# INFORMATION TECHNOLOGY'S IMPACT ON THE SPACE AND AUTOMOBILE RELATIONSHIP: A STUDY OF THE LINK BETWEEN INTERNET TECH, AUTOMOBILES, AND RESIDENTIAL PREFERENCES

by

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# ABSTRACT

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Many city planners, developers, real estate agents, and planning academics have been strong proponents of compact, mixed-use, New Urbanist developments. They point to the research that shows that younger generations will favor the revitalized mixed use, dense, urban downtown centers advocated by urbanists like Jane Jacobs and Richard Florida over newly developed, spacious, quiet suburbs In fact, recent research on ICT and driving suggests that the advent of the smart phone and ubiquitous computing (Ubicomp) may be indeed influencing the lifestyle and preference of young adults, who rather than driving are substituting shopping, social, entertainment, and

other trips with virtual trips. The question is whether this substitution of car with virtual trips would be likely to occur in dense downtown or as Joel Kotkin argues, in "smart" suburbs.

Using survey data, this study explores the relationship between ICT usage, perceptions on driving, and preferences for current and future residential place –the latter operationalized in terms of New Urbanist transect zones. It tests the hypothesis that the more an individual's usage of ICT and the more negative the individual's perception of driving, the higher the individual's preference for dense urban downtowns—controlling for age and other demographic factors. Furthermore, the study hypothesizes that individuals' preferences for current versus future place of residence remain constant over time (i.e., in five, ten and twenty years preference projections). Contrary to expectations, the survey data analysis did not support the hypothesized relationships. Instead, it suggests a relationship between age and driving perceptions that is more supportive of Joel Kotkin's argument for Nerdistans and "smart suburbs." In addition, the data suggests that the preferences for future residential environments varies over time and that the majority of the Millennial generation in this study favor less dense rather than more dense, central locations. Finally, the data does not reflect any significant relationships between ICT usage and Residential Preference.

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# CHAPTER 1

# INTRODUCTION

## 1.1 Ushering in a Ubicomp Society

Prior to 2007, the prevalence of mobile computing devices was primarily limited to the corporate industry and its employees. Software platform heavyweights Microsoft, Blackberry, and Palm powered the majority of the current generation of smartphones, devices deemed by most to be too feature heavy, complicated, and cumbersome for the general public. Why would an average person need to be able to check their email at all hours? Only about 715,000 of the devices had been sold worldwide up until that point. (DeGusta 2012) However, in June of 2007, Apple released their first iteration of the iPhone, a device with capabilities multiple generations ahead of what had previously been offered by the other smartphone companies. Within its first quarter of sales, Apple had sold 1.2 million iPhones, thereby eclipsing the amount of all smartphones sold previously worldwide within a matter of three months. Five years later, two out of the three companies mentioned before now contain less than 25% of the market share combined, and one company has gone out of business and disappeared completely (Comscore 2012). In addition, mobile computers are now on pace to be the most quickly adopted new technology in human history, with a market penetration of roughly 40% in the United States (MIT Technology Review). Numerous reasons exist for the rapid adoption of mobile computers, but many industry

observers note that a combination of Apple's exceptionally polished and technologically sophisticated phone, the maturation of wireless communication network technology, and a generation of individuals that depended on the internet finally possessed the expendable income to spend on a smartphone.

With the rise of mobile computing, a theory developed by Mark Weisser of Xerox in 1988 has reemerged. Termed "Ubiquitous Computing" or Ubicomp, Weisser described the theory as a post-desktop model of human computer interfacing in which data is both connected and everywhere at once, similar in concept to "smart cities" and "ambient intelligence" (Wiesser 1991). In an Ubicomp society, people and their data are highly interwoven into a greater fabric of information. The rise of intelligent devices, smart phones, high speed universal internet connectivity, and new media has accelerated the process and many observers have noted that we have crossed an important threshold where computing truly is ubiquitous and information connectivity is ever pervasive and thus plays a heightened role in everyday life.

## 1.2 Growing preference for Cities or Suburbs

Just as the automobile helped change an entire generation's disposition towards living outside the city in the suburbs, evidence is mounting that a similar effect is occurring in today's Ubicomp society. While the growth of urban cores versus suburbs is highly contested, many industries are noticing that preferences are shifting, including those in the automobile industry. Sheryl Connelly, head of global consumer trends for Ford, describes the predicament of attempting to market vehicles to the millennial

generation as, “You no longer need to feel connected to your friends with a car when you have this technology that’s so ubiquitous, it transcends time and space” (Thompson 2012). General Motor’s former head of Research and Development, Larry Burns, describes what he says is the way youth drivers see the problem of texting while driving as, “We asked younger people about texting while driving; they told us driving distracted them from texting” (Voelcker 2009). This observation is not limited to the United States either. A report by the Wall Street Journal reinforces this notion by stating,

> *“Reasons [for the drop in sales of automobiles] include higher gasoline prices and Japan's graying population. But even more worrying to automakers are signs that the downturn is part of a deeper generational shift among young Japanese consumers. Unlike their parents' generation, which viewed cars as the passport to freedom and higher social status, the Internet-connected Japanese youths today look to cars with indifference, according to market research by the Japan Automobile Manufacturers Association and Nissan. Having grown up with the Internet, they no longer depend on a car for shopping, entertainment and socializing and prefer to spend their money in other ways (Murphy 2008).*

Shannon King, the vice chair of strategic planning at the National Association of Realtors, argues that the types of properties that young people are buying are different from what previous generations bought five years ago and the key factor is that “they like feeling connected” (Thompson 2012). In 2008, the Metropolitan Institute at Virginia Tech released a report that examined trends in American demographics and housing patterns. They conclude that affluent and well educated people have begun moving back into urban zones and that the era of McMansions has peaked, leaving behind a surplus of 22 million large-lot suburban homes by 2025 (Nelson, 2008).

Research from the Brookings Institute has come to similar conclusions. Christopher Leinberger, a senior fellow at the institute, states, "Not surprisingly, fully 77 percent of millennials plan to live in America's urban cores" (Leinberger 2010). Leinberger continues by saying,

> *"Boomers are downsizing as their children leave home while the millennials, or generation Y, are setting out on their careers with far different housing needs and preferences. Both of these huge demographic groups want something that the U.S. housing market is not currently providing: small one- to three-bedroom homes in walkable, transit-oriented, economically dynamic, and job-rich neighborhoods" (Leinberger 2010).*

However, just as there is evidence in technology influencing urban patterns towards cities, there is also plenty of evidence that indicates that the majority of population growth will occur in the suburbs. According to the latest census numbers, Wendell Cox of the New Geography notes, suburbs attracted 91 percent of the growth in the decade, up from 85 percent from the decade before, while the metropolitan areas added 9 percent, down from 15 percent (Cox 2011). In addition, much of the growth in the metropolitan areas came from cities whose form is mostly suburban in nature, such as Kansas City, Austin, and the Dallas Fort-Worth region.

## 1.3 Mobile Technology and Connectivity in Urban Planning

The urban planning field underwent a radical change with the rise of the automobile in the post-world war II era, placing new emphasis on transportation planning and the social effects of suburbia. With mobile computing's increasingly

cultural and economic significance in the United States, perhaps it is time again to revisit and observe how technology is changing the urban landscape. At present, planning literature is generally divided into two camps: Those that side with Joel Kotkin's ideology, and those that side with Richard Florida. The two authors are at the forefront of discussing technology's impact on urban patterns, each wielding significant influence on public discourse regarding the subject. The term Nerdistan, which refers to high-end suburbs that cater towards high tech communities, is the future of urban growth according to Kotkin (Kotkin 2010). On the other hand, Florida and his colleagues have been arguing that a diverse, dense, and tolerant city that houses the much sought after, "creative class," is the city of the future (Florida 2002).

Seeing as the comparison between urban and suburban population growth is conceptually anachronistic in both data and analysis, it may be more appropriate to observe how individual preference is shifting as opposed to population growth. In addition, the comparison between urban and suburban tends to be a primarily binary in nature, so utilizing a model such as the Andres Duany's "urban transect" model affords us a more relevant representation of metropolitan urban patterns. Duany's urban transect model, widely adopted by new urbanists and the CNU, designates six different transect zones, each occupying a spectrum of urban density ranging from rural preserves to urban cores (Smartcode 2012).

This thesis will evaluate individuals' level of dependence on Ubicomp technologies, referred in this thesis as ICT usage; particularly the mobile computing and connectivity portion, with their preference for urban living conditions in terms of five of

the six transect zones. Through the analysis of survey data, it seeks confirmation on whether an individual who is considered more "connected" is predisposed towards a particular type of residential environment. The examination of patterns in the data will reveal if and how the extremely quick rise of mobile devices could potentially influence future urban form, and whether the data support either Richard Florida or Joel Kotkin's vision of the future city. Furthermore, if data patterns emerge, the study will seek to provide insights into why Ubicomp has the effect that it does. Does the ubiquity of Internet connectivity relate to preference for urban density or does it relate to preference for low density urban patterns?

# CHAPTER 2

# LITERATURE REVIEW

## 2.1 Ubicomp Literature

The original framework of an Ubicomp society was founded by various academic fields, including computer science, sociology, economics, and architecture. Mark Weiser officially coined the term in 1988. As a chief scientist at Xerox Palo Alto Research Center (Xerox PARC), he outlined a set of principles that guided his theory (PARC 2012):

- The purpose of a computer is to help you do something else.
- The best computer is quiet and invisible
- The computer should extend your consciousness
- Technology should be “calming”

Weiser placed heavy emphasis on what he described as calm technology, arguing that technology should be able to inform us without requiring our attention or focus (Weisser 1995). His decades of research at Xerox PARC led to the creating of their contextual intelligence services division, whose self-described goal was to “create context-aware services that help people see more of what they need, suppress the "noise", and discover hidden relationships between people, information, and events” (PARC 2012).

## 2.2 Network Society Literature

In 1973, Barry Wellman publishes *The Network City*. A professor of sociology at the University of Toronto, Wellman argues that societies are better understood as networks rather than bounded physical groups. He creates a concept known as “networked individualism,” in which community, work, and organizations form the

foundational networks of a society and that with recent advances in communications technology, an individual's community can be socially and spatially diversified (Wellman 2001). In Wellman's more recently literature, *Networked*, Wellman proposes that instead of isolating people, mobile networks and connectivity have increased the size of our social circles and expanded our opportunities for learning, problem solving, and personal interaction. Networked individualism liberates us from the restrictions of tightly knit groups, requiring us to live differently to maintain personal connections and manage multiple networks (Rainie 2012).

The term "network society" first makes its appearance in academic literature in 1991 in the book *De Netwerkmaatschappij* (*The Network Society*) by Dutch sociologist Jan van Dijk. Later used in Manuel Castells *Rise of the Network Society*, the first of a trilogy named *The Information Age,* the term has come to embody a society that organizes itself around media and information networks rather than physical co-presence. (Dijk 2005) Castells concurs, further arguing that culture is changing and organizing around electronic media and that "the space of flows and timeless time are the material foundations of a new culture." (Castells 2009) Timeless time refers to the collapse of delay in regards to communication and commerce and space of flows refers to the large powerful networks that are occupied by class elites.

While Weiser coined Ubicomp and explored its technical foundation and sociologists attempted to understand the network society, William Mitchell of MIT's Media Lab was investigating the effects of technology on architecture and space. An urban designer and architect, Mitchell's Smart Cities program at MIT, a subsidiary of

the MIT Media Lab, often delved into subjects ranging from the decentralizing and contextualizing of social forms of communication to creating algorithms aimed at understanding human responses to technology (MIT 2012). Mitchell's written work, *Me++, City of Bits, E-Topia*, among others, looked at various topics that touched upon the effects of technology on a city. Raising questions regarding the merging of physical and virtual space and the changing perception of urban space, Mitchell's E-Topia describes an urban landscape that is built upon ubiquitous telecommunications presence, smart machines, and intelligent buildings. This new landscape will produce "live work dwellings, twenty four hour neighborhoods, loose knit, far flung configurations of electronically mediated meeting places, flexible, decentralized production, marketing, and distribution systems, and electronically summoned delivery services" (Mitchell 1999). Most importantly for this thesis, Mitchell argues that the dematerialization of many services and goods combined with mass telecommunications will lead to a renewed importance on the agora, but that the agora may no longer be a physical location and be accessible from any electronic device.

## 2.3 ICT Planning Literature

Others, too, were looking to better understand how the physical landscape was shifting. Stephen Graham of Newcastle University describes a phenomenon of "urban reconfiguration" due to the influence of information technologies. More businesses are moving closer to internet network nodes, and the real estate values surrounding those areas are increasing at a much more rapid rate than elsewhere (Graham 2001).

Planners are also aware of the dramatic effect of Ubicomp and have written about what some have termed ICT, or Information and Communications Technology, and its effects on urban planning and in particular, the effects on community engagement and place making. D.J. Walmsley proclaims in his article, *Community, Place, and Cyberspace,* that cyberspace may have eliminated distance, but not place (Walmsley 2000). Michael Sivak & Brandon Schoettle, of the University of Michigan's Transportation Research Institute, examine and frame the effects of ICT and Ubicomp on cities and their desirability/place making and conclude that there is an inverse relationship between a country's internet connectivity index and the ownership of automobiles (Sivak 2011).

In their 2011 University of Michigan Transportation Research Institute report, Sivak and Schoettle find that, on the most fundamental level, a person's age influences decisions regarding the balancing of automobile driving and other modes of transportation. From 1983 to 2008, there was an extremely significant decrease in the percentage of young people with a driver's license, and a substantial increase in the percentage of older people with a license. With a statistically significant regression, P value less than 0.01 and an r^2 of 0.8, the report found that countries with a higher proportion of internet users were strongly negatively correlated with licensure rates among young people (Sivak 2011). The authors conclude, "This later finding is consistent with the hypothesis that access to virtual contact reduces the need for actual contact among young people" (Sivak 2011, 3).

Adding to the argument, a report commissioned by Cisco, called the Connected World Technology Report that surveyed over 2,800 college students and young professionals from 14 countries, found that 64% of the participants would choose net access over a car when being forced to make a decision between the two (Cisco 2011).

## 2.4 Millennial Literature

According to Forbes, Americans born between roughly 1980 and 1995 are known by many as either Millennials, Generation Y, or Echo boomers, due to their massive population size. (Forbes 2011). Peter Reilly, who writes specifically about the Millennials for Forbes, describes the generation as those who "works to live, not lives to work." (Forbes 2011). Writing about their preferences for homeownership, he states, "They preferred graduate degrees, living in social areas (not suburbs) and freedom instead of homeownership" (Forbes 2011).

## 2.5 Kotkin versus Florida

The most recent and controversial contribution to the debate of how technology would affect future city growth patterns in the Ubicomp era is contained within Joel Kotkin's *The New Geography*, his more recent *The Next Hundred Million,* and Richard Florida's *The Rise of the Creative Class.* In *The New Geography*, Kotkin asserts that the Millennial generation would flock towards cities due to their diversity and choice in lifestyle. Contrary to the perception that technology would allow people to work farther away in the suburbs due to connectivity, Kotkin argues that "the importance of

geography is not dwindling to nothing in the digital era; in fact, quite the opposite. In reality, place – geography – matters now more than ever before" (Kotkin 2000). Since many jobs and services have become decentralized to the point that they are attainable at almost any given location, thanks to mobile technology, the question of where to locate becomes increasingly contingent on the peculiar attributes of any given location (Kotkin 2000). He continues with the argument that many cities will no longer be industrial and corporate headquarters but rather centers of education, talent, and creativity. It is also in *The New Geography* that Kotkin coins the term Nerdistan. These self-contained, affluent, and high tech suburbs are rising and replacing the cities that fail to adapt in attracting the new urbanites. He cites locations such as Austin, TX, Irvine, CA, and Raleigh, NC as Nerdistans.

However, Kotkin (2010) changes his stance regarding cities in his most recent publication, *The Next Hundred Million, America in 2050*. In the book, he places less faith in the ability of cities to attract the future generations of Americans and bets heavily on the Nerdistans he discussed in *The New Geography*. Asserting that Nerdistans will adopt "Smart Sprawl," in which the low to medium density neighborhoods will provide the diversity and character that Jane Jacob's urban city provided while assimilating new immigrant populations. The internet and mobile technology's ability to make more information more accessible means that more people will work from home, and that home will be a suburb that appears to have more in common with a vibrant town center than bedroom communities of old. He says, "The growing use of the Internet, wireless phones, video conferencing, and other

communications technologies will allow even more people to commute from home: at least one in four or five will work full or part time from their residence" (Kotkin 2010, n.p.).

Richard Florida's (2002) *Rise of the Creative Class* does not necessarily emphasize technology as a preeminent factor of change in urban space, but he does cite it as a necessary component. Florida writes, "The key to understanding the new economic geography of creativity and its effect on economic outcomes lies in what I call the 3T's of economic development: Technology, Talent, and Tolerance. Each is a necessary but by itself insufficient condition" (Florida 2002). In his book, Florida essentially argues in favor of technology in a similar fashion as Kotkin did prior to *The Next Hundred Million,* believing that it would influence individuals to move to towards the city core, yet the two have exchanged barbs and criticisms over their publications and articles. Florida criticizes Kotkin for writing off the density advantages of cities like San Francisco and Boston because of the failed dotcom bubble of the early 2000's (Florida 2012) while Kotkin points out that low density cities like Dallas and Houston and their growth are not an anomaly but rather a trend (Kotkin 2010).

# CHAPTER 3

# METHODOLOGY

## 3.1 Hypothesis

Based on the previous literature review, this thesis hypothesizes that individuals' intensity of use and dependency on an internet connected device (ICT Usage) is related to their personal inclination for living in a denser environment—particularly among the Millennial generation. Likewise, individuals' favorable perception of driving is associated with their personal inclination for living in less dense environments. Furthermore, ICT usage and driving perception are related to individuals' difference in current and preferred residential environment. In addition, this thesis hypothesizes that there is an inverse relationship between the perception of driving as an opportunity versus an individual's ICT usage.

## 3.2 Data Collection and Sample Group

In order to examine these hypotheses an online survey instrument was designed and administered. The delivery mechanism for the survey was considered early on and it was determined that, since the target population was individuals who had regular contact with Internet connected devices, an online survey would suffice. In addition, the high market penetration of mobile connected devices in the United States meant that the online survey instrument would reach the target population yielding an acceptable sample size.

As a result, the sample size of the survey instrument was limited to those who possessed the capability to take the online survey within the data collection time frame

of seven days. A total sample size of 157 respondents was gathered throughout various online distribution channels. The initial distribution channel was primarily an email with a short introduction message and an attached hyperlink that directed the reader to the survey. However, the short message in the email also encouraged the recipients to forward and distribute the survey to anyone they wished through any delivery mechanism that they desired. As a result, while the initial delivery of the survey was done through email, the subsequent distribution of the survey could have been through any number of electronic means, including Instant Messaging, online forums, social networking, cellular SMS, and email forwarding.

## 3.3 Survey Instrument & Operationalization of Key Concepts

The survey questionnaire contains thirty-one multiple choice and fill-in-the blank questions (See Appendix for the complete survey instrument). The variables used to test this thesis' hypotheses were operationalized through the following survey questions:

**ICT Usage:**

In order to determine the relative intensity of ICT usage the following set of questions were used to gauge the respondent's usage regarding internet enabled devices.

- Do you own, or have access through your job, to a data enabled smartphone or tablet that allows browsing the Internet
- How many hours would you say you use it on a daily basis?

**Driving Perception:**

This was done by operationalizing an individual's personal inclination towards driving and automobiles as an opportunity or as a nuisance in the following question:

- On a scale of 1 to 7, how do you generally feel about driving an automobile? Do you think it is an opportunity or a nuisance?

**Density of Living Environment and Preference for Residential Environment:**

Participants were asked to complete a visual preference survey based on images representing five transect zones from T-2 rural to T-6 urban core as found in CNU's Smart Code Manual.

This visual preference survey, which is perhaps the most important portion of the survey, provides a hyperlink to the participants that show them five photographs, each representing T-2 (rural), T-3 (suburban), T4 (general urban), T-5 (urban center), T-6 (urban core), new urbanist rural-urban transect zones, followed by a series of questions:

1) Please select the image that comes closest to reflecting the neighborhood character of the place where you currently live.

2) Please select the image that comes closest to reflecting the neighborhood character of the place where you would prefer to live in 5 years.

3) Taking into account your projected income level, please select the image that comes closest to reflecting the neighborhood character of the place where you would prefer to live in 10 years.

4) Taking into account your projected income level, please select the image that comes closest to reflecting the neighborhood character of the place where you would prefer to live in 20 years.

Using the images provided, participants were to answer between A, which represented the most rural environment, through E, which represented the densest urban environment.

All images utilized in the survey were selected for a variety of reasons. First and foremost, they must, to a high degree, represent the ideals of their associated archetypal environment or transect zone. Second, the image itself must be of relatively high resolution while depicting an attractive environment, a sort of "best case environment" for their associated archetype. This was done in order to ensure that the primary reason for selecting an image was the environmental ideals it represented rather than the overall quality or attractiveness of the image.

## Image A

Figure 1 Image A

Image A was based on the "Rural" transect zone, T-2, (Smart Code Manual Duany 2006). Combining an overall lack of density with large, open space, and a natural landscape with picturesque country homes, Image A sought to appeal to those who would desire the ideal American rural country living experience.

## Image B

Figure 2 Image B

Image B is based on the T-3, or the Sub-Urban transect zone, and contains single family homes on a quiet residential street with moderately sized front yards, clean white painted homes, and a community church in the background. This image was intended to appeal to those who desire the ideal traditional suburban lifestyle.

## Image C

Figure 3 Image C

Image C is based on T-4, or the General Urban transect zone. With a very wide and friendly street lined on both sides with classic walk-up townhomes that are pushed together very closely and plenty of large green trees on the sidewalks, this image intends to appeal to those who would to like to live on the fringes of an urban core environment or in a more quiet, older residential pocket of a city.

## Image D


Figure 4 Image D

Image D is based on T-5, or Urban Center transect zone. With small urban sidewalks lined with trees in front of a four story mixed use development, brick lined crosswalks, and trolley tracts engraved into the street in front the building, this image intends to appeal to those looking for a prototypical mixed-use environment that provides multi-modal transit options, ground level retail, and apartment/loft residential units above.

## Image E

Figure 5 Image E

Image E is based upon the most dense of the transect zones, T6. Known as the Urban Core, this image illustrates an area dense with high rises and other multi-story structures that appear to be greater than four stories imbedded into the core downtown area of a major city. This image intends to appeal to those who strive to live in the most dense, traditionally urban location possible.

**Residential Differential:**

The current versus future change in preference over time of residential environment was operationalized as a scale variable called Diff, or "Residential Differential," where Diff represents the Current residence (T-zone) – Preferred

residence (T-zone), after Audirac and Smith (1991), the process is described in the steps below.

1) Participant Answers to Visual Preference Survey converted into numerical ordinal values.

    - Image A = 1
    - Image B = 2
    - Image C = 3
    - Image D = 4
    - Image E = 5

2) Conversion of time relationship questions into algebraic values.

    - Answers to "current living residence" = A
    - Answers to "5 year living residence" = B
    - Answers to "10 year living residence" = C
    - Answers to "20 year living residence" = D

3) Residential Differential, or DIFF, is represented by value X.

    FORMULAS:

    - X of Present = A - A
    - X of 5 years = B – A
    - X of 10 years = C – A
    - X of 20 years = D – A

    RESULTING DIFF MATRIX:

Table 1: Diff Matrix of Current – Preferred Place of Residence

| | | FUTURE | | | | |
|---|---|---|---|---|---|---|
| | | T-2 | T-3 | T-4 | T-5 | T-6 |
| PRESENT | T-2 | 0 | 1 | 2 | 3 | 4 |
| | T-3 | -1 | 0 | 1 | 2 | 3 |
| | T-4 | -2 | -1 | 0 | 1 | 2 |
| | T-5 | -3 | -2 | -1 | 0 | 1 |
| | T-6 | -4 | -3 | -2 | -1 | 0 |

This formula was applied to all survey participant answers.

**Millennials**

Lastly, the first five questions of the survey dealt with respondents' background characteristics including age, income, race, education, and marital status. Based on the literature and using the age data, the Millennial population was operationalized as:

1) Respondents who described themselves as between 18-34 years of age were classified as "Millennials," having been born in 1979 at the earliest.
2) Those who described themselves as over the age of 35 were classified as Non Millennials, having been born before 1979.

    - 18-24 = Millennial
    - 25-29 = Millennial
    - 30-34 = Millennial
    - 35-39 = Non Millennial
    - 40-44 = Non Millennial
    - 45-49 = Non Millennial
    - 50+ = Non Millennial

## 3.4 Data Analysis

As stated earlier, 157 participants responded to the online surveys. Of those 157, 86% of them described themselves as "White," making them by far the greatest racial demographic. The largest age group of the sample was the 18-24 bracket (44.6%), although there were also a significant number of respondents within the 25-29 (24.8%) and 30-34 bracket (19.7%). In terms of education, the majority (54.1%) had attained a typical four-year university degree or equivalent. Income was very evenly distributed among all ranges. In terms of job classification, 46.2% work in a white-collar environment with 36.5% classifying themselves as students.

The complete racial, age, education, income, and marital status breakdown can be seen in Appendix B.

## 3.5 Condensing and Analyzing the Data

Due to the uneven spread of responses regarding the demographic variables, the variables were condensed into groups that helped even out the number of responses within each category. Race was condensed into two categories, White (86%) versus NonWhite (14%). Education was condensed into those who possessed a four year University degree or above (71.3%) versus those who do not (28.7%). Jobs were condensed into White Collar (45.9%), Students (36.3%), and Neither White Collar nor Student (14%). Age was condensed into Millennials (89.2%) versus non-Millennials (10.8%). In this study, Millennials were those who were born after 1978 (18-34 years old), and non-Millennials were those who were born before 1978 (35 years or older). Income was condensed into Less than $40,000 (42.7%), $40-$80,000 (33.8%) and $80,000 + (23.6%). The table in Appendix C shows the condensing of the categories for each variable.

In addition to the demographic data, the values for Driving Perception and ICT usage were condensed in a similar manner. Driving Perception was condensed into Nuisance (33.1%) and Opportunity (66.9%), with an N = 127 due to 30 missing or neutral values regarding feelings on driving. ICT usage was condensed into Low Usage (43.3%) and High Usage (56.7%). Low usage is regarded as those who claimed ICT usage less than 2 hours a day, whereas those who used more than 2 hours daily were coded High Usage. The full breakdown of the condensed variables can be seen in Appendix C.

In addition to the creation of the Diff variable, various methods of data exploration were used including cross tabulation analysis of categorical and ordinal survey data. Evaluation of Pearson Chi-Square values was used to test the hypothesized relationships, as well as observations of any trends in the descriptive statistical data.

# CHAPTER 4

# FINDINGS

## 4.1 Demographic Variables and Residential Preference

When cross classifying the demographic data with the residential preference data, we see that only two relationships are statistically significant: Age and the residential preference of the participants within 5 and 10 years. In both 5 and 10 year preference projections, we see that Age displays a significant P value and a significant Linear by Linear Association value. Examining the frequency data reveals that, within this survey group, the Millennials are more likely to prefer the denser transect zones (T4 to T6) within a 5-10 year period while Non-Millennials are more likely to prefer the less dense transects (T2 and T3).

Table 2: Millennials and 5-Year Projected Preference for Density

| Age Condensed x 5 Year Preference | | | | | | | |
|---|---|---|---|---|---|---|---|
| Count | | | | | | | |
| | | 5 Year | | | | | Total |
| | | T-2 | T-3 | T-4 | T-5 | T-6 | |
| Age Condensed | Millennials | 15 | 32 | 45 | 18 | 27 | 137 |
| | Non-Millennials | 7 | 7 | 2 | 1 | 0 | 17 |
| Total | | 22 | 39 | 47 | 19 | 27 | 154 |

| Chi-Square Tests | | | |
|---|---|---|---|
| | Value | df | Asymp. Sig. (2-sided) |
| Pearson Chi-Square | 17.767[a] | 4 | .001 |
| Likelihood Ratio | 18.371 | 4 | .001 |
| Linear-by-Linear Association | 14.258 | 1 | .000 |

Table 3: Millennials and 10-Year Projected Preference for Density

| Age Condensed x 10 Year Preference | | | | | | | |
|---|---|---|---|---|---|---|---|
| Count | | | | | | | |
| | | 10 Year | | | | | Total |
| | | T-2 | T-3 | T-4 | T-5 | T-6 | |
| Age Condensed | Millennials | 24 | 38 | 40 | 17 | 18 | 137 |
| | Non-Millennials | 8 | 5 | 3 | 1 | 0 | 17 |
| Total | | 32 | 43 | 43 | 18 | 18 | 154 |

| Chi-Square Tests | | | |
|---|---|---|---|
| | Value | df | Asymp. Sig. (2-sided) |
| Pearson Chi-Square | 9.874[a] | 4 | .043 |
| Likelihood Ratio | 10.590 | 4 | .032 |
| Linear-by-Linear Association | 8.343 | 1 | .004 |

## 4.2 Driving Perception and ICT Frequencies

As discussed earlier, 33.1% of survey respondents answered that they view driving as a nuisance, compared to the 66.9% that viewed driving as an opportunity. This indicates that our survey group largely views driving in a positive light.

Table 4: Driving Perception Frequencies

| Driving Condensed Frequencies | | | | | |
|---|---|---|---|---|---|
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Nuisance | 42 | 26.8 | 33.1 | 33.1 |
| | Opportunity | 85 | 54.1 | 66.9 | 100.0 |
| | Total | 127 | 80.9 | 100.0 | |
| Missing | System | 30 | 19.1 | | |
| Total | | 157 | 100.0 | | |

Hourly Usage frequencies were more evenly split within the data group, with 43.4% of respondents categorizing themselves as using less than 2 hours of ICT daily, and 56.7% using more than 2 hours daily.

Table 5: Hourly Usage Frequencies

| Hourly Usage Condensed Frequencies | | | | | |
|---|---|---|---|---|---|
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Low Usage | 58 | 36.9 | 43.3 | 43.3 |
| | High Usage | 76 | 48.4 | 56.7 | 100.0 |
| | Total | 134 | 85.4 | 100.0 | |
| Missing | System | 23 | 14.6 | | |
| Total | | 157 | 100.0 | | |

## 4.3 Driving Perception and ICT Relationship

When ICT Usage and Driving Perception were cross-classified, they reveal a P value of 0.552, indicating no relationship between the two. Looking closely at the numbers, we observe that 71/104 respondents saw driving as an opportunity and that majority of respondents who were low in ICT usage also saw driving as an opportunity (30/46). Among those who dislike driving and see it as a nuisance, there is practically no difference between Low (16/33) and High Usage (17/33) respondents (see Table 6).

Table 6: Hourly Usage and Driving Perception Compared

| Hourly Usage Condensed * Driving Condensed | | | | |
|---|---|---|---|---|
| Count | | | | |
| | | Driving Condensed | | Total |
| | | **Nuisance** | Opportunity | |
| Hourly Usage Condensed | Low Usage | **16** | 30 | 46 |
| | High Usage | **17** | 41 | 58 |
| Total | | **33** | 71 | 104 |

| Chi-Square Tests | | | | | |
|---|---|---|---|---|---|
| | Value | df | Asymp. Sig. (2-sided) | Exact Sig. (2-sided) | Exact Sig. (1-sided) |
| Pearson Chi-Square | .355[a] | 1 | **.552** | | |

Contrary to expectations based on the literature, there was no relationship between age and ICT usage. However, when the relationship between ICT usage and Driving Perception is controlled for Jobs, specifically the Student category, we see a significant association with a P value of 0.022. Breaking down the numbers, it appears as though the students who view driving as an opportunity are also students who are high in ICT usage, while students who dislike driving are low in ICT usage.

Table 7: Hourly Usage and Driving Perception Controlled For Jobs

| **Hourly Usage Condensed * Driving Condensed * Job** | | | | | |
|---|---|---|---|---|---|
| Count | | | | | |
| Job Condensed | | | Driving Condensed | | Total |
| | | | Nuisance | Opportunity | |
| White Collar | Hourly Usage Condensed | Low | 5 | 15 | 20 |
| | | High | 11 | 16 | 27 |
| | Total | | 16 | 31 | 47 |
| **Student** | **Hourly Usage Condensed** | **Low** | **10** | **9** | 19 |
| | | **High** | **3** | **15** | 18 |
| | Total | | 13 | 24 | 37 |
| Neither White Collar nor Student | Hourly Usage Condensed | Low | 0 | 4 | 4 |
| | | High | 3 | 8 | 11 |
| | Total | | 3 | 12 | 15 |
| Total | Hourly Usage Condensed | Low | 15 | 28 | 43 |
| | | High | 17 | 39 | 56 |
| | Total | | 32 | 67 | 99 |

| | | | | |
|---|---|---|---|---|
| Student | Pearson Chi-Square | 5.246[d] | 1 | .022 |
| | Continuity Correction[b] | 3.787 | 1 | .052 |
| | Likelihood Ratio | 5.466 | 1 | .019 |
| | Fisher's Exact Test | | | |
| | Linear-by-Linear Association | 5.104 | 1 | .024 |
| | N of Valid Cases | 37 | | |

Based on the literature, we expected to see a relationship between ICT Usage and Driving Perception controlling for Age. However, we saw a relationship with Students instead, and that relationship was opposed to what we would have expected from the literature. While the Sivak (2012) report would had made us expect ICT Usage and Driving Perception to be in an inverse relationship, the data shows a positive relationship suggesting synergy between ICT Usage and Driving for the student population.

## 4.4 Driving Perception, ICT Usage, and Five Year Preference

The next part of the hypothesis calls for an examination of the possible relationship between ICT Usage, Driving Perception, and preference for residential location. What we see is that, within a 5-year time frame, there is no significant relationship between residential preference and ICT Usage/Driving Perception, except when Residential Preference is cross tabulated with Driving Perception and controlled for Education.

When controlling for Education, we see that those who have acquired a university education display a significant relationship, with a P value of 0.055. With a Linear by Linear Association value of 0.019, we can observe that among those with a university education, those who perceive driving as a nuisance prefer high density (6/10 for T6), while those who perceive it as an opportunity prefer suburban places (9/25 for T3).

Table 8: Driving Perception and 5 Year Residential Preference Controlled by Education

| **Driving Perception * 5 Year Preference * Education** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Count | | | | | | | | |
| Education Condensed | | | 5 Year Pref | | | | | Total |
| | | | T-2 | T-3 | T-4 | T-5 | T-6 | |
| **University** | **Driving Condensed** | **Nuisance** | **1** | **1** | **0** | **2** | **6** | 10 |
| | | **Opportunity** | **3** | **9** | **6** | **3** | **4** | 25 |
| | Total | | 4 | 10 | 6 | 5 | 10 | 35 |
| Non University | Driving Condensed | Nuisance | 5 | 8 | 10 | 2 | 5 | 30 |
| | | Opportunity | 10 | 16 | 21 | 6 | 7 | 60 |
| | Total | | 15 | 24 | 31 | 8 | 12 | 90 |
| Total | Driving Condensed | Nuisance | 6 | 9 | 10 | 4 | 11 | 40 |
| | | Opportunity | 13 | 25 | 27 | 9 | 11 | 85 |
| | Total | | 19 | 34 | 37 | 13 | 22 | 125 |

Table 8 continued

| Chi-Square Tests | | | | |
|---|---|---|---|---|
| Education Condensed | | Value | df | Asymp. Sig. (2-sided) |
| University | Pearson Chi-Square | 9.275[b] | 4 | .055 |
| | Likelihood Ratio | 10.688 | 4 | .030 |
| | Linear-by-Linear Association | 5.540 | 1 | .019 |

Additionally, when we run a cross tabulation between Driving Perception and the 5 Year Diff value (difference between current and 5-year preferred residential place) we see a significant association with a P value of 0.031. When we break down the frequencies, we see 36/85 (42%) of people who view driving as an opportunity are satisfied with where they currently live, represented by a "0" Diff value, compared to the 7/41 (17%) of those who viewed driving as a nuisance.

Table 9: Driving Perception and 5 Year Diff Values

| Driving Condensed * 5 Year Diff | | | | |
|---|---|---|---|---|
| Count | | | | |
| | | Driving Condensed | | Total |
| | | Nuisance | Opportunity | |
| LOCATIONDIFF Current 5 Years | -3.0 | 2 | 0 | 2 |
| | -2.0 | 3 | 4 | 7 |
| | -1.0 | 10 | 13 | 23 |
| | .0 | 7 | 36 | 43 |
| | 1.0 | 10 | 21 | 31 |
| | 2.0 | 3 | 5 | 8 |
| | 3.0 | 6 | 4 | 10 |
| | 4.0 | 0 | 2 | 2 |
| Total | | 41 | 85 | 126 |

Table 9 continued

| Chi-Square Tests | | | |
|---|---|---|---|
| | Value | df | Asymp. Sig. (2-sided) |
| Pearson Chi-Square | 15.410[a] | 7 | .031 |
| Likelihood Ratio | 16.688 | 7 | .020 |
| Linear-by-Linear Association | .052 | 1 | .819 |
| N of Valid Cases | 126 | | |

Looking further, when we use the demographic data as controls in the relationship between Driving Perception and 5 Year Diff, we see a significant association with Race and Age. In terms of race, the association was significant for those that identified themselves as White (P value of 0.009). Similar to the above observation, an examination of the cell frequencies for White respondents reveals that those who view driving as an opportunity were significantly more likely to be satisfied with where they currently live 34/77 (44%) compared to the people who viewed driving as a nuisance 6/32 (19%). In terms of age, it appears that there is an association between Driving Perception and 5 Year Diff among Non-Millennial, with a P value of 0.019, although this is difficult to interpret due to the low cell counts within the Non-Millennial category.

Table 10: Driving Perception and 5 Year Diff Values Controlled for Race

| **Driving Perception * 5 Year Diff * Race** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Count | | | | | | | | | | | |
| Whites vs. Not White | | | LOCATION DIFF Current 5 Years | | | | | | | | Total |
| | | | -3.0 | -2.0 | -1.0 | .0 | 1.0 | 2.0 | 3.0 | 4.0 | |
| **White** | **Driving Condensed** | **Nuisance** | **2** | **3** | **9** | **6** | **6** | **1** | **5** | **0** | 32 |
| | | **Opportunity** | **0** | **4** | **12** | **34** | **19** | **4** | **2** | **2** | 77 |
| | Total | | 2 | 7 | 21 | 40 | 25 | 5 | 7 | 2 | 109 |
| Non White | Driving Condensed | Nuisance | | | 1 | 1 | 4 | 2 | 1 | | 9 |
| | | Opportunity | | | 1 | 2 | 2 | 1 | 2 | | 8 |
| | Total | | | | 2 | 3 | 6 | 3 | 3 | | 17 |
| Total | Driving Condensed | Nuisance | 2 | 3 | 10 | 7 | 10 | 3 | 6 | 0 | 41 |
| | | Opportunity | 0 | 4 | 13 | 36 | 21 | 5 | 4 | 2 | 85 |
| | Total | | 2 | 7 | 23 | 43 | 31 | 8 | 10 | 2 | 126 |

| **Chi-Square Tests** | | | | |
|---|---|---|---|---|
| Whites vs. Not White | | Value | df | Asymp. Sig. (2-sided) |
| White | Pearson Chi-Square | 18.611[b] | 7 | .009 |
| | Likelihood Ratio | 18.967 | 7 | .008 |
| | Linear-by-Linear Association | .534 | 1 | .465 |
| | N of Valid Cases | 109 | | |

Table 11: Driving Perception and 5 Year Diff Values Controlled for Age

| Driving Perception * 5 Year Diff * Age | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Count | | | | | | | | | | | |
| Age Condensed | | | LOCATION DIFF Current 5 Years | | | | | | | | Total |
| | | | -3.0 | -2.0 | -1.0 | .0 | 1.0 | 2.0 | 3.0 | 4.0 | |
| Millennials | Driving Condensed | Nuisance | 2 | 3 | 9 | 7 | 10 | 3 | 5 | 0 | 39 |
| | | Opportunity | 0 | 4 | 10 | 27 | 21 | 5 | 4 | 2 | 73 |
| | Total | | 2 | 7 | 19 | 34 | 31 | 8 | 9 | 2 | 112 |
| **Non Millennials** | **Driving Condensed** | **Nuisance** | | | **1** | **0** | | | **1** | | **2** |
| | | **Opportunity** | | | **3** | **9** | | | **0** | | **12** |
| | Total | | | | 4 | 9 | | | 1 | | 14 |
| Total | Driving Condensed | Nuisance | 2 | 3 | 10 | 7 | 10 | 3 | 6 | 0 | 41 |
| | | Opportunity | 0 | 4 | 13 | 36 | 21 | 5 | 4 | 2 | 85 |
| | Total | | 2 | 7 | 23 | 43 | 31 | 8 | 10 | 2 | 126 |

| Chi-Square Tests | | | | |
|---|---|---|---|---|
| Age Condensed | | Value | df | Asymp. Sig. (2-sided) |
| Non Millennials | Pearson Chi-Square | 7.875[c] | 2 | .019 |
| | Likelihood Ratio | 6.985 | 2 | .030 |
| | Linear-by-Linear Association | 2.693 | 1 | .101 |

ICT Usage was a different story. When running a cross tabulation between ICT Usage with the 5 Year Diff, we see a P value of 0.716, indicating no relationship. The same occurs when we control for the various demographics, demonstrating that ICT Usage displayed no relationships in our survey group within the 5 year projection period.

## 4.5 Driving Perception, ICT Usage, and Ten Year Preference

Driving Perception displayed no significant relationship within the 10 year residential preferences of the survey group, even when controlled for the various demographic variables. However, similar to the above results, when we look at the 10 Year Diff instead and Driving Perception data, we see an association within the White (Race) and the University (Education) categories, displaying P values of 0.007 and 0.032, respectively. Unfortunately, the data here holds many cells with low counts, making it difficult to draw any reliable implications.

Table 12: Driving Perception and 10 Year Diff Values Controlled for Race

| **Driving Preference * 10 Year Diff * Race** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Count | | | | | | | | | | | | |
| Whites vs. Not White | | | LOCATIONDIFFCurrent10Years | | | | | | | | | Total |
| | | | -4.0 | -3.0 | -2.0 | -1.0 | .0 | 1.0 | 2.0 | 3.0 | 4.0 | |
| **White** | **Driving Condensed** | **Nuisance** | **1** | **4** | **4** | **8** | **8** | **0** | **3** | **4** | **0** | 32 |
| | | **Opportunity** | **0** | **1** | **6** | **19** | **27** | **17** | **3** | **3** | **1** | 77 |
| | Total | | 1 | 5 | 10 | 27 | 35 | 17 | 6 | 7 | 1 | 109 |
| Non White | Driving Condensed | Nuisance | | | | 2 | 1 | 4 | 2 | 0 | | 9 |
| | | Opportunity | | | | 1 | 2 | 1 | 3 | 1 | | 8 |
| | Total | | | | | 3 | 3 | 5 | 5 | 1 | | 17 |
| Total | Driving Condensed | Nuisance | 1 | 4 | 4 | 10 | 9 | 4 | 5 | 4 | 0 | 41 |
| | | Opportunity | 0 | 1 | 6 | 20 | 29 | 18 | 6 | 4 | 1 | 85 |
| | Total | | 1 | 5 | 10 | 30 | 38 | 22 | 11 | 8 | 1 | 126 |

| **Chi-Square Tests** | | | | |
|---|---|---|---|---|
| Whites Not White | | Value | df | Asymp. Sig. (2-sided) |
| White | Pearson Chi-Square | 21.169[b] | 8 | .007 |
| | Likelihood Ratio | 25.174 | 8 | .001 |
| | Linear-by-Linear Association | 2.126 | 1 | .145 |
| | N of Valid Cases | 109 | | |

Table 13: Driving Perception and 10 Year Diff Values Controlled for Education

| Driving Preference * 10 Year Diff * Education | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Count | | | | | | | | | | | | |
| Education Condensed | | | LOCATIONDIFFCurrent10Years | | | | | | | | | Total |
| | | | -4.0 | -3.0 | -2.0 | -1.0 | .0 | 1.0 | 2.0 | 3.0 | 4.0 | |
| **University** | **Driving Condensed** | **Nuisance** | | **2** | **1** | **1** | **1** | **1** | **1** | **3** | | 10 |
| | | **Opportunity** | | **0** | **0** | **8** | **5** | **8** | **0** | **4** | | 25 |
| | Total | | | 2 | 1 | 9 | 6 | 9 | 1 | 7 | | 35 |
| Non University | Driving Condensed | Nuisance | 1 | 2 | 3 | 9 | 8 | 3 | 4 | 1 | 0 | 31 |
| | | Opportunity | 0 | 1 | 6 | 12 | 24 | 10 | 6 | 0 | 1 | 60 |
| | Total | | 1 | 3 | 9 | 21 | 32 | 13 | 10 | 1 | 1 | 91 |
| Total | Driving Condensed | Nuisance | 1 | 4 | 4 | 10 | 9 | 4 | 5 | 4 | 0 | 41 |
| | | Opportunity | 0 | 1 | 6 | 20 | 29 | 18 | 6 | 4 | 1 | 85 |
| | Total | | 1 | 5 | 10 | 30 | 38 | 22 | 11 | 8 | 1 | 126 |

| Chi-Square Tests | | | | |
|---|---|---|---|---|
| Education Condensed | | Value | df | Asymp. Sig. (2-sided) |
| University | Pearson Chi-Square | 13.806[b] | 6 | .032 |
| | Likelihood Ratio | 14.353 | 6 | .026 |
| | Linear-by-Linear Association | .078 | 1 | .780 |
| | N of Valid Cases | 35 | | |

ICT usage and the 10 Year Preference data presented a P value of 0.709, indicating that there is no significant association. However, when controlled for Income in the Less Than $40,000 income range, we see a P value of 0.022 with a Linear by Linear Association of 0.018. Looking at the cell frequencies for Less than $40,000 data, we can observe that High ICT Usage is associated with preference for the less dense transect zones while Low ICT Usage is associated with the less dense transect zones.

Table 14: ICT Usage and 10 Year Residential Preference Controlled for Income

| ICT Usage x 10 Year Preference x Income | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Count | | | | | | | | |
| Income Condensed | | | 10 Year | | | | | Total |
| | | | T-2 | T-3 | T-4 | T-5 | T-6 | |
| **Less than 40k** | **Hourly Usage Condensed** | **Low** | **3** | **3** | **7** | **2** | **6** | 21 |
| | | **High** | **7** | **10** | **11** | **5** | **0** | 33 |
| | Total | | 10 | 13 | 18 | 7 | 6 | 54 |
| 40-80k | Hourly Usage Condensed | Low | 3 | 8 | 6 | 2 | 2 | 21 |
| | | High | 7 | 4 | 7 | 2 | 3 | 23 |
| | Total | | 10 | 12 | 13 | 4 | 5 | 44 |
| 80k+ | Hourly Usage Condensed | Low | 5 | 5 | 3 | 1 | 1 | 15 |
| | | High | 2 | 6 | 2 | 4 | 4 | 18 |
| | Total | | 7 | 11 | 5 | 5 | 5 | 33 |
| Total | Hourly Usage Condensed | Low | 11 | 16 | 16 | 5 | 9 | 57 |
| | | High | 16 | 20 | 20 | 11 | 7 | 74 |
| | Total | | 27 | 36 | 36 | 16 | 16 | 131 |

| Chi-Square Tests | | | | |
|---|---|---|---|---|
| Income Condensed | | Value | df | Asymp. Sig. (2-sided) |
| Less than 40k | Pearson Chi-Square | 11.442[b] | 4 | .022 |
| | Likelihood Ratio | 13.476 | 4 | .009 |
| | Linear-by-Linear Association | 5.605 | 1 | .018 |
| | N of Valid Cases | 54 | | |

## 4.6 Driving Perception, ICT Usage, and Twenty Year Preference

The cross tabulation between Driving Perception and the 20 Year residential preference reveals a P value of 0.339, indicating no relationship. However, when we control for the demographics, we see a relationship with the Job variable, specifically, with the White Collar (Job) category (P value: 0.04) and a Linear by Linear Association of 0.03. Cell frequencies indicate that White Collar respondents who viewed driving as

an opportunity heavily favored living in the T-2 and T-3 transect zones--the least dense environments.

Table 15: Driving Perception and 10 Year Residential Preference Controlled for Job

| **Driving Condensed * 20 Year Pref * Job** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Count | | | | | | | | |
| Job Condensed | | | 20 Year | | | | | Total |
| | | | T-2 | T-3 | T-4 | T-5 | T-6 | |
| **White Collar** | **Driving Condensed** | **Nuisance** | **2** | **5** | **5** | **4** | **1** | 17 |
| | | **Opportunity** | **14** | **14** | **5** | **1** | **3** | 37 |
| | Total | | 16 | 19 | 10 | 5 | 4 | 54 |
| Student | Driving Condensed | Nuisance | 7 | 7 | 1 | 1 | 3 | 19 |
| | | Opportunity | 7 | 11 | 6 | 4 | 1 | 29 |
| | Total | | 14 | 18 | 7 | 5 | 4 | 48 |
| Neither White Collar nor Student | Driving Condensed | Nuisance | 1 | 0 | 1 | 1 | 0 | 3 |
| | | Opportunity | 5 | 7 | 1 | 0 | 1 | 14 |
| | Total | | 6 | 7 | 2 | 1 | 1 | 17 |
| Total | Driving Condensed | Nuisance | 10 | 12 | 7 | 6 | 4 | 39 |
| | | Opportunity | 26 | 32 | 12 | 5 | 5 | 80 |
| | Total | | 36 | 44 | 19 | 11 | 9 | 119 |

| **Chi-Square Tests** | | | | |
|---|---|---|---|---|
| Job Condensed | | Value | df | Asymp. Sig. (2-sided) |
| White Collar | Pearson Chi-Square | 10.032[b] | 4 | .040 |
| | Likelihood Ratio | 9.950 | 4 | .041 |
| | Linear-by-Linear Association | 4.731 | 1 | .030 |
| | N of Valid Cases | 54 | | |

ICT usage did not display any significant relationship in the 20 Year Preference projection with the exception of when usage is controlled for Job type. When viewing the relationship between ICT Usage and 20 Year Preference controlling for Student (Job

Type) category, we observe a P value of 0.042 and a Linear by Linear Association value of 0.004. The cell frequencies show that students who were high ICT users tended to prefer the less dense T-2 and T-3 transect zones.

Table 16: ICT Usage and 20 Year Residential Preference Controlled for Jobs

| **ICT Usage x 20 Year Pref x Job** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Count | | | | | | | | |
| JobCondensed | | | 20 Year | | | | | Total |
| | | | T-2 | T-3 | T-4 | T-5 | T-6 | |
| White Collar | Hourly Usage Condensed | Low | 8 | 8 | 4 | 1 | 3 | 24 |
| | | High | 10 | 10 | 10 | 6 | 2 | 38 |
| | Total | | 18 | 18 | 14 | 7 | 5 | 62 |
| **Student** | **Hourly Usage Condensed** | **Low** | **4** | **7** | **5** | **5** | **3** | 24 |
| | | **High** | **8** | **10** | **4** | **0** | **0** | 22 |
| | Total | | 12 | 17 | 9 | 5 | 3 | 46 |
| Neither White Collar nor Student | Hourly Usage Condensed | Low | 2 | 2 | 1 | | 1 | 6 |
| | | High | 6 | 4 | 2 | | 0 | 12 |
| | Total | | 8 | 6 | 3 | | 1 | 18 |
| Total | Hourly Usage Condensed | Low | 14 | 17 | 10 | 6 | 7 | 54 |
| | | High | 24 | 24 | 16 | 6 | 2 | 72 |
| | Total | | 38 | 41 | 26 | 12 | 9 | 126 |

| **Chi-Square Tests** | | | | |
|---|---|---|---|---|
| Job Condensed | | Value | df | Asymp. Sig. (2-sided) |
| Student | Pearson Chi-Square | 9.906[c] | 4 | .042 |
| | Likelihood Ratio | 13.006 | 4 | .011 |
| | Linear-by-Linear Association | 8.526 | 1 | .004 |

## 4.7 Graphing the Preferences

While the P values provide us with insight into the statistical significance of the different relationships and associations between the variables, the visualizing of the relationships between ICT Usage, Driving Perception, and residential preference data offer additional insight. With the graphs below, we can see a few trends more clearly:

1) Within a 5 year preference projection, those who view driving as a nuisance are far more willing to live in the denser transect zones. Those who view driving as an opportunity tend to favor the least dense T-2 and T-3 transect zones.

2) In terms of Driving Perception, as survey respondents project their preferences further into the future, they tend to favor the T-2 an T-3 transect zones regardless of their view on driving.

3) The Diff graphs demonstrate clearly that those who perceive driving as an Opportunity were much more satisfied with where they currently live compared to those who viewed driving as a Nuisance.

4) ICT Usage effect on residential preference is less clear and difficult to interpret.

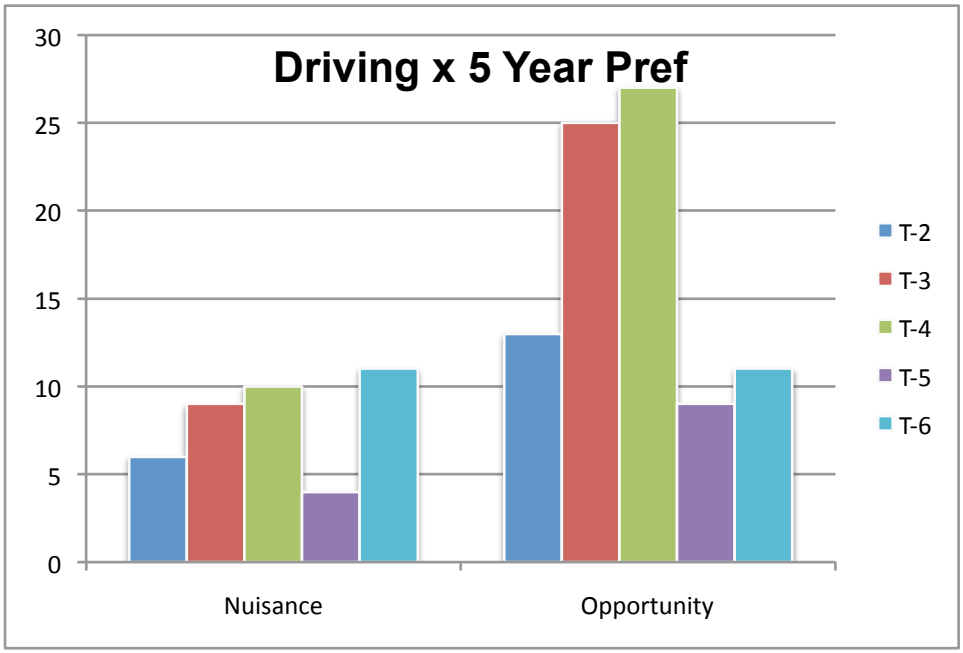


Figure 6: Driving Perception and 5 Year Residential Preference

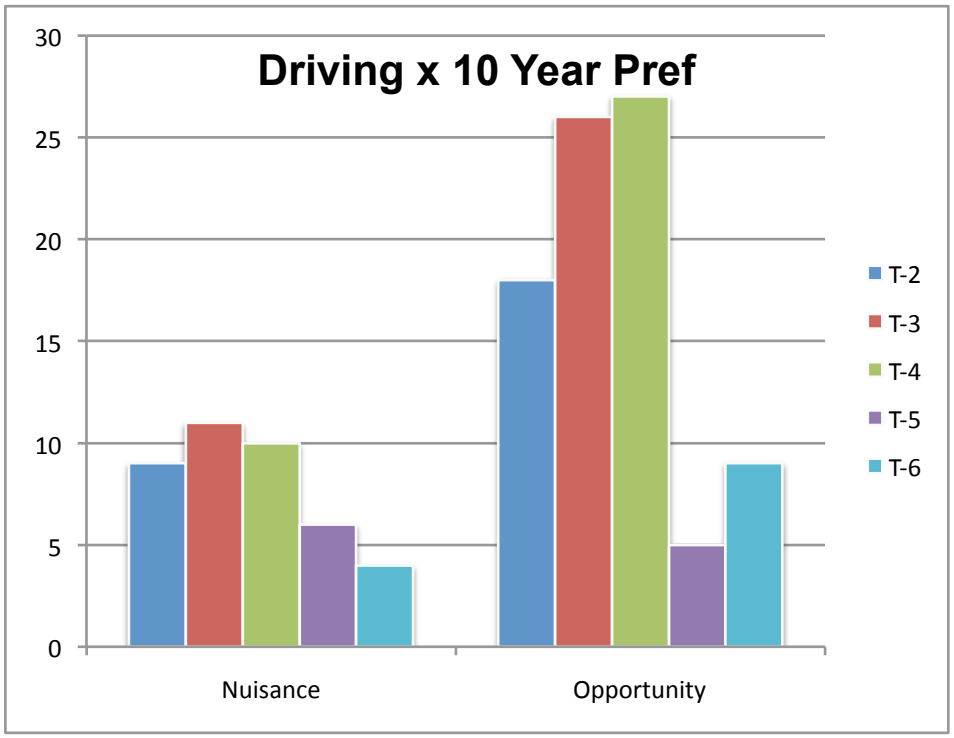


Figure 7: Driving Perception and 10 Year Residential Preference

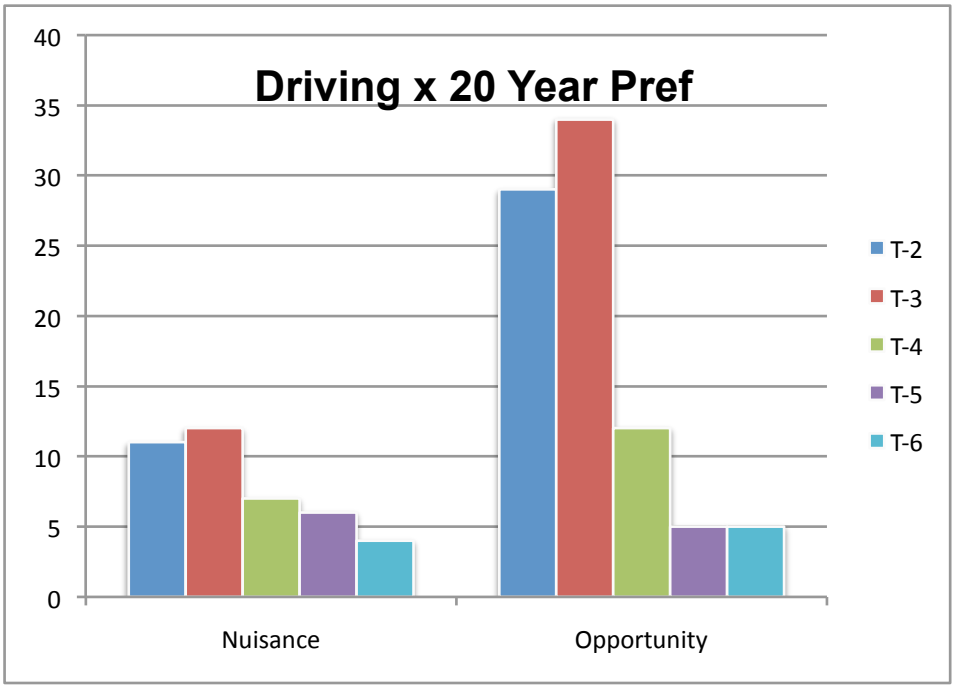


Figure 8: Driving Perception and 20 Year Residential Preference

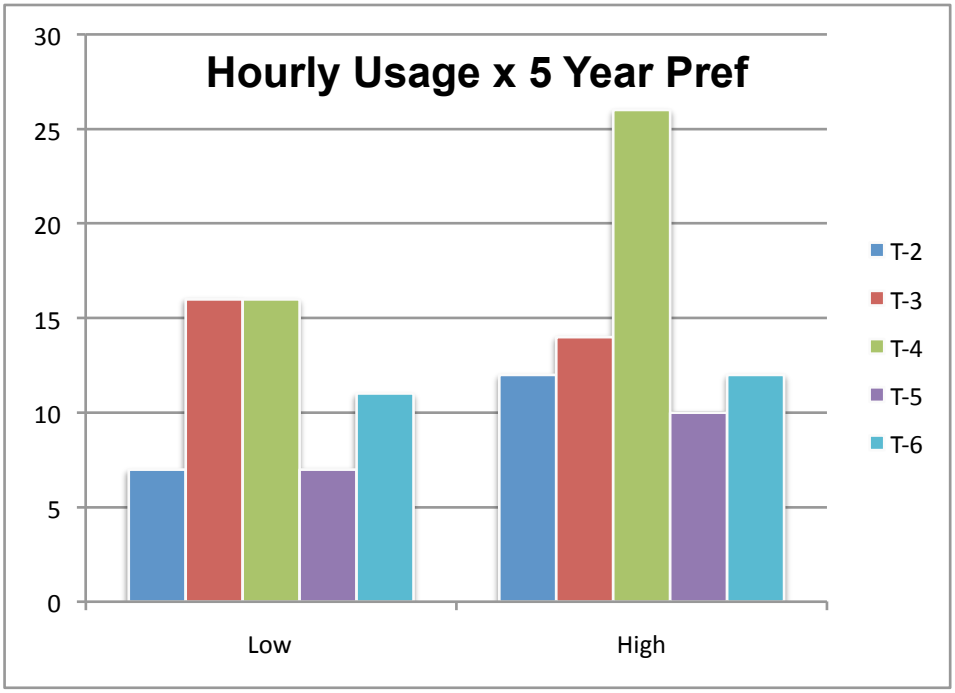


Figure 9: ICT Usage and 5 Year Residential Preference

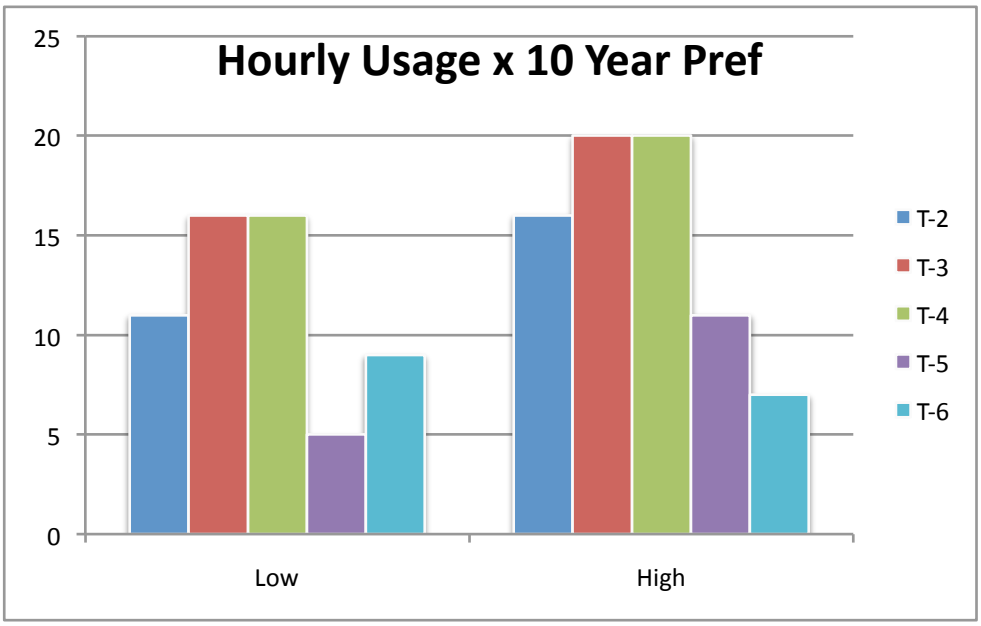


Figure 10: ICT Usage and 10 Year Residential Preference

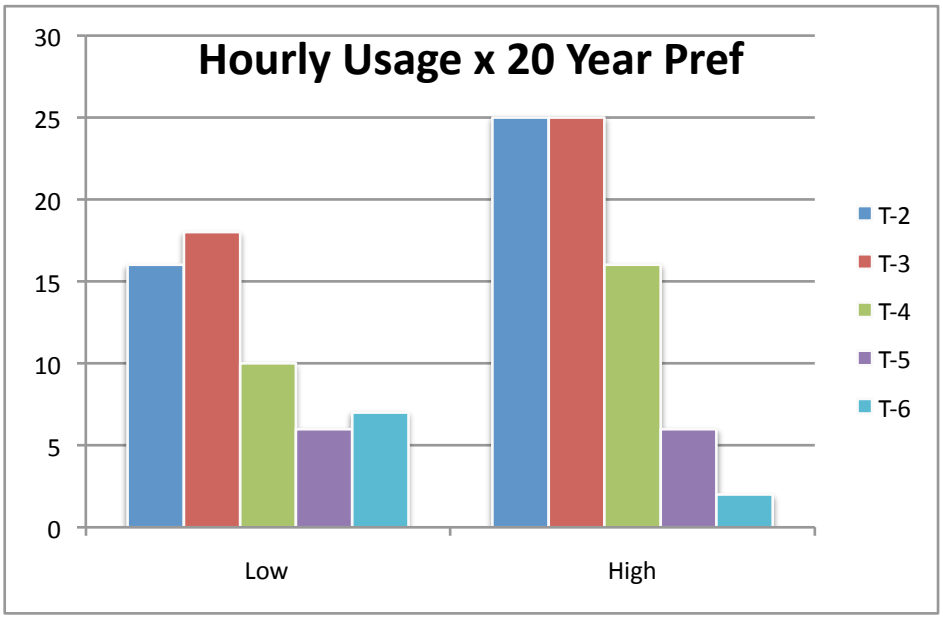


Figure 11: ICT Usage and 20 Year Residential Preference

# CHAPTER 5

# RESULTS

## 5.1 Interpreting the Findings

Within the survey sample that the analysis was performed on, the overall trends are quite clear. One conclusion that can be drawn is that, in the long run, the majority of participants projected their preference for living in a less dense transect zone rather than the so-often-touted more urban ones. The common notion about older households wanting to move back to the city is not reflected in this sampled group. In fact, the opposite appears; with the older groups overwhelmingly wishing to reside in the low density T-2 and T-3 transect zones.

The Millennials show a similar 20-year projected residential preference for lower density, but the time in-between the 20 year projection and their immediate area of residence offers interesting insight. In the near future, compared to those older than them, they seem to be more willing to prefer a wide spectrum of residential environments.

Table 2 showed that, for Millennials, their preference for residential environment within 5 years is highly variable and dispersed among the different transect zones. This is especially interesting considering that the majority of them currently reside in a T-3 Suburban area, indicating that they have a high desire to move to a different location. This can be seen in their Location DIFF value.

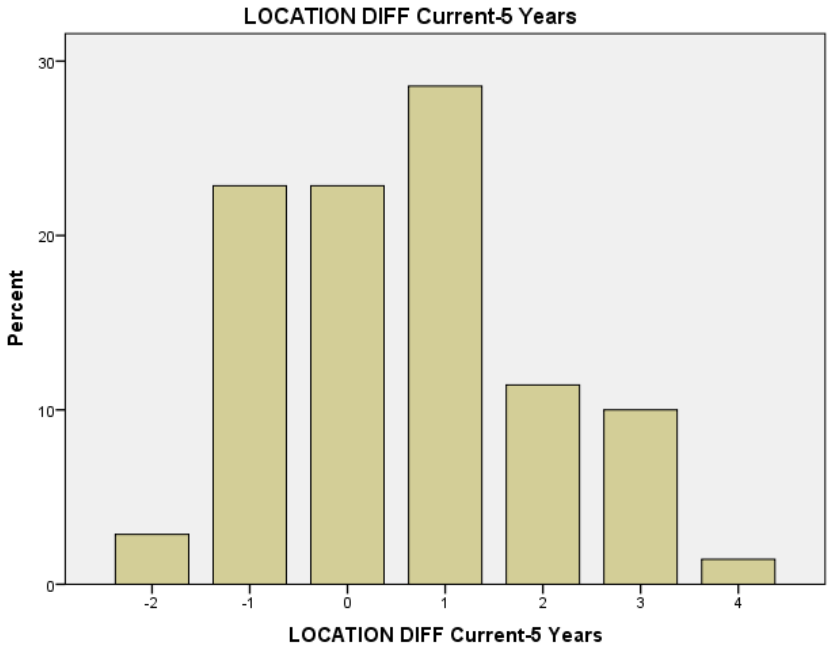


Figure 12: Millennials' Location Diff for 5 Year Projection

However, once they project their preferences further into the future, they typically envision themselves in a rural or suburban environment. The most evident explanation for this is that after a ten year projection, those respondents are no longer in their twenties and are now in their early to mid-thirties, a time when many typical Americans find themselves in a two-person household and possibly with children. So how could ICT usage and driving perception figure into this scenario?

Contrary to the hypothesized relationship between Driving Perception and ICT Usage, we do not arrive at the same conclusions that Sivak's (2012) report does. A significant relationship did not appear between the two unless it was controlled for

Student (Job Type) rather than Age. When a significant relationship did occur, the relationship appeared positive instead of negative as suggested by the Sivak (2012) report.

While this analysis suggests a slight synergistic relationship between high ICT usage and the perception of driving as an opportunity, the data suggest that, between Driving Perception and ICT Usage, Driving Perception plays a much more significant role in influencing residential preference. Furthermore, it appears as though the residential preferences of those who are either White, a student, or hold a university education are most influenced by their Driving Perception.

When we compared the two categories of Driving Perception, Nuisance and Opportunity, we found that there were observable differences in preference for where they wanted to live in the next 5 to 10 years. Those that viewed driving as a nuisance were more likely to prefer to live in the denser transect zones, while those that enjoyed driving were more inclined to project their preferences towards the less dense transect zones. The relationship of ICT usage and residential preference was uncertain in this study, with almost every analysis involving ICT usage leading to a high P value or unclear relationship.

# CHAPTER 6

# LIMITATIONS

## 6.1 Weaknesses of Study

The sample size and method of data collection are limitations of this study. In addition to the relatively small sample size, there exists sample bias due to the primary distribution method of the survey instrument. The participants were largely located within the author's social network and thus, partially concentrated geographically within the Southwest and the Mid-Atlantic region of the United States. While there were indeed survey results from all over the country, and even included some international participants, approximately half of the participants came from those U.S. regions.

Another limitation of the study is that the majority of survey participants are young (Millennials) while the control or comparison group (Non Millennials) was relatively small. If the survey had reached more older people in the Non Millennial category, the findings may have been different and perhaps more significant differences would have been found between the two groups.

The operationalization of the hypothesized ideas into categorical variables for analysis also presents a limitation of the study. The concepts behind the hypotheses represent complex relationships very roughly captured by their operationalization in this study's survey questions. As a result, the data is "coarse" and the analysis only offers a first approximation and exploration of the empirical referents of the concepts and relationships between ICT connectivity, driving perceptions and residential preference.

Another possible weakness of the study is the fact that the survey was taken by people who most likely had never considered many of the questions before and thus answered the survey without a deep understanding of how the automobile and ICT usage had truly impacted their lives. In essence, the participants most likely answered the questions based on superficial feelings and knowledge regarding the subject. This, however, is not unusual in many surveys of all different types and is somewhat counteracted by the abundance of "preference" questions rather than objective questions.

Finally, the visual preference survey images were chosen to represent ideal locations and residential density patterns. However, it is possible that the images evoked emotional attachments to a particular location rather than the residential density they were meant to represent.

For future study, this thesis could incorporate more of the data gathered by the survey to see if there existed any additional relationships among those data values and the ICT usage, Feelings on Driving, and transect zone preference. The survey instrument could also be updated to include questions regarding Gender while adding additional questions regarding the preference for an Internet connected device or an automobile if cost was not a concern. In addition, a larger and completely random sample could be used instead.

# CHAPTER 7

# CONCLUSIONS

## 7.1 Conclusions and Final Thoughts

Many people have touted the rise of Ubicomp, ICT, and mobile phone technology as a game changer regarding the relationship between people, the automobile, and urbanism. Real estate agents, planners, developers, and academics alike have been strong proponents of Mixed Use, New Urbanist developments. They argue that younger individuals are tired of the time and monetary requirements of owning and operating an automobile and thus are eschewing driving for new media technologies such as smartphones and tablets, which not only have a lower cost of entry, but allow access to an enormous network of individuals, content, and entertainment almost instantaneously. At the same time, they have been debating whether a new generation will favor the revitalized mixed use, dense, urban downtown centers advocated by urbanists like Jane Jacobs and Richard Florida, or whether they will be flocking to newly developed, spacious, quiet suburbs with quaint downtown main streets.

This study suggests that among respondents that are students, possess a university education, or are white, their positive automobile perceptions are strongly associated with their five to ten year projected preferences for residential environment. Keeping in mind that the largest proportion of participants in this study are 18 to 35 years old, so that their expected age in five to ten years would be somewhere between 23-45 years old, the participants in this study displayed three primary trends:

1) Residential preferences among those who dislike driving tend to lean towards the more dense T-zones represented in this study by the T-4 general urban, T-5 urban center, and T-6 urban core transect zones.

2) Residential preferences among those who enjoy driving tend to lean towards the less dense T-zones, represented in this study as T-2 rural and T-3 suburban transect zones.

3) However, eventually, the majority in the sample wishes to live in the less dense T-zones.

It is very important to note that almost everyone in the sample eventually preferred to live in a T-2 or T-3 zone at the 20-year level projection. Paradoxically, these are the type of residential environments that planners have wanted to densify for decades.

In addition, this sampled group did not display the inverse relationship between Driving Perception and ICT Usage suggested in the Sivak (2012) report and initially hypothesized in this thesis. Quite the opposite, this group seems to be slightly inclined to synergize ICT Usage with driving perceived as an opportunity. This suggests, as others have reported (Audirac 2005), that being virtually connected enhances desired mobility, i.e. more automobile trips rather than trip substitution.

The findings suggest more support for Joel Kotkin's argument that Nerdistans and "smart suburbs" may be the future. While the sample group used here was not necessarily diverse; its demographics--white, young, and educated-- mimic the group many developers and cities are looking to attract to increase their tax base, and thus could represent a very influential subpopulation in terms of preference and demand for urban development. This research suggests that rather than an entire generational trend,

the preference for higher density zones among this study's Millennial population may possibly be a temporary trend that evolves following the stages of household change.

While we are unable to generalize the findings from this sample to the greater population, the findings provide a reason to further research and contemplate the influence of ICT connectivity on driving patterns and vice versa, as well as further explore how this relationship of ICT and automobiles may contribute to higher demand for mobility and low density rather than high density residential environments. This study suggests that new urbanist developments that offer the entire array of residential zones, from T-2 to T-6, may be the type of place that caters to an individual who wishes to grow older in the same place by allowing them to shift from T-zone to T-zone as the household grows and shrinks over time. In the end, the larger implications from this study, if future and continuing research supports its findings, is that the largest proportion of land devoted to these new urbanist developments would most likely be destined to accommodate the preferences of single family household living rather than multifamily apartment housing.

# APPENDIX A

# SURVEY INSTRUMENT

# Thesis Survey for Steven Duong

Survey Page

The following are general demographic questions.

**Which of these would describe you best?**

- White
- African American
- American Indian/Native Alaskan
- Asian
- Other Pacific Islander
- Hispanic
- Other

**How old are you?**

- 18-24
- 25-29
- 30-34
- 35-39
- 40-44
- 45-49
- 50+

**What is the highest level of education you have completed?**

- Eight or fewer years of elementary education
- High School or GED equivalent
- Two year community college or equivalent
- Four year university of equivalent
- Graduate degree or advanced degree
- None of the above

**What is your average annual household income? If you do not earn an income, use the income of those that claim you as a dependent.**

- Less than $20,000
- Between $21,000 and $40,000

- Between $41,000 and $60,000
- Between $61,000 and $80,000
- Over $80,000

**What is your marital status?**

- Single
- Married
- In a Relationship

The following questions aim to find out your general feelings about driving an automobile.

**On a scale of 7, how do you generally feel about driving an automobile? Do you think it is a nuisance or an opportunity?**

- 1 - big nuisance
- 2 - a nuisance
- 3 - somewhat of a nuisance
- 4 - not a nuisance nor an opportunity
- 5 - somewhat of an opportunity
- 6 - an opportunity
- 7 - big opportunity
- Do not own an automobile or drive

**On a scale of 1-7, how do you feel specifically about driving an automobile to your workplace or school?**

- 1 - big nuisance
- 2 - a nuisance
- 3 - somewhat of a nuisance
- 4 - not a nuisance nor an opportunity
- 5 - somewhat of an opportunity
- 6 - an opportunity
- 7 - big opportunity
- Do not own an automobile or drive
- Do not currently work or go to school

**How long is your drive to work or school?**

- Less than 5 minutes
- 5-10 minutes
- 10-20 minutes
- 20-30 minutes
- 30-40 minutes
- 40-50 minutes
- 50-60 minutes
- More than 60 minutes

**On a scale of 1-7, how do you feel specifically about driving an automobile to casually socialize with friends or family?**

- 1 - big nuisance
- 2 - a nuisance
- 3 - somewhat of a nuisance
- 4 - not a nuisance or an opportunity
- 5 - somewhat  of an opportunity
- 6 - an opportunity
- 7 - big opportunity
- Do not own an automobile or drive

This next set of questions aims to find out your usage patterns of mobile technology and PCs.

**Do you own, or have access through your job, to a data enabled smartphone or tablet that allows browsing the Internet?**

- Yes
- No

**How long have you owned or used one?**

- Less than one year
- Less than three years
- Less than five years
- More than five years
- Do not own or have access to a smartphone

**How many hours would you say you use it on a daily basis?**

- Less than one hour
- Between 1-2 hours
- Between 2-3 hours
- More than 3 hours
- Do not own or have access to a smartphone or tablet

**On scale of 1 to 10, please rate how important is your smart phone device/tablet or internet enabled PC for your social life?**

- 1 - little or negligible importance
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10 - of utmost importance
- Do not own or have access to a smartphone or tablet

**On scale of 1 to 10, how important is your smart phone device or tablet in keeping in touch with close friends and family?**

- 1 - little or negligible importance
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10 - of utmost importance

- Do not own or have access to a smartphone or tablet

**On scale of 1 to 10, how important is it for keeping in touch with long distance friends?**

- 1 - little or negligible importance
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10 - of utmost importance
- Do not own or have access to a smartphone or tablet

**On a scale of 1 to 10, how beneficial do you feel that using a smartphone is in your relationship with friends and family?**

- 1 - little or no benefit
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10 - most beneficial
- Do not have own or have access to a smartphone or tablet

**How would you classify your job type or work situation?**

- White Collar (Typically office environment)
- Blue Collar (Typically manual labor)
- Pink Collar (Typically service or customer related)

- Student
- Homemaker
- Retired
- Unemployed

These next set of questions aim to find out how important mobile internet and PCs are to your job or school activities.

**On a scale from 1 to 10, how important is a smartphone/tablet or internet enabled PC to your work or school life?**

- 1 - least important
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10 - most important
- Do not own or have access to a smartphone or tablet

**Does your job or school situation require the use of a smartphone/tablet or internet or internet enabled PC?**

- Yes
- No

**On a scale from 1 to 10, please rate how much has your smartphone/tablet or internet enabled PC helped enhance your job or school performance?**

- 1 - no or little help
- 2
- 3
- 4
- 5
- 6

- 7
- 8
- 9
- 10 - huge help
- Do not own or have access to a smartphone/tablet or internet enabled PC

**On a scale of 1 to 10, how often have you used your device to do work away from your place of employment or school?**

- 1 - never used
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10 - often used
- Do not own or have access to a smartphone/tablet or internet enabled PC

**On a scale of 1-10, how often have you used your device or internet enabled PC to shop online?**

- 1 - rarely
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10 - always

- Do not own or have access to an internet enabled device

**On a scale of 1 to 10, how important is it for you to have the ability to shop online?**

- 1 - little or not important
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10 - very important
- Do not own or have access to an internet enabled device

**On a scale of 1 to 10, how important is your device or internet enabled PC to doing online errands of any sort? (I.e. pay bills, do taxes, sending packages, research information, etc.)**

- 1 - of little importance
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10 - of utmost importance
- Do not own or have access to an internet enabled device

**On a scale of 1-10, how often do you use some sort of public "review" service such as Yelp, Zagat, UrbanSpoon, etc., before you decide to go somewhere?**

- 1 - rarely
- 2

- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10 - always
- Do not own or have access to an internet enabled device

Almost done! Just a few last questions about your general location and preference for living environment.

**Please provide the zipcode of the place where you currently live. If you are outside of the US, put your relevant postal code and country.**

**Please provide the zipcode of the place where you go to work or school. If you are outside of the US, put your relevant postal code and country.**

The next few questions are about the place where you currently live and the place where you would like to live. Although none of the images provided may exactly match your current and preferred place of residence, we ask you that you choose the one that most approximates your current and preferred place.

Please visit this link and use the images provided to answer the following questions.

https://docs.google.com/file/d/0B0hhuEfl1yYRVVpkMXUzN2k2bEk/edit?usp=sharing

**Please select the image that comes closest to reflecting the neighborhood character of the place where you currently live**

- A
- B
- C
- D
- E

**Please select the image that comes closest to reflecting the neighborhood character of the place where you would prefer to live in 5 years.**

- A
- B
- C
- D
- E

**Taking into account your projected income level, please select the image that comes closest to reflecting the neighborhood character of the place where you would prefer to live in 10 years.**

- A
- B
- C
- D
- E

**Taking into account your projected income level, please select the image that comes closest to reflecting the neighborhood character of the place where you would prefer to live in 20 years.**

- A
- B
- C
- D
- E

CONGRATUATIONS! You have reached the end!

Thank you for participating in this survey, please click submit to complete the survey and confirm your submission.

« Back Submit

# APPENDIX B

# SURVEY DATA DEMOGRAPHICS BREAKDOWN

## RACE

| Race | Frequency | Percent | Cumulative Percent |
|---|---|---|---|
| White | 135 | 86 | 86 |
| African American | 1 | 0.6 | 86.6 |
| Asian | 14 | 8.9 | 95.5 |
| Other Pacific Islander | 1 | 0.6 | 96.2 |
| Hispanic | 5 | 3.2 | 99.4 |
| Other | 1 | 0.6 | 100 |
| Total | 157 | 100 | |

## AGE

| Age | Frequency | Percent | Cumulative Percent |
|---|---|---|---|
| 18-24 | 70 | 44.6 | 44.6 |
| 25-29 | 39 | 24.8 | 69.4 |
| 30-34 | 31 | 19.7 | 89.2 |
| 35-39 | 5 | 3.2 | 92.4 |
| 40-44 | 2 | 1.3 | 93.6 |
| 45-49 | 10 | 6.4 | 100.0 |
| Total | 157 | 100.0 | |

## INCOME

| Income | Frequency | Percent | Cumulative Percent |
|---|---|---|---|
| Less than $20,000 | 32 | 20.4 | 20.4 |
| Between $21,000 and $40,000 | 35 | 22.3 | 42.7 |
| Between $41,000 and $60,000 | 33 | 21.0 | 63.7 |
| Between $61,000 and $80,000 | 20 | 12.7 | 76.4 |
| Over $80,000 | 37 | 23.6 | 100.0 |
| Total | 157 | 100.0 | |

## EDUCATION

| Education | Frequency | Percent | Cumulative Percent |
|---|---|---|---|
| Eight or fewer years of elementary education | 2 | 1.3 | 1.3 |
| High School Diploma or GED equivalent | 23 | 14.6 | 15.9 |
| Two year community college or equivalent | 20 | 12.7 | 28.7 |
| Four year university or equivalent | 85 | 54.1 | 82.8 |
| Graduate degree or advanced degree | 27 | 17.2 | 100 |
| Total | 157 | 100 | |

## MARITAL STATUS

| Marital Status | Frequency | Percent | Cumulative Percent |
|---|---|---|---|
| Single | 67 | 42.7 | 43.2 |
| Married | 40 | 25.5 | 69.0 |
| In a Relationship | 48 | 30.6 | 100.0 |
| Total | 155 | 98.7 | |
| Missing | 2 | 1.3 | |
| Total with Missing | 157 | 100.0 | |

## JOB CLASSIFICATION

| Job | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|
| White Collar | 72 | 45.9 | 46.2 | 46.2 |
| Blue Collar | 4 | 2.5 | 2.6 | 48.7 |
| Pink Collar | 18 | 11.5 | 11.5 | 60.3 |
| Student | 57 | 36.3 | 36.5 | 96.8 |
| Homemaker | 3 | 1.9 | 1.9 | 98.7 |
| Retired | 1 | .6 | .6 | 99.4 |
| Unemployed | 1 | .6 | .6 | 100.0 |

# APPENDIX C

## CONDENSED CATEGORIES

| RACE | | | |
|---|---|---|---|
| **Original Category** | **Value** | **Condensed Value** | **New Category** |
| White | 1 | 1 | White |
| African American | 2 | 2 | Non-White |
| American Indian | 3 | 2 | |
| Asian | 4 | 2 | |
| Other Pacific Islander | 5 | 2 | |
| Hispanic | 6 | 2 | |
| Other | 7 | 2 | |

| AGE | | | |
|---|---|---|---|
| **Original Category** | **Value** | **Condensed Value** | **New Category** |
| 18-24 | 1 | 1 | Millennials |
| 25-29 | 2 | 2 | |
| 30-34 | 3 | 3 | |
| 35-39 | 4 | 4 | Non-Millennials |
| 40-44 | 5 | 4 | |
| 45-49 | 6 | 4 | |
| 50+ | 7 | 4 | |

| FEELINGS ON DRIVING | | | |
|---|---|---|---|
| **Original Category** | **Value** | **Condense Value** | **New Category** |
| A big nuisance | 1 | 1 | Nuisance |
| Somewhat a nuisance | 2 | 1 | |
| A nuisance | 3 | 1 | |
| Neither | 4 | NULL | Neutral |
| An opportunity | 5 | 2 | Opportunity |
| Somewhat an opportunity | 6 | 2 | |
| A big opportunity | 7 | 2 | |

| INCOME | | | |
|---|---|---|---|
| **Original Category** | **Value** | **Condensed Value** | **New Category** |
| Less than 20k | 1 | 1 | 1 |
| 20-40k | 2 | 1 | |
| 40-60k | 3 | 2 | 2 |
| 60-80k | 4 | 2 | |
| 80k+ | 5 | 3 | 3 |

| EDUCATION | | | |
|---|---|---|---|
| **Original Category** | **Value** | **Condensed Value** | **New Category** |
| Eight or Fewer Years of Elementary Education | 1 | 1 | NonUniversity |
| High School or GED | 2 | 1 | |
| Two Year Community College | 3 | 1 | |
| Four Year University | 4 | 2 | University |
| Graduate Degree | 5 | 2 | |
| None of the Above | 6 | NULL | Missing |

| JOB CLASSIFICATION | | | |
|---|---|---|---|
| **Original Category** | **Value** | **Condensed Value** | **New Category** |
| White Collar | 1 | 1 | White Collar |
| Blue Collar | 2 | 3 | Neither |
| Pink Collar | 3 | 3 | |
| Student | 4 | 2 | Student |
| Homemaker | 5 | 3 | Neither |
| Retired | 6 | 3 | |
| Unemployed | 7 | 3 | |

| ICT USAGE | | | |
|---|---|---|---|
| **Original Category** | **Value** | **Condense Value** | **New Category** |
| 0-1 Hours | 1 | 1 | Low Usage |
| 1-2 Hours | 2 | 1 | |
| 2-3 Hours | 3 | 2 | High Usage |
| 3+ Hours | 4 | 2 | |

# APPENDIX D

SPSS OUTPUTS (ATTACHED SEPERATELY)

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# BIOGRAPHICAL INFORMATION

Having completed his undergraduate degree in Urban Planning at Virginia Tech, Steven Duong is now a candidate for a master's degree in City and Regional Planning at the University of Texas at Arlington. He is most interested in the converging of planning, architecture, urban design, and technology.