities) than Out-Of-Home Shoppers. Home Teleshoppers spent 25 more minutes every two days on In-Home Work activities than Out-Of-Home Shoppers (124 versus 99 minutes respectively). In terms of maintenance activities, the tendency to Home Teleshop appears to be influenced by the place where maintenance activities take place – at home or away from home. On average, Home Teleshoppers reported spending less time on Out-Of-Home Maintenance Activities than Out-Of-Home Shoppers survey participants (108 versus 135 minutes) but spent more time than Out-Of-Home Shoppers on In-Home Maintenance tasks (1,029 versus 980 minutes).

Participation in discretionary activities followed a similar pattern. Home Teleshoppers spent less time than Out-Of-Home Shoppers on Out-Of-Home Discretionary activities (47 versus 83 minutes) and more time on In-Home Discretionary activities (221 versus 191). Finally, Home Teleshoppers reported spending less time than Out-Of-Home Shoppers on Out-Of-Home Shopping activities (63 versus 82 minutes), suggesting that there may be a substitutive relationship between Home Teleshopping and Out-Of-Home Shopping.

T-test results confirm that Home Teleshoppers have a statistically distinct set of daily activity patterns. Home Teleshoppers tend to spend more time than Out-Of-Home Shoppers on in-home activities than the Out-Of-Home Shopper group (and compared to the total BATS 2000 population as well), including Out-Of-Home Shopping. This suggests that there is substitutive relationship between Home Teleshopping and Out-Of-Home Shopping, where people Home Teleshop as a replacement for shopping in stores.

Teleshopper Travel Profile

An initial analysis of the BATS 2000 data was conducted to provide a glimpse of what the patterns of shopping travel behavior are of Home Teleshopping and Out-Of-Home Shopping survey participants. First, the average shopping trip distances, average number of shopping trips, shopping trip chains, and the average shop trip distance per shop trip were tabulated for these three survey participant groups. T-tests were then run to determine if any differences between the Home Teleshopper and Out-Of-Home Shopper groups were statistically significant.

Table 13 shows that persons who teleshopped from home tended to make fewer shopping trips of shorter distances and shorter time periods, and engaged in fewer shop trip chaining activities than those who only shopped outside the home during the same two-day survey period.   These results are in contrast to the findings of Ferrell (2004), which, using BATS 2000 data as well, reported evidence of a complementary relationship between home teleshopping and shop trips as well as between teleshopping and shop trip chains.

TABLE 13: AVERAGE TWO-DAY PERSON-LEVEL SHOPPING TRIP CHARACTERISTICS

Variables	All Persons	Home Teleshoppers	Out-Of-Home Shoppers	Home Teleshopper vs. Out-Of-Home Shopper T-Test Results	
				T-Test	Sig.
Shop Trip Distance (Miles)[1]	4.4	4.8	9.0	***8.52***	***0.000***
Shop Trips	0.8	1.1	1.9	***15.79***	***0.000***
Shop Trip Travel Time (Mins.)[2]	23	20	37	***7.89***	***0.000***
Shop Trip Chains	0.4	0.7	1.0	***7.37***	***0.000***
Shop Trip Distance Per Trip (Miles)[1]	5.7	4.5	4.9	0.99	0.324
N=	21,741	697	9,280	-	-

Notes:

Italic and Bold typeface indicates a relationship at the p = 0.05 level or better.

1 - Distances calculated from MTC's Travel Demand Model network.

2 - Travel Times calculated from reported BATS 2000 survey times.

There are several possible reasons why these findings differ. First, since the analysis in Ferrell (2004) was performed at the household level, it is possible that the differences between that study's findings and the preliminary analysis of person-level data shown in Table 13 are the result of how households distribute shopping responsibilities among their members. In this case, home teleshopping may allow household members to distribute shopping activities among their members differently than households that do not home teleshop; potentially by allowing one or more household members to accomplish more tasks from home than he or she would be able to do without access to home teleshopping. Therefore, while home teleshopping enables one household member to stay home (as inferred from the results of Tables 7, 8, and 9), travel less for shopping purposes (as reported in Table 13), and possibly do more home-based work, maintenance discretionary and activities (as reported in Table 12), other household members, freed from the need to do tasks around the home that are now done by the home teleshopper, are able to engage in more out-of-home work, maintenance and discretionary activities and less out-of-home shopping (as reported in Table 12). Therefore, under this hypothesis home teleshopping allows greater specialization of outside versus in-the-home tasks among household members with home teleshoppers specializing in (both Home and Out-Of-Home) shopping activities.

Another possible explanation as to why these results differ from those found in Ferrell (2004) is that the instrumentation used to construct the two-staged least squares regression models in Ferrell (2004) may have been flawed. If this is the case, we would expect to see a similar set of relationships between average shop trips, shop trip distances traveled, and shop trip chains undertaken between Home Teleshoppers and Out-Of-Home Shoppers at the household level of aggregation as seen for individuals in Table 13.

Table 14 shows the average two-day shopping trip characteristics of survey respondents compiled at the household-level of analysis. A review of t-test results shown in Table 14 at the household-level of analysis provides support for the notion that there may have been model specification problems in the previous research by Ferrell (2004). T-test results indicate that Home Teleshopper households tend to make fewer shop trips of shorter distances than non-teleshopping, Out-Of-Home Shoppers – results that echo those found in Table 13 at the person-level of analysis. Similarly, Table 14 shows that just as seen at the person-level of analysis shown in Table 13, households with Home Teleshoppers in them made fewer shop trip chains than households that do no teleshopping from home but engaged in shopping activities outside the home.

TABLE 14: AVERAGE TWO-DAY HOUSEHOLD-LEVEL SHOPPING TRIP CHARACTERISTICS

Variables	All Households	Home Teleshopper HHs	Out-Of-Home Shopper HHs	Home Teleshopper vs. Non-Home Teleshopper Household T-Test Results	
				T-Test	Sig.
Shop Trip Distance (Miles)[1]	8.4	10.0	14.8	***5.32***	***0.00***
Shop Trips	1.6	2.3	3.1	***7.47***	***0.00***
Shop Trip Travel Time (Mins.)[2]	78	81	72	-1.51	0.13
Shop Trip Chains	1.0	1.5	1.8	***3.23***	***0.00***
Shop Trip Distance Per Trip (Miles)[1]	5.5	4.4	4.8	1.16	0.25
N=	10,081	636	6,210	-	-

Notes:

Italic and Bold typeface indicates a relationship at the p = 0.05 level or better.

1 - Distances calculated from MTC's Travel Demand Model network.

2 - Travel Times calculated from reported BATS 2000 survey times.

These household-level findings reinforce the hypothesis that the model specifications as reported in Ferrell (2004) were flawed. However, the notion that there may be household burden-sharing activities and household activities being restructured between household members cannot be dismissed. Additional modeling of person-level activities and travel behavior should help clarify these differences and help shed further light on the potential differences between the household and person-level effects of Home Teleshopping. Further analysis with improved methods may reveal that by controlling for the amount of discretionary, maintenance, and shopping time each person engages in during the survey period (as was done somewhat roughly in Ferrell (2004)), this complementary relationship suggested from the results reported in Ferrell (2004) may reassert itself.

Spatial Distribution of Home Teleshoppers

As discussed previously, the potential time-savings offered by home teleshopping may be particularly attractive to people living in areas with poor accessibility to retail opportunities. If true, then we would expect that BATS 2000 survey respondents living in suburban and urban fringe areas to report that they spent more time than their urban counterparts (those survey respondents living in the “core” urban and inner ring suburbs of the Bay Area) on home teleshopping activities. To provide some preliminary insights into this hypothesis, the total number of minutes spent on Home Teleshopping activities by residents of each Transportation Analysis Zone (TAZ) in the Bay Area was summed, normalized (divided) by the number of survey respondents in each TAZ, and graphically displayed using a Geographic Information System (GIS) software package. The distribution of Home Teleshopping as shown for the North Bay Counties (Marin, Sonoma, Solano, and Napa) in Figure 4, suggests that TAZs with large amounts of Home Teleshopping activities (as recorded by the BATS 2000 activity survey) are generally concentrated in or near the urban areas of the North Bay counties. Generally, the smaller a TAZ is, the denser its settlement patterns are. The smallest TAZs are usually the older, core urban areas. Patterns of reported home teleshopping in the North Bay counties do not appear concentrated in these smallest, urban TAZs, nor in the largest, most rural area TAZs. Rather, Figure 4 suggests that for North Bay residents, home teleshopping is most attractive in the mid-sized TAZs in what are best described as the newer suburban and exurban areas. However, in general it appears that most of these higher frequency home teleshopping (darker) TAZs are those that are close to state or Interstate – TAZs with the highest levels of accessibility.

Figure 5 shows the levels of reported home teleshopping for the Central Bay Area counties (San Francisco and the Peninsula, Alameda and Contra Costa Counties). This sub-region shows a similar pattern to that seen in the North Bay, where the TAZs in the suburban areas tend to have higher than average amounts of reported home teleshopping activities. However, the darkest-colored TAZs in this map are those in the inner-ring suburbs and cities of the region – cities such as San Francisco, Oakland, Berkeley, San Leandro and Hayward. While this would seem to be a different pattern from that found for the North Bay, it is actually consistent to the extent that these cities all have very high levels of accessibility to retail opportunities using a variety of transportation modes. Therefore, while it was originally hypothesized here that areas with low levels of retail accessibility may be more attracted to home teleshopping, the geographical distribution of reported home teleshopping activities suggests just the opposite – that people who live in areas with high levels of retail accessibility are more likely to home teleshop.

Figure 6 shows the distribution of home teleshopping activities for the southern Bay Area (Santa Clara, southern San Mateo, and southern Alameda counties). This map generally confirms the conclusions drawn previously. The TAZs with the highest reported rates of home teleshopping are those that are physically adjacent to retail opportunities (such as Alviso at the southern tip of San Francisco Bay in northern San Jose) or TAZs with good access to regional transportation facilities (Interstate highways).

FIGURE 4: HOME TELESHOPPING MINUTES (TWO-DAY) PER SURVEY PERSON—NORTHERN BAY AREA

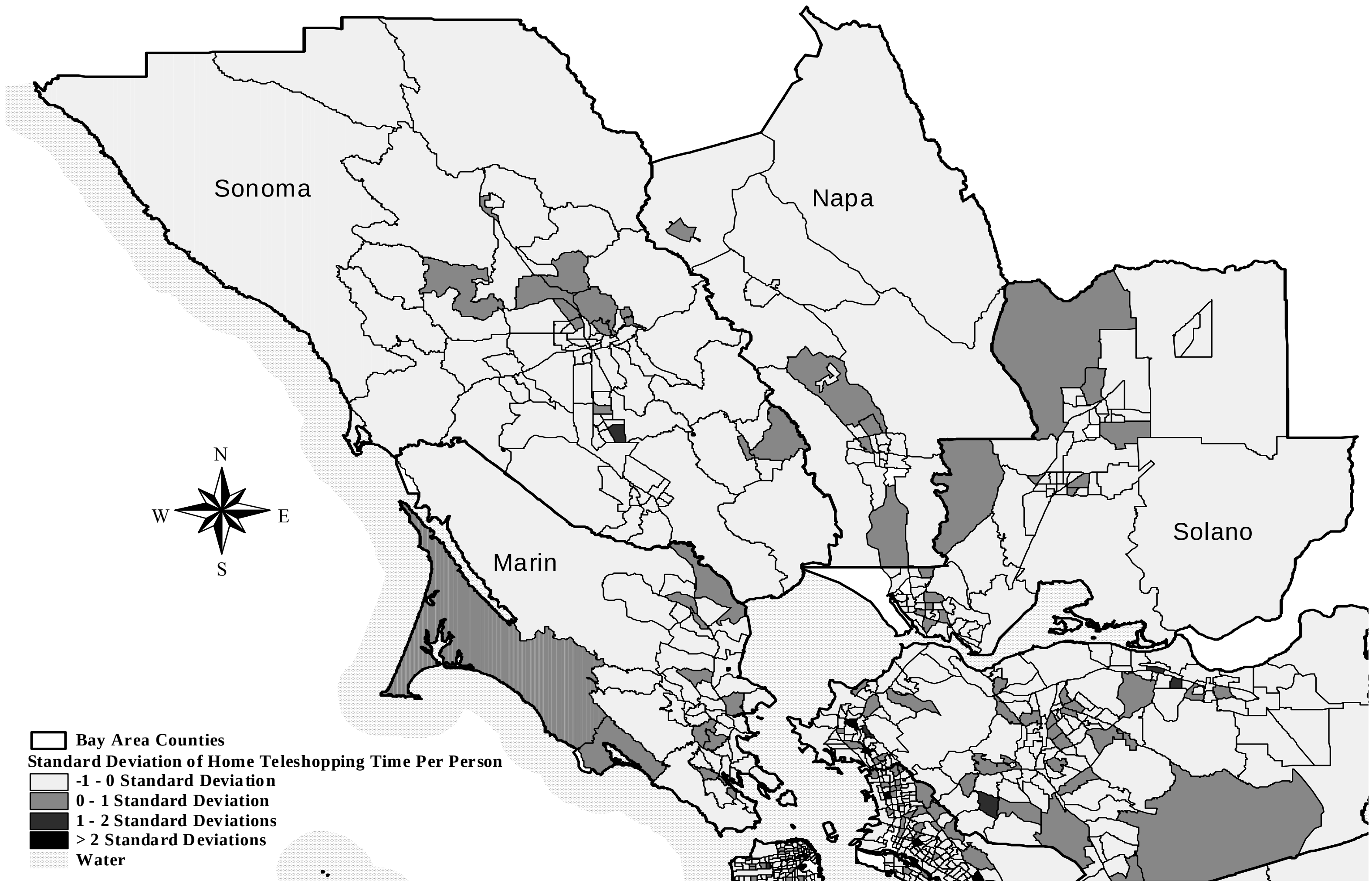


FIGURE 5: HOME TELESHOPPING MINUTES (TWO-DAY) PER SURVEY PERSON—CENTRAL BAY AREA

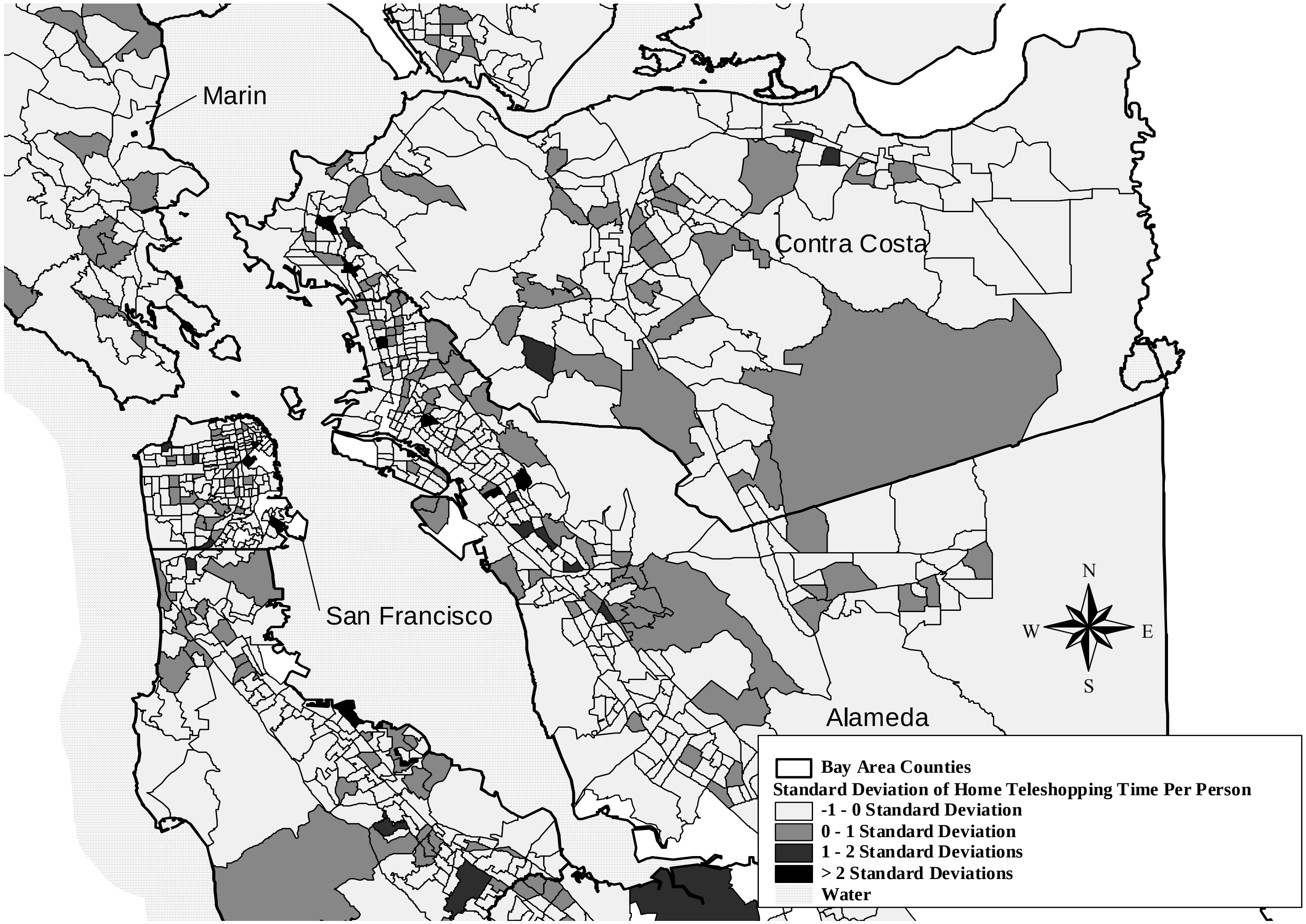
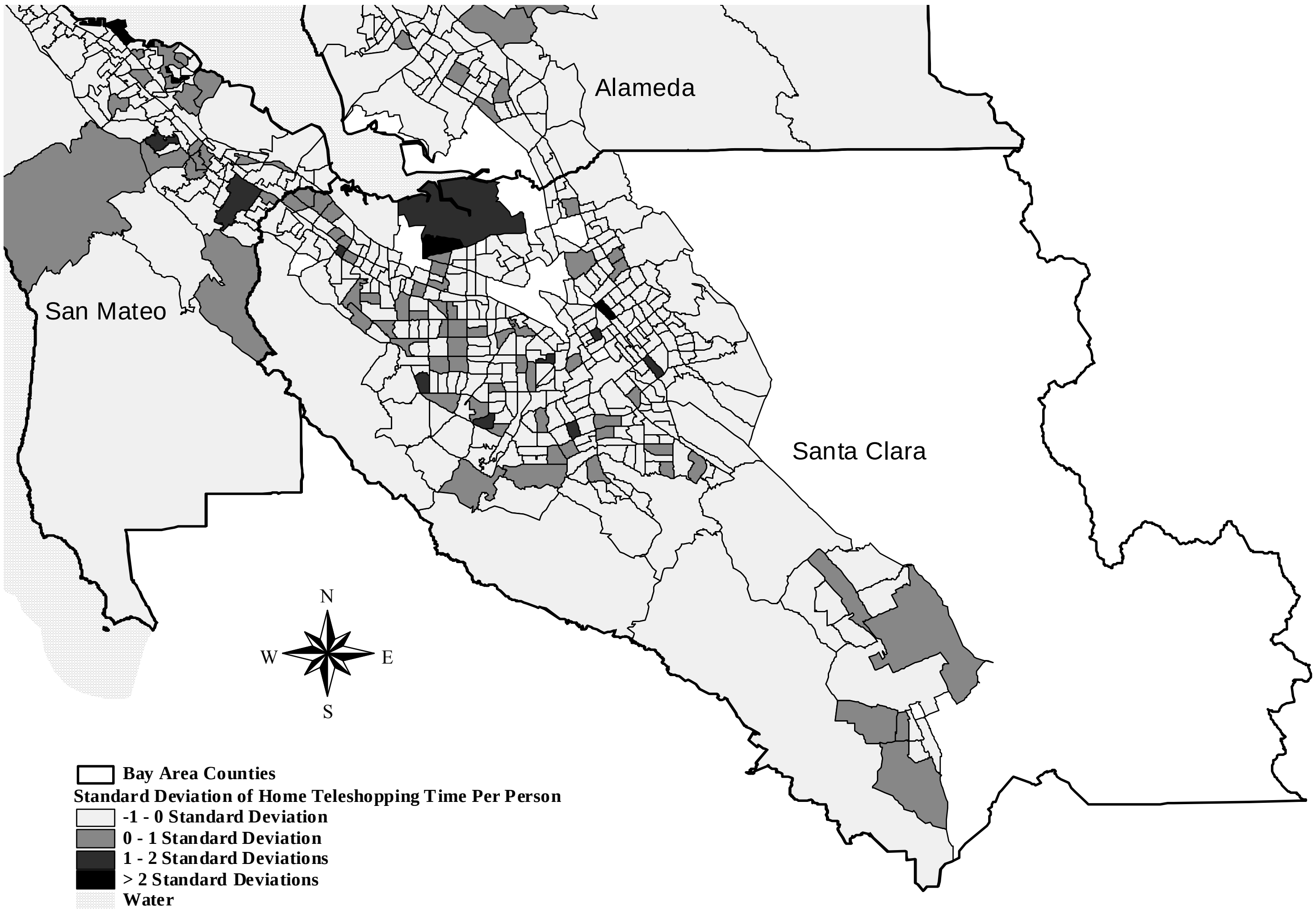


FIGURE 6: HOME TELESHOPPING MINUTES (TWO-DAY) PER SURVEY PERSON—SOUTHERN BAY AREA



MODEL ESTIMATION AND RESULTS

Tables 15, 16 and 17 provide the total, direct, and indirect effects between the variables included in the SEM model as well as their significance levels. Variable names can be interpreted by referring to Tables 5 and 6. The direct effect between variables is the influence (one-way) that one variable has on another. The indirect effect is the influence one variable has on another in combination with a third, or intervening, variable or set of variables. The total effects of one variable on another are the combined effects of the direct and indirect effects. The tables provide the estimated parameters for each of the modeled variable relationships. Each parameter represents the number of units (e.g., minutes, miles, etc.) above (positive relationship) or below (negative relationship) the sampled average values of the resulting variable that occurs from a one-unit increase in the causal variable. These are all two-day values based on the BATS 2000 data sample[4] used for this analysis.

Due to the large number of statistical results that are displayed in these tables and the difficulties that may be encountered when searching for the meaning of variable names, additional, summary tables have been provided to direct the reader's attention to specific findings as they are discussed sequentially in the text of the following discussion. When a model result is referenced, a table reference and a result number accompany it (e.g.; Table 18, Result 2).

As described above, a group of measures of SEM model fit have been used. Critical values for each measure that indicate a good or lack of good model fit are detailed above as well (see the "Assessing Model Goodness of Fit" section). In terms of the $\chi 2$ statistic, the model appears to fit well with a value of 89.29, 91 degrees of freedom and was insignificant at p=0.531. Additional goodness of fit measures, such as the $\chi 2$/df measure which was below the critical threshold of three at 0.981, while the Bentler-Bonett Normed Fit Index (NFI) (0.999), and the Benteler Comparative Fit Index (CFI) (1.0) both had values greater than 0.90 and therefore indicate a good model fit. The Root Mean Square Error of Approximation (RMSEA) scored a 0.0, well below the critical 0.05 level considered to reflect a good model fit. Overall, these results indicate that the model statistically "fits" the dataset and provides reliable estimates of interrelationships between the variables included.

Exogenous Variable Effects

While many of the exogenous variables included in the model were intended to act as control variables, three in particular – the two time-starved factor variables (as developed using factor analysis) and the retail employee accessibility measure – are of particular analytical interest. Unless otherwise noted, the following discussion of results refers to "Total" effects, as opposed to "Direct" or "Indirect" effects.

[4] SEM model runs were limited to using only persons over 16 years of age to limit any effects of different activity patterns of pre-working age persons.

TABLE 15: HOUSEHOLD-LEVEL EXOGENOUS VARIABLE SEM RESULTS

Causal Variables			Resulting Variables											
			WIHTM	WOHTM	MIHTM	MOHTM	DIHTM	DOHTM	SHTIM	HSTIME	SHOPTT	SCHAIN	STRIP	AS_DIS
Household-Level Variables	AGE6_17HH	Total	**-10.04**	**-12.32**	**45.30**	**4.35**	**-13.64**	0.10	**0.34**	-0.38	-0.49	**0.04**	0.00	-3.57
		Direct	xxxx	**-21.43**	**37.93**	xxxx	**-7.39**	xxxx	xxxx	xxxx	**-1.57**	0.02	**-0.03**	xxxx
		Indirect	**-10.04**	**9.11**	**7.37**	**4.35**	**-6.25**	0.10	**0.34**	-0.38	**1.09**	**0.01**	**0.03**	-3.57
	ALWAYS	Total	**15.24**	**18.70**	**-11.75**	**-4.20**	**-6.97**	7.29	-0.67	**2.09**	0.07	0.01	**0.05**	16.97
		Direct	xxxx	**32.54**	xxxx	xxxx	xxxx	9.13	xxxx	**2.73**	xxxx	**0.07**	**0.04**	xxxx
		Indirect	**15.24**	**-13.83**	**-11.75**	**-4.20**	**-6.97**	-1.84	-0.67	-0.64	0.07	**-0.06**	0.01	16.97
	HHINC<35K	Total	**-29.85**	**-36.64**	-30.68	**5.74**	**19.94**	**8.22**	**2.50**	**1.25**	**1.23**	**0.02**	**0.04**	**20.31**
		Direct	xxxx	**-63.74**	**-63.19**	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx
		Indirect	**-29.85**	**27.10**	**32.51**	**5.74**	**19.94**	**8.22**	**2.50**	**1.25**	**1.23**	**0.02**	**0.04**	**20.31**
	HHINC>85K	Total	**14.60**	**-13.26**	1.41	**-0.93**	**25.75**	-1.73	-3.18	1.54	-2.08	-0.01	-0.04	**-89.86**
		Direct	**25.41**	xxxx	xxxx	xxxx	**27.82**	xxxx	-3.00	xxxx	-1.38	xxxx	xxxx	**-56.20**
		Indirect	**-10.80**	**-13.26**	1.41	**-0.93**	-2.08	-1.73	**-0.19**	1.54	**-0.70**	-0.01	-0.04	**-33.65**
	HM_TE_ACC	Total	xxxx	xxxx	**-0.06**	**0.06**	0.02	0.02	0.00	0.00	**0.00**	0.00	0.00	-0.01
		Direct	xxxx	xxxx	xxxx	**0.06**	0.03	**0.02**	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx
		Indirect	xxxx	xxxx	**-0.06**	0.00	**-0.01**	**-0.01**	0.00	0.00	**0.00**	0.00	0.00	-0.01
	HM_RE_ACC	Total	xxxx	xxxx	0.07	0.02	**-0.09**	-0.02	**0.07**	**0.05**	0.00	**0.00**	**0.00**	**-4.43**
		Direct	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	**0.08**	0.04	**-0.04**	**0.00**	0.00	**-4.97**
		Indirect	xxxx	xxxx	0.07	0.02	**-0.09**	-0.02	0.00	0.02	**0.04**	0.00	**0.00**	**0.54**
	INTERNM2	Total	**-6.87**	**-21.32**	**18.46**	**3.40**	4.59	**2.01**	0.63	**5.10**	**1.80**	**0.06**	**0.07**	**30.64**
		Direct	10.50	**-27.55**	xxxx	xxxx	10.06	xxxx	xxxx	**4.04**	xxxx	**0.11**	xxxx	xxxx
		Indirect	**-17.37**	**6.24**	**18.46**	**3.40**	**-5.47**	**2.01**	0.63	1.06	**1.80**	-0.05	**0.07**	**30.64**
	TENURE	Total	**-18.77**	**-23.04**	**57.93**	**7.47**	**-28.31**	1.65	**3.07**	-0.95	**2.20**	**0.06**	**0.11**	**77.62**
		Direct	xxxx	**-40.08**	**43.16**	xxxx	**-23.55**	xxxx	**2.20**	xxxx	xxxx	**0.09**	0.02	**28.43**
		Indirect	**-18.77**	**17.04**	**14.77**	**7.47**	**-4.76**	1.65	0.88	-0.95	**2.20**	-0.02	**0.09**	**49.19**
	UNDER6HH	Total	**-19.19**	**-23.56**	**87.50**	**-11.95**	**-33.80**	-2.27	**1.37**	-1.49	**-2.86**	-0.01	**-0.03**	**-28.38**
		Direct	xxxx	**-40.98**	**53.87**	**-20.50**	**-29.36**	**-5.63**	xxxx	0.67	**-3.30**	-0.06	-0.01	xxxx
		Indirect	**-19.19**	**17.43**	**33.63**	8.56	-4.44	**3.36**	**1.37**	**-2.16**	0.44	**0.05**	-0.02	**-28.38**

*Notes: "*xxxx*" indicates the variable was constrained to zero in the model due to its insignificance at the 90% level. Certain connections between variables were retained despite the lack of a significant finding for consistency with theory.*

Bold and Underlined *values indicate signficance at the 95% level.*

Bold *values indicate significance at the 90% level.*

TABLE 16: PERSON-LEVEL EXOGENOUS VARIABLE SEM RESULTS

	Causal Variables		Resulting Variables											
			WIHTM	WOHTM	MIHTM	MOHTM	DIHTM	DOHTM	SHTIM	HSTIME	SHOPTT	SCHAIN	STRIP	AS_DIS
Person-Level Variables	DISABLE	Total	**-34.18**	**-41.95**	**56.51**	-15.24	**38.52**	-14.01	-4.65	0.92	**-3.74**	**-0.15**	**-0.19**	**-103.00**
		Direct	xxxx	**-72.98**	xxxx	-24.33	29.65	**-20.48**	-6.91	xxxx	xxxx	**-0.26**	-0.02	xxxx
		Indirect	**-34.18**	**31.03**	**56.51**	**9.10**	**8.87**	6.48	2.26	0.92	**-3.74**	**0.11**	**-0.16**	**-103.00**
	EMPLOYED	Total	**242.30**	**394.39**	**-397.79**	**-52.96**	**-80.69**	**-33.19**	**-18.18**	**-5.61**	**-7.35**	**-0.12**	**-0.36**	**-115.68**
		Direct	**-79.02**	**614.38**	**-93.68**	**31.65**	**-44.02**	xxxx	xxxx	xxxx	xxxx	**0.06**	**-0.04**	xxxx
		Indirect	**321.33**	**-219.99**	**-304.11**	**-84.62**	**-36.67**	**-33.19**	**-18.18**	**-5.61**	**-7.35**	**-0.18**	**-0.32**	**-115.68**
	PROFESSIONALS	Total	**-6.09**	**5.53**	-5.95	**6.74**	**-16.06**	**5.12**	0.49	0.33	0.35	**0.06**	**0.05**	**21.69**
		Direct	**-10.59**	xxxx	xxxx	**6.83**	**-14.77**	**3.67**	0.48	0.77	**-1.35**	**0.09**	xxxx	xxxx
		Indirect	**4.50**	**5.53**	-5.95	-0.09	-1.29	1.45	0.01	**-0.44**	**1.70**	**-0.03**	**0.05**	**21.69**
	FEM_HHH	Total	**-13.00**	**-15.95**	**47.33**	-1.20	**-9.49**	-0.74	**5.26**	**1.60**	**4.37**	**0.11**	**0.16**	**81.90**
		Direct	xxxx	**-27.75**	**27.08**	**-7.20**	-3.47	xxxx	**4.58**	0.60	1.02	**0.16**	0.00	xxxx
		Indirect	**-13.00**	**11.80**	**20.25**	**6.00**	**-6.02**	-0.74	**0.68**	1.00	**3.34**	-0.05	**0.16**	**81.90**
	LICDRIVE	Total	**30.88**	**37.90**	**-42.35**	8.38	**-11.43**	15.66	**5.99**	1.44	**10.50**	**0.20**	**0.41**	**214.78**
		Direct	xxxx	**65.93**	xxxx	**15.98**	xxxx	**24.52**	**7.80**	xxxx	**5.51**	**0.44**	**0.13**	5.20
		Indirect	**30.88**	**-28.03**	**-42.35**	**-7.60**	**-11.43**	**-8.85**	-1.81	1.44	**4.99**	**-0.25**	**0.28**	**209.58**
	OVER64	Total	**-61.91**	**-75.98**	**118.36**	3.23	-20.27	**9.96**	**4.25**	0.83	**6.18**	**0.18**	**0.24**	**71.04**
		Direct	xxxx	**-132.19**	**44.70**	**-16.68**	**-23.51**	xxxx	xxxx	xxxx	xxxx	**0.24**	xxxx	-32.39
		Indirect	**-61.91**	**56.21**	**73.66**	**19.91**	3.23	**9.96**	**4.25**	0.83	**6.18**	-0.06	**0.24**	**103.43**
	SCHOOL	Total	**-49.72**	**-61.02**	**-60.62**	**115.69**	**-17.11**	**23.12**	**-4.71**	**-2.80**	**-3.19**	**-0.04**	**-0.15**	**-72.34**
		Direct	xxxx	**-106.16**	xxxx	**108.10**	**-24.30**	**14.73**	-5.17	xxxx	-1.61	**-0.16**	**-0.06**	xxxx
		Indirect	**-49.72**	**45.14**	**-60.62**	7.59	**7.20**	**8.39**	0.46	**-2.80**	**-1.57**	**0.12**	**-0.09**	**-72.34**

Notes: "xxxx" indicates the variable was constrained to zero in the model due to its insignificance at the 90% level. Certain connections between variables were retained despite the lack of a significant finding for consistency with theory.

Bold and Underlined *values indicate signficance at the 95% level.*

TABLE 17: ENDOGENOUS VARIABLE SEM RESULTS

Causal Variables		Resulting Variables: WIHTM	WOHTM	MIHTM	MOHTM	DIHTM	DOHTM	SHTIM	HSTIME	SHOPTT	SCHAIN	STRIP	AS_DIS
WIHTM	Total	**-0.425**	**-0.522**	-0.016	-0.010	0.010	**-0.022**	**-0.004**	0.000	**-0.008**	**0.000**	**0.000**	**-0.165**
	Direct	xxxx	**-0.908**	**-0.538**	**-0.104**	**-0.229**	**-0.163**	**-0.036**	-0.001	**-0.015**	**-0.001**	**0.000**	**0.049**
	Indirect	**-0.425**	**0.386**	**0.522**	**0.093**	**0.239**	**0.141**	**0.032**	0.000	**0.008**	**0.001**	0.000	**-0.214**
WOHTM	Total	**0.468**	**-0.425**	**-0.452**	**-0.130**	**-0.094**	**-0.071**	**-0.030**	**-0.008**	**-0.016**	**0.000**	**-0.001**	**-0.245**
	Direct	**0.815**	xxxx	**-0.545**	**-0.097**	**-0.257**	**-0.130**	**-0.032**	xxxx	**-0.008**	**0.000**	**0.000**	**0.136**
	Indirect	**-0.346**	**-0.425**	**0.093**	**-0.033**	**0.163**	**0.058**	0.002	**-0.008**	**-0.008**	0.000	**-0.001**	**-0.380**
MIHTM	Total	xxxx	xxxx	-0.058	**0.041**	**-0.221**	**-0.058**	-0.009	**-0.012**	**-0.003**	0.000	0.000	-0.075
	Direct	xxxx	xxxx	xxxx	**0.044**	**-0.238**	**-0.084**	-0.006	-0.001	**-0.005**	xxxx	**0.000**	**-0.037**
	Indirect	xxxx	xxxx	-0.058	-0.004	0.017	**0.026**	-0.003	**-0.012**	0.001	0.000	0.000	-0.038
MOHTM	Total	xxxx	xxxx	**-0.965**	**-0.050**	**-0.078**	**-0.029**	**-0.034**	**-0.003**	**-0.009**	**0.000**	**0.000**	-0.125
	Direct	xxxx	xxxx	**-1.002**	xxxx	**-0.330**	**-0.141**	**-0.040**	xxxx	**-0.015**	0.000	**0.000**	**0.079**
	Indirect	xxxx	xxxx	**0.037**	**-0.050**	**0.251**	**0.112**	0.006	**-0.003**	**0.005**	0.000	**0.000**	**-0.203**
DIHTM	Total	xxxx	xxxx	**0.076**	-0.002	**-0.101**	**-0.092**	**-0.006**	**0.061**	**-0.010**	**0.000**	**0.000**	**-0.162**
	Direct	xxxx	xxxx	xxxx	xxxx	xxxx	**-0.112**	xxxx	**0.064**	**-0.009**	0.000	xxxx	**-0.044**
	Indirect	xxxx	xxxx	**0.076**	-0.002	**-0.101**	0.019	**-0.006**	-0.004	-0.001	0.000	**0.000**	**-0.118**
DOHTM	Total	xxxx	xxxx	-0.047	0.009	0.061	-0.031	0.042	-0.038	0.000	**0.000**	0.000	0.195
	Direct	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	0.042	-0.047	**-0.007**	0.000	xxxx	xxxx
	Indirect	xxxx	xxxx	-0.047	0.009	0.061	-0.031	0.000	**0.009**	0.007	**0.000**	0.000	0.195
SHTIM	Total	xxxx	xxxx	0.128	0.205	-0.192	-0.463	xxxx	0.068	**0.122**	**0.003**	**0.008**	**5.278**
	Direct	xxxx	xxxx	0.256	0.210	xxxx	**-0.472**	xxxx	0.015	0.037	**0.009**	**0.004**	**2.131**
	Indirect	xxxx	xxxx	-0.128	-0.005	-0.192	0.009	xxxx	0.053	**0.085**	**-0.005**	**0.003**	**3.147**
HSTIME	Total	xxxx	xxxx	**1.087**	-0.013	**-1.437**	0.244	-0.020	**-0.138**	**-0.052**	-0.002	**-0.002**	**-0.994**
	Direct	xxxx	xxxx	**1.253**	-0.066	**-1.372**	0.190	-0.029	xxxx	0.008	-0.004	0.001	-0.070
	Indirect	xxxx	xxxx	-0.166	0.053	-0.065	**0.054**	0.008	**-0.138**	-0.061	0.001	-0.002	**-0.923**
SHOPTT	Total	xxxx	xxxx	-0.055	0.001	0.073	**-0.012**	0.001	-0.044	**-0.095**	**-0.003**	**0.006**	**6.632**
	Direct	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	**0.009**	**5.334**
	Indirect	xxxx	xxxx	-0.055	0.001	0.073	**-0.012**	0.001	-0.044	**-0.095**	**-0.003**	**-0.004**	**1.298**
SCHAIN	Total	xxxx	xxxx	**9.262**	-0.108	**-12.239**	**2.076**	-0.173	**7.339**	**16.033**	**-0.423**	**0.618**	**286.717**
	Direct	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	14.275	**27.619**	xxxx	**0.805**	5.863
	Indirect	xxxx	xxxx	**9.262**	-0.108	**-12.239**	**2.076**	-0.173	-6.936	**-11.585**	**-0.423**	-0.187	**280.855**
STRIP	Total	xxxx	xxxx	**-5.890**	0.069	7.783	**-1.320**	0.110	-4.667	**-10.196**	**-0.367**	**-0.393**	**138.934**
	Direct	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	**-0.636**	xxxx	**321.258**
	Indirect	xxxx	xxxx	**-5.890**	0.069	7.783	**-1.320**	0.110	-4.667	**-10.196**	**0.269**	**-0.393**	**-182.323**

Notes: "xxxx" indicates the variable was constrained to zero in the model due to its insignificance at the 90% level. Certain connections between variables were retained despite the lack of a significant finding for consistency with theory.

Bold and Underlined *values indicate signficance at the 95% level.*

Bold *values indicate significance at the 90% level.*

The Time-Starved Lifestyle

As hypothesized earlier, results from the SEM model confirm that there are at least two distinct groups of time-starved persons: female heads of household and those that live in a household with multiple professionally employed people. The model results that measure the influence of these two distinct lifestyles on activities participation in adds further support to this distinction.

Discretionary Activities Participation of Time-Starved Persons

Time-starved people are unlikely to have much discretionary (or "free") time – this is an obvious and tautological conclusion that we would expect the SEM model findings to reflect. Consistent with theory, members of the both time-starved groups reported less In-Home Discretionary time than the typical survey respondent, with people from the Professionals Household Time-Starved Group (the factor representing those time-starved persons who are between the ages of 17 and 64 and live in households with a larger than average share of people employed as "professionals") having spent roughly 16 minutes less than the typical survey respondent over the two day period and Female Head of Household Time-Starved Group members (the factor representing those time-starved persons who were listed as the head of their households and are female) spending roughly 10 minutes less than the typical survey respondent (Table 18, Results 1 and 2). While both groups have less in-home discretionary time, the fact that persons from Professionals households tended to have less of this time (roughly 16 minutes less than the typical survey respondent) than Female Head of Household members (roughly 10 minutes less than the typical survey respondent) is a distinction worthy of note. This difference suggests that, as might be expected, Professionals household members tend to focus their activities outside the home (possibly due to their focus on work-related activities), while the demands of the home mean Female Head of Household group members spend more of their limited discretionary time at home.

TABLE 18: DISCRETIONARY ACTIVITIES PARTICIPATION OF TIME-STARVED FACTOR GROUPS

Result #	Variable		Effect	Findings	
	Causal	Resulting		Amount	Unit
1	**Female Head of Household Time-Starved Factor**	**In-Home Discretionary Time**	Total Direct Indirect	-9.49 -- -6.02	Minutes -- Minutes
2	**Professionals Household Time-Starved Factor**	**In-Home Discretionary Time**	Total Direct Indirect	-16.06 -14.77 --	Minutes Minutes --
3	**Professionals Household Time-Starved Factor**	**Out-Of-Home Discretionary Time**	Total Direct Indirect	5.12 3.67 --	Minutes Minutes --

Notes: "Professionals" and "Female Head of Household" variables are "dummy" variables where a value of "1" means the survey participant has been classfied through factor analysis as a member of the "Professionals" or "Female Head of Household" time-starved households and "0" means the paricipant is not.
"--" indicates that the model did not find a statistically significant relationship a the p = 0.10 level or better.

Findings for the amount of time spent by both time-starved groups in out-of-home discretionary time lend further support to this distinction. While there were no significant findings for the amount of time female heads of households spend on discretionary activities outside the home, the sign of the relationship was negative suggesting that they may have less out-of-home discretionary time than the typical survey respondent.

Interestingly, Professionals group members have more out-of-home discretionary time than the average survey participant (Table 18, Result 3). Overall, survey respondents in the Professionals group had roughly five more minutes of discretionary time outside the home than the average survey participant. This suggests that survey participants in the Professionals group are substituting out-of-home for in-home discretionary time and in general have roughly 11 fewer minutes over a two day period for discretionary activities (both in-home and out-of-home[5]) than the typical survey respondent while Female Head of Household group members have 10 total minutes less than average of both (Table 18, Result 1).[6]

These findings may reflect the different societal pressures at work on members of each of these time-starved groups. Since professional employees presumably have high demands placed on them to work long hours at office locations that are usually outside the home, they are more likely to spend what discretionary time they have in activities outside the home as well. Similarly, since females are still expected to carry a larger share of household duties in our society and since heads of households presumably carry the weight of decision-making and "breadwinner" responsibilities for the home, female heads of household are doubly burdened. Since many of these responsibilities center on the household itself, it stands to reason that the locus of discretionary activities for this group would be centered in the household as well.

Work Activities Participation of Time-Starved Persons

SEM model results also reveal that persons from Professionals households tend to work (as wage earners) outside the home six minutes more than average (Table 19, Result 1),

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[5] Calculated by adding Table 18, Result 2 and Table 18, Result 3 (-16 + 5 = -11).

[6] While these combined findings are not directly produced by the model, and therefore, was not statistically tested for significance, they add incremental support for the distinction between the two time-starved groups.

while working from home six minutes less (Table 19, Result 2). These results add further weight to the hypothesis that Professionals group members focus their work and other activities outside the home. However, the notion that they are time-starved because they are overwhelmed with work is placed somewhat in doubt by these findings. When the results from these two Professionals/work variables are combined we find that on average, people in the Professionals group work (both in and outside the home[7]) roughly the same amount as the average survey respondent. But if this group is not time-starved due to overwork, then what is the cause? Other results from the model suggest answers to this question and are addressed in the discussion the of maintenance activities participation patterns of time-starved group members.

Female heads of household tend to work (as wage earners) less than the typical survey respondent, both outside the home where they spend 16 minutes less than the typical survey respondent (Table 19, Result 3) and in it where they spend 13 minutes less than average (Table 19, Result 4). Therefore, as found for the Professionals group, work does not appear to be the primary cause of Female Head of Household group members' time-starvation. Examination of the maintenance activities participation of both factor groups provides a possible explanation.

[7] Calculated by adding Table 19, Results 1 and 2 (-6 + 6 = 0).

TABLE 19: WORK ACTIVITIES PARTICIPATION OF TIME-STARVED FACTOR GROUPS

Result #	Variable		Effect	Findings	
	Causal	Resulting		Amount	Unit
1	Professionals Household Time-Starved Factor	Out-Of-Home Work Time	Total Direct Indirect	5.53 -- 5.53	Minutes -- Minutes
2	Professionals Household Time-Starved Factor	In-Home Work Time	Total Direct Indirect	-6.09 -10.59 4.50	Minutes Minutes Minutes
3	Female Head of Household Time-Starved Factor	Out-Of-Home Work Time	Total Direct Indirect	-15.95 -27.75 11.80	Minutes Minutes Minutes
4	Female Head of Household Time-Starved Factor	In-Home Work Time	Total Direct Indirect	-13.00 -- -13.00	Minutes -- Minutes

Notes: "Professionals" and "Female Head of Household" variables are "dummy" variables where a value of "1" means the survey participant has been classfied through factor analysis as a member of the "Professionals" or "Female Head of Household" time-starved households and "0" means the paricipant is not.
"--" indicates that the model did not find a statistically significant relationship a the p = 0.10 level or better.

Maintenance Activities Participation of Time-Starved Persons

Presumably, time-starved female heads of households are so over-loaded with their household maintenance activities they have less time to work as wage earners. This is borne out by the findings for the maintenance time variable results where Female Head of Household persons worked roughly 47 minutes more per day than the average participant on In-Home Maintenance activities (Table 20, Result 1). Compared to the other activities participation findings discussed so far, this is a large difference, suggesting that the daily schedules of Female Head of Household group members are dominated by their In-Home Maintenance activities.

While persons who were identified as part of the Professionals group did not differ statistically from the average survey respondent in their amount of reported In-Home Maintenance activity participation (Table 20, Result 2), model results indicate that Professionals group members tend to spend roughly seven minutes more than the average survey respondent on Out-Of-Home Maintenance activities (Table 20, Result 3). This suggests that Professionals group members are time-starved, at least in part, due to their increased Out-Of-Home Maintenance duties.

TABLE 20: MAINTENANCE ACTIVITIES PARTICIPATION OF TIME-STARVED FACTOR GROUPS

Result #	Variable		Effect	Findings	
	Causal	Resulting		Amount	Unit
1	**Female Head of Household Time-Starved Factor**	**In-Home Maintenance Time**	Total Direct Indirect	47.33 27.08 20.25	Minutes Minutes Minutes
2	**Professionals Household Time-Starved Factor**	**In-Home Maintenance Time**	Total Direct Indirect	-- -- --	-- -- --
3	**Professionals Household Time-Starved Factor**	**Out-Of-Home Maintenance Time**	Total Direct Indirect	6.74 6.83 --	Minutes Minutes --

Notes: "Professionals" and "Female Head of Household" variables are "dummy" variables where a value of "1" means the survey participant has been classfied through factor analysis as a member of the "Professionals" or "Female Head of Household" time-starved households and "0" means the paricipant is not.
"--" indicates that the model did not find a statistically significant relationship a the p = 0.10 level or better.

Shopping Activities Participation of Time-Starved Persons

Based on these results, it appears that in general, Professionals group members are primarily focused on activities outside the home and Female Head of Household persons are overwhelmed with in-home activities. These findings are useful when interpreting the Home Teleshopping and Out-Of-Home Shopping results for these time-starved groups. Results for these relationships indicate that Female Head of Household persons teleshop from home (roughly 1.6 minutes, see Table 21, Result 1) and outside the home (roughly five minutes, see Table 21, Result 2) significantly more than the average survey respondent. These findings are consistent with the notion that women are primarily tasked with running and maintaining the functions of the home, of which shopping is a major component. The home teleshopping results indicate that they may be using this mode as a means to reduce the time burdens of shop travel.

TABLE 21: SHOPPING ACTIVITIES PARTICIPATION OF TIME-STARVED FACTOR GROUPS

Result #	Variable		Effect	Findings	
	Causal	Resulting		Amount	Unit
1	**Female Head of Household Time-Starved Factor**	**Home Teleshopping Time**	Total	1.60	Minutes
			Direct	--	--
			Indirect	--	--
2	**Female Head of Household Time-Starved Factor**	**Out-Of-Home Shopping Time**	Total	5.26	Minutes
			Direct	4.58	Minutes
			Indirect	0.68	Minutes
3	**Professionals Household Time-Starved Factor**	**Out-Of-Home Shopping Time**	Total	--	--
			Direct	--	--
			Indirect	--	--
4	**Professionals Household Time-Starved Factor**	**Home Teleshopping Time**	Total	--	--
			Direct	--	--
			Indirect	-0.44	Minutes

Notes: "Professionals" and "Female Head of Household" variables are "dummy" variables where a value of "1" means the survey participant has been classfied through factor analysis as a member of the "Professionals" or "Female Head of Household" time-starved households and "0" means the paricipant is not.
"--" indicates that the model did not find a statistically significant relationship a the p = 0.10 level or better.

On the other hand, Professionals group members seem to be primarily tasked with maintenance tasks outside the home (see Table 20, Result 3) and the amount of time they spend on shopping activities does not significantly differ from the typical survey participant (Table 20, Results 3 and 4)[8]. These findings suggest that time-starved female heads of household may be attracted to home teleshopping since they are spending more time in the home than time-starved persons from the Professionals group and survey respondents in general, and since they are tasked with shopping duties to a greater degree as well.

Shopping Travel Behavior of Time-Starved Persons

Since activities participation results for our two time-starved groups indicate that Female Head of Household group members spend more time shopping outside (as well as from) the home than the average survey respondent and people from the Professionals time-starved group, we would expect that shopping travel variables would mirror these findings. Specifically, we would expect Female Head of Household group members to make more shop trips, shop trip chains, spend more time on shop trip travel, and travel further distances for those trips than the Professionals group members and the other survey participants. In fact, these hypotheses are supported by model results which show that while the total shop trip travel time is roughly the same for the Professionals group members and the survey respondent population as a whole (see Table 22, Result 1)[9] Female Head of Household group members had roughly four minutes more shopping travel time every two days than the typical survey respondent (Table 22, Result 2). Therefore, Female Head of Household group members spend more time shopping outside the home and traveling for shopping purposes.

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[8] This is with the exception of an indirect, significant result for home teleshopping, which Professionals group members appear to do roughly one-half of a minute less than the average survey participant.

[9] The direct and indirect effects are both significant, but with opposite signs, so they cancel each other out.

TABLE 22: SHOPPING TRAVEL BEHAVIOR OF TIME-STARVED FACTOR GROUPS

Result #	Variable		Effect	Findings	
	Causal	Resulting		Amount	Unit
1	**Professionals Household Time-Starved Factor**	**Shop Travel Time**	Total	--	--
			Direct	-1.35	Minutes
			Indirect	1.70	Minutes
2	**Female Head of Household Time-Starved Factor**	**Shop Travel Time**	Total	4.37	Minutes
			Direct	--	--
			Indirect	3.34	Minutes
3	**Professionals Household Time-Starved Factor**	**Shop Trip Chains**	Total	0.06	Trip Chains
			Direct	0.09	Trip Chains
			Indirect	-0.03	Trip Chains
4	**Female Head of Household Time-Starved Factor**	**Shop Trip Chains**	Total	0.11	Trip Chains
			Direct	0.16	Trip Chains
			Indirect	--	--
5	**Professionals Household Time-Starved Factor**	**Shop Trips**	Total	0.05	Shop Trips
			Direct	--	--
			Indirect	0.05	Shop Trips
6	**Female Head of Household Time-Starved Factor**	**Shop Trips**	Total	0.16	Shop Trips
			Direct	--	--
			Indirect	0.16	Shop Trips
7	**Professionals Household Time-Starved Factor**	**Shop Trips Distance**	Total	0.22	Miles
			Direct	--	--
			Indirect	0.22	Miles
8	**Female Head of Household Time-Starved Factor**	**Shop Trips Distance**	Total	0.82	Miles
			Direct	--	--
			Indirect	0.82	Miles

Notes: "Professionals" and "Female Head of Household" variables are "dummy" variables where a value of "1" means the survey participant has been classfied through factor analysis as a member of the "Professionals" or "Female Head of Household" time-starved households and "0" means the paricipant is not.
"--" indicates that the model did not find a statistically significant relationship a the p = 0.10 level or better.

Other shop travel variable results support these conclusions. Female Head of Household group members were found to make more shop trip chains (Table 22, Result 4), more shop trips (Table 22, Result 6), and travel further for those shop trips (Table 22, Result 8) than the typical survey respondent. Interestingly, for all but one of these results, the effects are indirect as well as total, suggesting that the significant total effects are largely due to the strength of the indirect effects. Of all the measured relationships between the

Female Head of Household variable and the shop travel variables, the only significant, direct relationship found was for the number of shop trip chains. In other words, taken as a group, the model's significant findings for these variables suggests that Female Head of Household group members spend more time shopping than other survey participants (see Table 21, Result 2) and to minimize the amount of time required to accomplish this task due to their time-starved lifestyle, they embed this additional shopping activity time within existing trip chains, thereby increasing their total number of shopping trip chains (Table 22, Result 4). The other trip variables – shop trips and shop trip distance – are higher for this time-starved group as a result of these increased shop time and shop trip chain variables.

Professionals group members reported similar trip-making behavior. Like their Female Head of Household fellow time-starvation sufferers, they made more shop trip chains (Table 22, Result 3), more shop trips (Table 22, Result 5), and traveled further for those shop trips (Table 22, Result 7) than the typical survey respondent. Also similar to the Female Head of Household group members, in all but one of these results, the strength of the total effects result appears to owe its significance to the strength of the indirect effects. The only significant, direct relationship found between the Professionals group classification and the shop travel variables was for the number of shop trip chains. However, while the other trip variables – Shop Trips and Shop Trip Distance – are significantly higher for Professionals just as they were for the Female Head of Household group, unlike Female Head of Household group members, Professionals group members do not spend more time shopping than other survey participants (Table 21, Result 3). It would appear that higher than average shopping duties (as represented by time spent shopping) are not causing Professionals to travel for shop purposes more and further, but perhaps is caused by the type of shopping they do and where they have to travel to do it. Confirmation of this deduction will require further study using a dataset that distinguishes between different shopping purposes with the associated trip information.

Retail Accessibility, Shopping and Teleshopping Behavior

There were a number of significant findings for the influence of retail employment accessibility variable on the collection of key endogenous variables. While the accessibility values are not easily interpretable (since their calculated values are only meaningful in relative terms and do not represent any concrete value of accessibility in and of themselves), the signs of the variable coefficients and their significance test results provide a number of insights into shopping and teleshopping behavior.

The model results indicate that people who live near retail opportunities generally spend more time shopping outside the home (Table 23, Result 1). This suggests that the more opportunities people have to shop, the more likely they are to shop. An alternate interpretation is that people who like or need to shop more than average choose to live in areas with high levels of retail accessibility.

The SEM model produced a similar finding for home teleshopping. Households with high levels of retail accessibility also home teleshop more than the average survey respondent (Table 23, Result 2), lending support to the hypothesis that people who live near shopping opportunities are more likely to shop, either because shopping opportunities encourage them to shop more (from home as well as out of the home) or because they like or need to shop more and choose to live near concentrations of retail opportunities.

TABLE 23: EXOGENOUS (ACCESSIBILITY) VARIABLE RESULTS

Result #	Variable		Effect	Findings	
	Causal	Resulting		Amount	Unit
1	**Home Retail Accessibility**	**Shop Travel Time**	Total Direct Indirect	0.07 0.08 --	Minutes Minutes --
2	**Home Retail Accessibility**	**Home Teleshopping Time**	Total Direct Indirect	0.05 -- --	Minutes -- --
3	**Home Retail Accessibility**	**Shop Trips**	Total Direct Indirect	0.001 -- --	Shop Trips -- --
4	**Home Retail Accessibility**	**Shop Trip Chains**	Total Direct Indirect	0.001 0.002 --	Trip Chains Trip Chains --
5	**Home Retail Accessibility**	**Shop Trips Distance**	Total Direct Indirect	-0.044 -0.050 0.005	Miles Miles Miles

Notes: "Home Retail Accessibility" is the variable that measures the accessibility of each BATS 2000 household residence to retail opportunities relative to the impedance coefficient value of -0.206 used in the gravity-based model of accessibility. Calculated accessibility values were then divided by 1000 since the SEM model application produced errors when those values calculated direct from the gravity model were used.
"--" indicates that the model did not find a statistically significant relationship a the p = 0.10 level or better.

Survey respondents living in high retail accessibility locations also tend to take more shopping trips (Table 23, Result 3), make more shopping trip chains (Table 23, Result 4), but generally travel shorter total distances for shopping (Table 23, Result 5) than the average survey participant.

These results suggest that people living in high retail accessibility neighborhoods are able to travel shorter distances for shopping purposes by chaining more of these shopping trips together than the typical survey respondent and are consistent with the findings of a previous study done by this author that found that high accessibility households tend to make more shop chained trips and travel shorter distances for shop trips (Ferrell 2004).

Endogenous Variable Effects

The endogenous variable results from the SEM model provide insights into the detailed trade-offs that people make between different activities in their daily lives (including home teleshopping and out-of-home shopping) and their travel behaviors. The effects of time-use variables included in the model on home teleshopping, home teleshopping on time-use, and home teleshopping on shopping travel are reported below.

Time-Use Variable Effects on Home Teleshopping

In general, findings for the effects of endogenous variables on home teleshopping indicate that the more time a person spends on work or maintenance activities, the less time they spend home teleshopping, and the more time they spend on discretionary activities the more home teleshopping s/he will do. For every 100 minutes of time spent on Out-Of-Home Work activities (over the two-day survey period), BATS survey participants reported spending roughly one less minute Home Teleshopping Time (Table 24, Result 1). While statistically significant, the relatively small size of this effect suggests that the causal link from Out-Of-Home Work on Home Teleshopping Time is weak.

A number of statistically significant but weak causal links were found for several other time-use variables on Home Teleshopping Time. For every 100 minutes of In-Home Maintenance activity time, survey respondents reported spending roughly one minute less than the typical survey respondent on Home Teleshopping (Table 24, Result 2), for every 100 minutes spent on Out-Of-Home Maintenance activities, survey respondents spent roughly 18 seconds fewer than the typical survey respondent on Home Teleshopping (Table 24, Result 3), and for every 100 minutes spent on discretionary activities outside the home, survey respondents spent an additional one minute teleshopping from home (Table 24, Result 5). A more notable result was the finding that for every 100 minutes spent at home on discretionary activities, survey respondents spent roughly six minutes more minutes teleshopping from home (Table 24, Result 4).

One possible interpretation of these results is that home teleshopping is not an activity that is typically undertaken by people with high levels of maintenance and work responsibilities – two findings that would seem to perfectly describe our definition of a time-starved person yet seems to contradict our earlier findings that suggested that time-starved people are more likely to home teleshop. This apparent contradiction is explained by the inclusion of the two time-starved variables in the SEM model structure. These "dummy" variables effectively control for the effects of the time-starved lifestyle on home teleshopping. That being the case, the three results for Out-Of-Home Work, In-Home and Out-Of-Home Maintenance activities on Home Teleshopping are actually measuring the effects of increased work and maintenance activities on Home Teleshopping for people who are otherwise not time-starved.

TABLE 24: ENDOGENOUS VARIABLE EFFECTS ON HOME TELESHOPPING

Result #	Causal Variable			Resulting Variable	Effect	Findings	
	Name	Amount	Unit			Amount	Unit
1	**Out-Of-Home Work Time**	100 xxxx 100	Minutes xxxx Minutes	**Home Teleshopping Time**	Total Direct Indirect	-0.800 xxxx -0.800	Minutes xxxx Minutes
2	**In-Home Maintenance Time**	100 -- 100	Minutes -- Minutes	**Home Teleshopping Time**	Total Direct Indirect	-1.200 -- -1.200	Minutes -- Minutes
3	**Out-Of-Home Maintenance Time**	100 xxxx 100	Minutes xxxx Minutes	**Home Teleshopping Time**	Total Direct Indirect	-0.300 xxxx -0.300	Minutes xxxx Minutes
4	**In-Home Discretionary Time**	100 100 --	Minutes Minutes --	**Home Teleshopping Time**	Total Direct Indirect	6.100 6.400 --	Minutes Minutes --
5	**Out-Of-Home Discretionary Time**	-- -- 100	-- -- Minutes	**Home Teleshopping Time**	Total Direct Indirect	-- -- 0.900	-- -- Minutes
6	**Home Teleshopping Time**	100 -- 100	Minutes -- Minutes	**Home Teleshopping Time**	Total Direct Indirect	-13.800 xxxx -13.800	Minutes xxxx Minutes
7	**Shop Trip Chains**	1 -- --	Shop Chain -- --	**Home Teleshopping Time**	Total Direct Indirect	7.339 -- --	Minutes -- --

Notes: "--" indicates that the model did not find a statistically significant relationship a the p = 0.10 level or better. "xxxx" indicates the variable was constrianed to zero in the model due to its insignficance at the 90% confidence level.

An analysis of the direct and indirect relationships between these statistically significant findings adds further support to these interpretations. Of the five significant findings listed above – the effects of Out-Of-Home Work, In-Home and Out-Of-Home Maintenance and In-Home and Out-Of-Home Discretionary activities participation on home teleshopping – and of all the endogenous variable effects on Home Teleshopping Time, the only statistically significant, direct finding was for In-Home Discretionary

Time on Home Teleshopping Time. The other four effects listed above (and the other endogenous effects described below) were indirect and not coincidentally, had very weak causal effects. The relationships between these variables and their effects on home teleshopping time are graphically represented in a path diagram using standardized regression weights in Figure 7.[10]

Therefore, it appears that In-Home Discretionary Time is the key variable that determines home teleshopping activity participation. Figure 7 also shows that for all but the effects of In-Home Discretionary Time on Home Teleshopping Time, the significant effects of all variables on In-Home Discretionary Time are negative in sign. In other words, any increases in Out-of-Home Work, In-Home and Out-of-Home Maintenance and Out-of-Home Discretionary Time will reduce the amount of time spent on In-Home Discretionary Time and on Home Teleshopping Time as a consequence. In essence, people appear to take time from these other four activity time categories in order to make time for In-Home Discretionary Time and Home Teleshopping Time.

Therefore, it would seem that home teleshopping attracts people who have discretionary time on their hands who are (slightly) less encumbered by work or maintenance responsibilities. Taken a step further, these results suggest that home teleshopping is more closely associated with and therefore, more likely is a discretionary (an optional or entertainment) activity than a maintenance or work (necessary) activity for the typical survey respondent.

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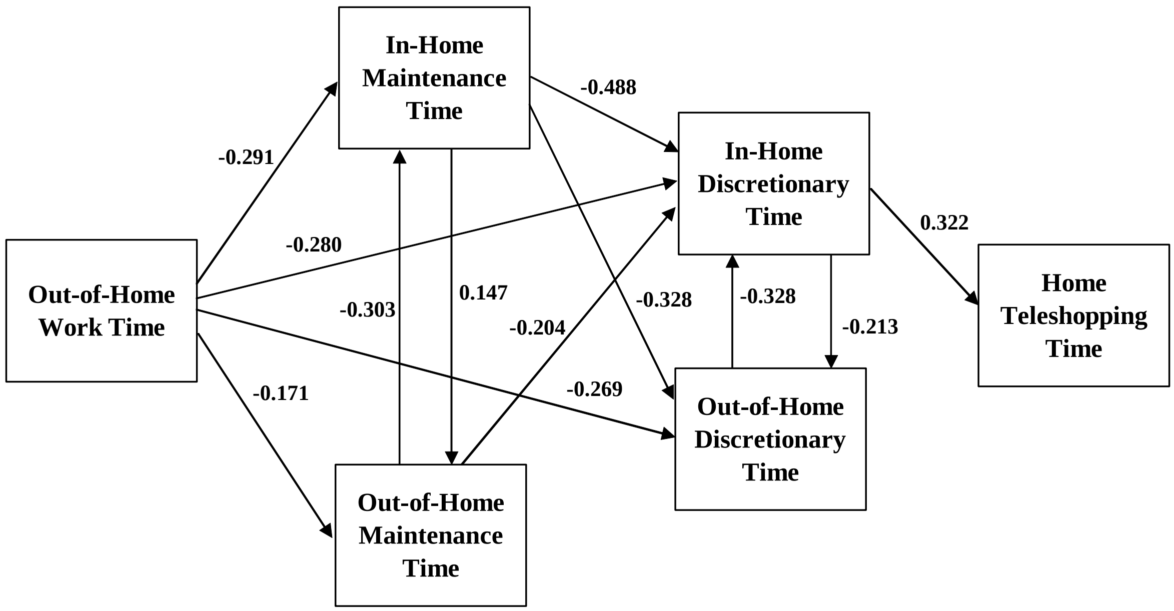
[10] Only model results that were "direct" and statistically significant at the $p < 0.10$ level are included in the path diagrams.

FIGURE 7: PATH DIAGRAM FOR VARIABLES INFLUENCING HOME TELESHOPPING TIME USING STANDARDIZED REGRESSION WEIGHTS



Home Teleshopping Variable Effects on Time-Use

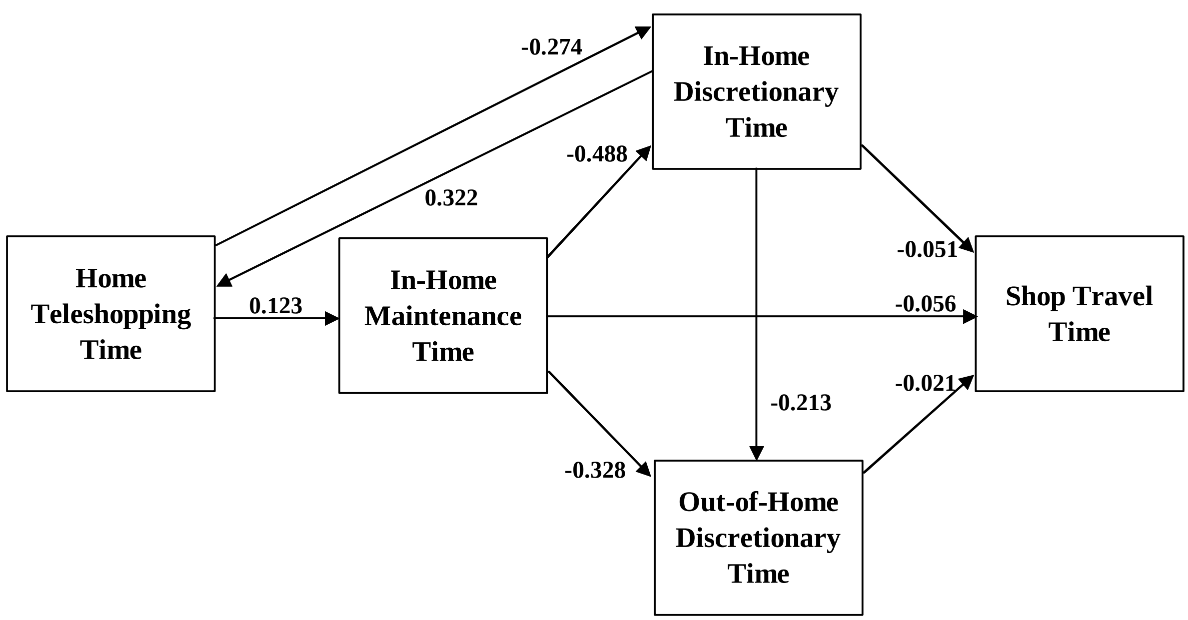
In general, home teleshoppers appear to get the time to perform this activity by reducing In-Home Discretionary Time – i.e., Home Teleshopping Time substitutes for other In-Home Discretionary activities – while it increases the time available for In-Home Maintenance Time. For every 100 minutes spent home teleshopping, survey respondents increased their In-Home Maintenance Time by roughly 109 minutes (Table 25, Result 1) and reduced their In-Home Discretionary time by roughly 144 minutes (Table 25, Result 2). Compared with the somewhat weak causal relationships found for the endogenous time-use variables on Home Teleshopping Time, the effects of Home Teleshopping Time on time use variables, though less numerous, have considerable causal potency.

TABLE 25: HOME SHOPPING EFFECTS ON TIME-USE ENDOGENOUS VARIABLES

Result #	Causal Variable			Resulting Variable	Effect	Findings	
	Name	Amount	Unit			Amount	Unit
1	**Home Teleshopping Time**	100	Minutes	**In-Home Maintenance Time**	Total	108.700	Minutes
		100	Minutes		Direct	125.300	Minutes
		--	--		Indirect	--	--
2	**Home Teleshopping Time**	100	Minutes	**In-Home Discretionary Time**	Total	-143.700	Minutes
		100	Minutes		Direct	-137.200	Minutes
		--	--		Indirect	--	--
3	**Home Teleshopping Time**	100	Minutes	**Out-Of-Home Discretionary Time**	Total	--	--
		100	Minutes		Direct	--	--
		--	--		Indirect	5.400	Minutes

Notes: "--" indicates that the model did not find a statistically significant relationship a the p = 0.10 level or better. "xxxx" indicates the variable was constrianed to zero in the model due to its insignficance at the 90% confidence level.

FIGURE 8: PATH DIAGRAM FOR HOME TELESHOPPING'S INFLUENCE ON ACTIVITY TIMES USING STANDARDIZED REGRESSION WEIGHTS



As we might expect, home teleshopping largely affects other activities done at home. Model results displayed in Figure 8 show that the only significant, direct causal effects of Home Teleshopping Time on other variables are on the two in-home time use variables –

In-Home Maintenance and In-Home Discretionary Time – suggesting that home teleshoppers engage in fewer In-Home Discretionary activities and more In-Home Maintenance activities than the typical survey respondent. In particular, it appears that home teleshoppers find time to engage in home teleshopping and In-Home Maintenance activities by, in part, reducing their In-Home Discretionary Time.

Home Teleshopping also has an indirect effect on Out-Of-Home Discretionary activities (see Table 25, Result #3). The more Home Teleshopping a person does the less Out-Of-Home Discretionary activities s/he will do. This indirect effect seems to be largely influenced via the direct effects of Home Teleshopping on In-Home Maintenance and In-Home Discretionary activities (see Figure 8). Since the indirect effect of Home Teleshopping Time on Out-Of-Home Discretionary Time is negative, it appears that Home Teleshoppers also make time for Home Teleshopping and In-Home Maintenance activities by reducing Out-Of-Home Discretionary time.

The model also reported a significant, total effect for Home Teleshopping on Shop Travel Time, even though the direct and indirect effects of this interaction were statistically insignificant (see Table 26, Result #2). Since the total effect is negative and the direct effect is positive and smaller in magnitude than the negative indirect effects, it appears that the main contributions to this significant, total effect are indirect. Though their causal strength is relatively weak (as suggested by their low standardized regression weights as shown in Figure 8), these indirect effects are likely mediated through the significant, direct effects of the In-Home Maintenance, In-Home Discretionary, and Out-of-Home Discretionary time variables.

Home Teleshopping Variable Effects on Shopping Travel

There is evidence from the SEM model that home teleshoppers also use this activity as a means to save time and effort on (i.e., as a substitute for) shopping travel. For every 100 minutes spent home teleshopping, survey participants saved roughly five minutes of shopping travel time (Table 26, Result 1) as well as nearly one mile[11] in shopping travel (Table 26, Result 2). For every 100 minutes spent home teleshopping over the two-day survey period, BATS participants avoided taking 2/10th of a shopping trip (Table 26, Result 3). There were no significant findings for the effects of home teleshopping on trip chaining or on out-of-home shopping time.

While these results suggest that there is a small substitution effect of home teleshopping for Out-Of-Home Shop Travel Time (roughly five minutes saved over two days for every 100 minutes spent home teleshopping), this does not appear to be the main impetus for people to home teleshop. Closer scrutiny of the results shown in Table 26 reveals that the total effect found for Home Teleshopping Time on Shop Travel Time, Shop Trips, and Shop Travel Distance are either indirect (as between Home Teleshopping Time and Shop Trip Distance) or are significant only for their total effects while the direct and indirect effects were insignificant (as for Home Teleshopping Time's influence on Shop Travel Time and Shop Trips). Evaluation of the estimated effects and directions of influence for

[11] Travel distances used in the MTC travel demand model are presented in 1/100th of a mile values. The values shown in Table 26 have been converted to miles.

Home Teleshopping Time on Shop Travel Time and Shop Trips (see Figure 9) further suggests that the most important contribution to the significant total effects findings is made by the indirect effects portion of the equation. Therefore, it is likely that the influence of Home Teleshopping Time on the three shop travel variables is primarily indirect.

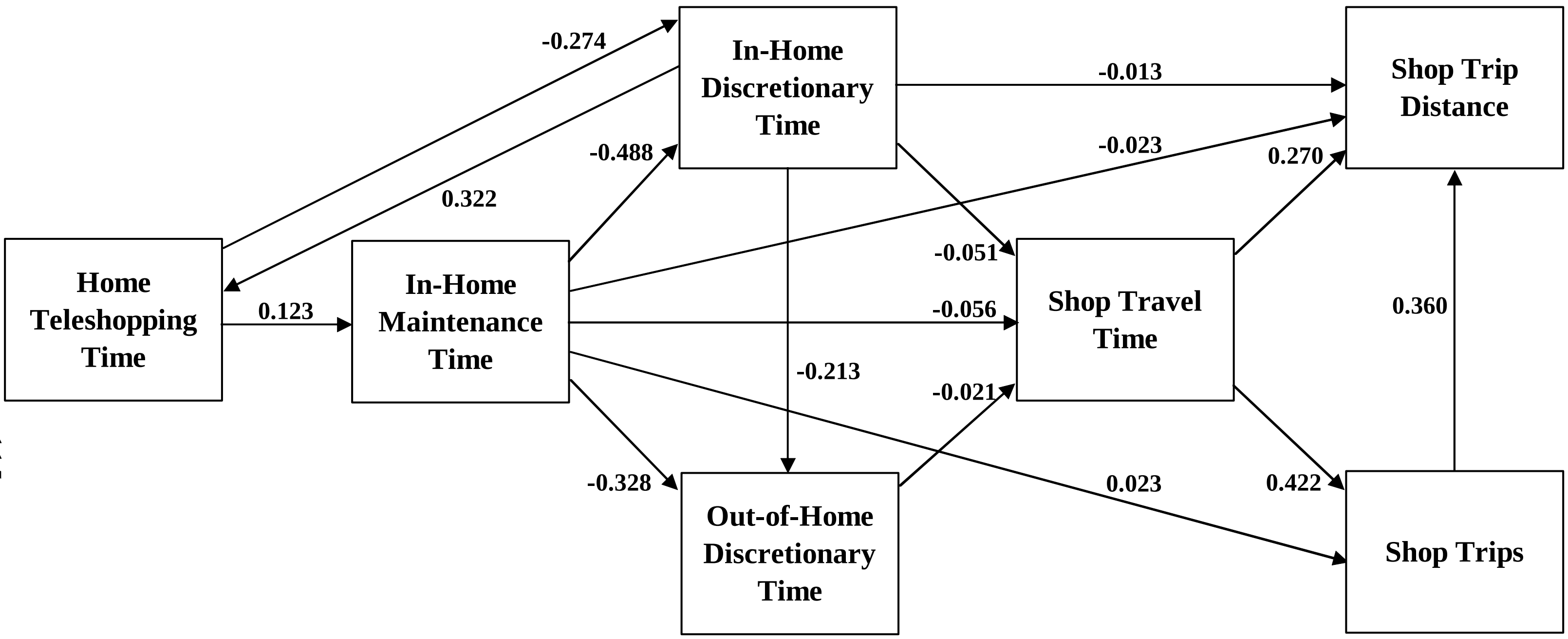
Figure 9 presents a graphical representation of the indirect effects of Home Teleshopping Time on shop travel. Inspection of this diagram reveals that the primary, significant influences of Home Teleshopping Time on the three shop travel variables are all mediated through In-Home Maintenance and Discretionary activities. These findings add further weight to the argument that people are using home teleshopping as a means to modify their in-home activities, which in turn, affect their shopping travel behavior.

TABLE 26: HOME SHOPPING EFFECTS ON SHOP TRAVEL ENDOGENOUS VARIABLES

Result #	Causal Variable			Resulting Variable	Effect	Findings	
	Name	Amount	Unit			Parameter	Unit
1	Home Teleshopping Time	100 -- --	Minutes -- --	Shop Travel Time	Total Direct Indirect	-5.200 -- --	Minutes -- --
2	Home Teleshopping Time	100 -- 100	Minutes -- Minutes	Shop Trip Distance	Total Direct Indirect	-0.994 -- -0.923	Miles -- Miles
3	Home Teleshopping Time	100 -- --	Minutes -- --	Shop Trips	Total Direct Indirect	-0.200 -- --	Shop Trips -- --

Notes: "--" indicates that the model did not find a statistically significant relationship a the p = 0.10 level or better. "xxxx" indicates the variable was constrianed to zero in the model due to its insignficance at the 90% confidence level.

FIGURE 9: PATH DIAGRAM FOR HOME TELESHOPPING'S INFLUENCE ON ACTIVITY TIMES AND SHOPPING TRAVEL BEHAVIOR USING STANDARDIZED REGRESSION WEIGHTS



While there is measurable substitution of home teleshopping substituting for out-of-home shopping travel time, these benefits are small and the strength of the causal relationships for the various time use variables (the In-Home Maintenance and Discretionary as well as Out-Of Home Discretionary Time variables) on Shop Travel Time, Shop Trip Distance, and Shop Trips are weak. Indeed, only roughly five percent of the time spent home teleshopping is recouped from the benefits of its substitution for shopping travel time – the average home teleshopper must spend 100 minutes home teleshopping to save five minutes of shopping travel time. Therefore, in general, Home Teleshopping is not serving an important substitutive role with regard to other shopping or shopping-related travel activities.

Rather, it appears that home teleshopping affects the way people schedule the timing and locations of their daily activities – specifically, increasing In-Home Maintenance and reducing In-Home Discretionary Time. There are three possible (and not necessarily mutually exclusive) interpretations of how it is acting upon these activities: 1) as a direct substitute for in-home discretionary activities – thereby implying that home teleshopping is being used as a discretionary activity itself – and as a means to free-up time from discretionary activities to allow more In-Home Maintenance activities; 2) as a means to enhance or complement In-Home Maintenance activities; and 3) as a means to organize more daily maintenance activities around the home in concert with other household members.

For most survey participants, Home Teleshopping's main function appears to be as a substitute for In-Home Discretionary activities. With regard to In-Home Discretionary Time, Home Teleshopping Time appears to be viewed as more satisfying to users as than other In-Home Discretionary activities since 100 minutes of Home Teleshopping is roughly equivalent in terms of satisfaction as roughly 144 minutes of In-Home Discretionary Time. The fact that the direct effect (and therefore, the total effects) of Home Teleshopping on In-Home Discretionary Time is statistically significant while the indirect effects are not supports this argument – in effect Home Teleshopping serves as a "direct" substitute for In-Home Discretionary Time. If this is the most important role for home teleshopping, then it also follows that home teleshopping is so effective as an In-Home Discretionary Activity (i.e., it provides more entertainment value than other forms of discretionary activity) that it creates surplus time for In-Home Maintenance activities. If true then we would expect to see a significant, indirect effect of Home Teleshopping Time on In-Home Maintenance Time and a significant, direct effect of In-Home Discretionary Time on In-Home Maintenance, which would indicate that it is the indirect effect of Home Teleshopping Time substituting directly for In-Home Discretionary Time that enables a person to engage in more In-Home Maintenance activities. However, the SEM model findings do not support this argument. Rather, they clearly state that there are strong, direct effects of Home Teleshopping Time on In-Home Maintenance and In-Home Discretionary Time and no indirect effects of Home Teleshopping Time on either of the other two.

Another possibility is that survey respondents are using home teleshopping as a means to enhance the efficiency of their In-Home Maintenance activities. Here, Home Teleshopping does not serve as a means to make time for more In-Home Maintenance activities by substituting for discretionary time, but it plays a direct, complementary role for those maintenance activities. To be precise, this hypothesis asserts that Home Teleshopping has a complementary relationship with In-Home Maintenance Time because it enhances the effectiveness and efficiency of In-Home Maintenance, enabling the home teleshopper to tackle even more In-Home Maintenance activities and in turn, changing the destinations and amount of travel for out-of-home shopping trips. Based on the information available, this hypothesis seems to be the most likely explanation for how home teleshopping is affecting In-Home Maintenance activities.

Nevertheless, the question remains as to where the Home Teleshopper gets the time needed to perform these extra In-Home Maintenance activities – if not from the freed-up, In-Home Discretionary Time variable (as we could conclude if there was an indirect effect of Home Teleshopping on In-Home Maintenance), then where? One possible explanation is that (as discussed earlier for the results shown in Table 13 and Table 14) home teleshopping allows household members reorganize their activities as a whole, with the home teleshopper given more in-the-home and home-related (such as shopping) activities, thereby freeing up time for other household members to do more activities outside the home. The Female Head of Household Time-Starved variable results provide additional support for this hypothesis. Since this variable has significant, indirect effects on both In-Home Maintenance and Discretionary time use variables with the same causal directions as found for home teleshopping, we may assume that time-starved female heads of household are using home teleshopping to increase the amount of In-Home Maintenance activities they undertake, while the other members of their households are released from some of their in-home and shopping activities burdens. This suggests there is another variable or set of variables causing female heads of household to be time-starved. Those variables might best be represented within the structure of an SEM model by including the time burdens of other household members on Female Heads of Households to determine if these household-member demands cause their female household heads to be time-starved and indirectly causes them to adopt home teleshopping as a coping strategy. Further research will be required to adequately test this hypothesis – research that measures the effects of household members' activities on one another.

CONCLUSIONS

This dissertation reports on the results of a structural equation model (SEM) constructed to measure the relationships between home teleshopping, out-of-home shopping, shopping travel, lifestyle characteristics (i.e., time-starvation) and home accessibility to retail opportunities. The SEM model utilized a nonrecursive structure fit to activity survey data from the San Francisco Bay Area using maximum likelihood estimation.

Results from this model were similar to those found in a previous study undertaken by the author of this paper and as reported in Ferrell (2004) but there were a few critical differences. While the previous study found that households that home teleshop tended to take more shop trips and more shop trip chains (a complementary relationship between home teleshopping and shopping travel) this study found that home teleshoppers tend to take less time for shopping travel, travel shorter total distances for shopping trips, and took fewer shopping trips (a substitutive relationship). The different units of analysis used in each study may explain these different findings – Ferrell (2004) studied household aggregate behaviors while this study looked at person-level behaviors. However, these results should also be considered within the context of this study's limitations – primarily the limitations of the dataset, which does not provide information on differences between subcategories of shopping types (e.g., maintenance or discretionary) and its limited two-day sample period.

While at first glance it may appear that home teleshoppers primarily get the time for In-Home Maintenance activities by reducing the amount of time traveling for shopping purposes and the amount of time spent at home on discretionary activities, a closer look at the model output suggests that some home teleshoppers use this activity to help them focus more of their daily maintenance activities in the home, while some home teleshoppers appear to use this activity as a direct substitute for other in-home discretionary activities as well. Consequently, it appears that Home Teleshopping can serve both maintenance and discretionary purposes, but in different ways – it acts as a stimulus for other maintenance activities (a complementary effect) while it substitutes for discretionary ones.

As for its effect on out-of-home shopping and shop travel, SEM results suggest that Home Teleshopping does not have a significant effect on the amount of time spent shopping outside the home, but it does appear to reduce (substitute for) the number of shopping trips, the shop trip distances traveled (VMT) and the amount of time spent for shop trip travel. Since these significant effects are indirect (i.e., acting through intervening variables), a reasonable assumption is that home teleshopping is used as a means to enhance the efficiency of shopping travel by allowing users to reorganize their daily activities patterns (i.e.; In-Home Discretionary and Maintenance Time).

The SEM model also found that time-starved, female heads of households shop more than other survey participants and travel more for shopping purposes – both in-home teleshopping and out-of-home shopping modes. It appears that this population subgroup is drawn to home teleshopping simply because they do more shopping of all kinds than the typical survey participant. However, while the indirect effect of this time-starved variable on Home Teleshopping is statistically insignificant, it appears that this effect contributes the most statistical influence to bring about the significant, positive total effect. Therefore, this time-starved group may be encouraged to home teleshop since they are spending more time on In-Home Maintenance activities.

The relative accessibility of each participant's home to shopping opportunities also plays a role in home teleshopping behavior. Consistent with the findings from Ferrell (2004) and somewhat contrary to the findings of Gould and Golob (2002), people with high retail accessible homes tend to spend more time shopping both inside (i.e., Home Teleshopping) and outside the home, take more trips and trip chains for shopping, but travel shorter total distances and spend less time traveling for shopping purposes. This suggests that high levels of retail accessibility offer more opportunities to optimize shopping travel by chaining more trips and reducing the distances and time spent traveling. While it was hypothesized that these benefits would allow more time for out-of-home shopping and home shopping alike, the results of this study suggest that the time benefits of home teleshopping are being utilized for other, non-shopping activities and potentially as time for additional, recreational home teleshopping. However, people who are "time-starved" from the pressures of their work and maintenance activities may be using a combination of home teleshopping and trip chaining to reduce the travel costs of traveling, thereby allowing more time for shopping outside the home as suggested in the previous study (Ferrell 2004).

There are several implications of the findings reported here for transportation planning practice and future research. First, the findings that home teleshopping is primarily used as a tool to reorganize daily activity patterns (In-Home Maintenance and Discretionary activities in particular) potentially provides critical insights and useful parameters for travel demand modelers. Recent efforts to develop activities-based travel demand models – where people's activity patterns are used to predict their travel behavior – could particularly benefit from these findings, where explicit Home Teleshopping activities variables would in turn predict participation in other activities and associated travel. While the research results presented here did not find a strong effect of Home Teleshopping on shop travel behavior, the findings were statistically significant and could be useful to activities-based travel demand modeling efforts if embedded within a larger, predictive model structure.

To the extent that planners, policy-makers, and politicians can work towards guiding future urban areas towards more compact, mixed-use forms, these research findings suggest that the total distance traveled (vehicle miles traveled) for shopping purposes will be reduced. However, while the SEM model results suggest there is a direct, causal link between the accessibility of one's home to retail opportunities and home teleshopping (where people living in high retail accessibility areas tend to home teleshop more), the indirect, positive effect found for Home Retail Accessibility on Shop Trip Distance (suggesting that intermediating variables work to increase shop trip VMT when Home Retail Accessibility is high), implies there is a possibility that people in low Home Retail Accessibility locations, using home teleshopping as a means to reduce their Shop Trip

Distances, even though people in these areas tend to Home Teleshop less than those in high accessibility areas. If confirmed by further research, this finding implies that home teleshopping may be playing a role in encouraging urban dispersal, and therefore, Home Retail Accessibility could be used as a variable to predict Home Teleshopping activity participation in activity-based travel demand models.

Similarly, activity-based models could be improved by introducing the Female Head of Household Time-Starved variables, both for its direct effects on shopping travel behavior as shown in the results presented here, and also for predicting Home Teleshopping activity levels. Additional research is required to further identify and confirm these relationships.

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