Time Use, Disability and Mobility among Older Americans

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ABSTRACT

This paper explores how disability, mobility, social and leisure engagement, and travel behavior influence older people's life satisfaction. We use the 2013 Disability and Use of Time data of people aged 50 and above many of whom report physical impairments. We develop a model that relates life satisfaction with different time uses, disability, and mobility variables. Summary statistics of time use show that as people get older, they spend more time on solitary passive leisure activities while social face-to-face time does not seem to change very much. Alone passive leisure time use is especially large for those experiencing a physical mobility related disability and are car-less. Using an ordinal logistic regression, we find that longer alone leisure time uses are associated with lower life satisfaction. Life satisfaction is positively affected by different transportation related variables such as vehicle availability. We also find that social face-to-face time use has a weak positive relationship with life satisfaction while technology mediated social activities had a strong negative relationship with life satisfaction.

INTRODUCTION

Older Americans are making up an increasing part of the nation's population. In 2014, 14.5% of the U.S. population was over the age of 65 and this number is expected to almost double by 2060 (*1*). According to census figures, almost two in five among the elderly (38.7%) report some form of disability (*2*). Noting these population changes, a 2003 USDOT report indicated the importance of increasing efforts to address the significant mobility needs of this group. Among the recommendations of the report was increased research on the effect that loss of mobility can have on the quality of lives of older people (*3*). This study seeks to contribute to that research gap by looking at the connections between mobility, disability, social and leisure activity participation, and life satisfaction among elderly Americans.

For many older people, daily time use structure changes with the transition from work to retirement. Much of the time that was allotted to work becomes discretionary time which can be used for social and leisure activities among other time uses. Both social and leisure activities that occur outside of the home require mobility of the person (physical capability and/or the personal assistance that make mobility possible) and access to the instruments of mobility (e.g. car, bike, bus, wheel chair, etc. and the physical infrastructure that supports these). Limitations in either is likely to impede the extent to which people can allocate their discretionary time in out-of-home activities including socializing and other forms of leisure activities. Some of these limitations in mobility may arise from difficulties in seeing, hearing, moving around, and so on, which in turn may affect the ability of people to drive, take transit or independently engage in activities. This is all the more an issue because, despite some shifts from private vehicle use to public transit since 2000 (*4*), older people are heavily reliant on automobiles (*5*). Given that the oldest old population,

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which is at a higher risk of eroding these capabilities is projected to grow considerably, policy makers need to plan for the transportation alternatives that can fill these mobility needs.

Our study focuses particularly on time use shifts that occur in old age, particularly in social and leisure activities, and how these interact with physical disability and mobility and get affect overall life satisfaction. In recent years, there has been an increasing amount of work analyzing the travel behavior of seniors and the connections between travel, social networks and social activities. However, much of the literature does not closely look at the impact of disability status and aging on overall social and leisure activity engagement and life satisfaction. Our study uses the 2013 Disability and Use of Time (DUST) data which focuses on couples in the Panel Study of Income Dynamics who were aged 50 or older. We investigate participant's patterns of social and leisure activity engagement, how these are related to disability and the mobility options available to them, and whether these factors affect people's overall life satisfaction.

BACKGROUND

Researchers have long found the importance of contacts in people's daily lives including in their labor market outcomes, health, and overall well-being (*6,7,8,9,10*). In particular, Unger et al. (*11*) observed a strong positive relationship for elderly persons between the number of social ties and the person's functioning status. They also found that social relationships with friends have a larger impact on people's well-being than relationships with families. Work by de Leon et al. (*12*) find that social networks are associated with lower risks of developing activities of daily living (ADL) disability and that networks were also important in recovery. People with a variety of casual contacts also tend to be better informed about health (*13*). While in general social network engagement appears to have a positive impact, in some contexts, over reliance on others may lead to a limited ability to have independent physical performance (*14*).

Many social relationships, particularly non-familial ones, get built over time through a cycle of meetings which often require travel. Santos et al. (*15*) found that 80.7% of social and recreational trips are made using private vehicles. In addition to vehicle ownership, these activities are likely to depend on household makeup and socio-demographic variables (*16,17,18,19,20*). In addition, as much recent research has shown, social network variables can also influence social activities (*21,22,23,24,25,26,27,28,29,30,31,32,33,34,35*) including frequencies, schedules, distance travelled, destination choice, and duration decisions.

It seems intuitively clear that mobility is an important component of quality of life. To understand its impact, Metz (*36*) argues for a clearer definition of mobility, and offers a conception that allows for its empirical measurement, including psychological benefits of movement and having the potential to travel among others. Spinney et al. (*37*), separating psychological benefits, exercise benefits, and community-socializing benefits, show that increases in these domains is associated with higher overall life satisfaction among elderly Canadians. Banister and Bowling (*38*) find transport to be an important part of some of the "building blocks" of quality of life indicators. Tacken (*39*) argues that the elderly's life quality is conditioned on their ability to live independently and to engage in activities with families and friends.

Among papers that look at older adults, Everard et al. (*40*) state that social and leisure activities are the first to decline among elderly's daily time use because these are not necessary for survival. In their study of the elderly in Canada, Newbold et al. (*41*) find that despite increased discretionary time and flexibility, the elderly make fewer trips every day than younger working adults. They also observe that recent cohorts of the elderly are more reliant on the personal automobile than prior elderly cohorts. But there may also be local or cultural factors that influence

the behaviors of the elderly. In the Dutch context for example, Van den Berg et al. (*42*) find that the elderly are as mobile as younger adults when it comes to number of social trips.

Looking closely at those with disabilities, Sweeney (*43*) finds that older people with disabilities remain mobile, going out and traveling at least once a week, except for people with severe disabilities. She also finds a reliance on the private automobile though those with disabilities are often passengers as compared to the elderly without disabilities. Similar dependence on the automobile is found by Alsnih and Hensher (*44*) who distinguish between the young elderly (65 to 75yr old) and older elderly (75yr +) to capture the disability effect. Schmöcker et al. (*45*) find that the young elderly generates more trips whereas the older elderly make fewer trips because of the possible mobility impairments.

A related question is the extent to which Information and Communication Technologies (ICT) influence daily activities and social interactions and whether they can serve to fill a long-term mobility gap that may arise due to disability or aging. In looking at the potential impacts of ICT on leisure activity participation, Mokhtarian et. al. (*46*) discuss the ways in which ICT can affect leisure activities including replacement, generation, re-allocation of time, and facilitation of activities. Particularly referring to social activities, they note ICT's role may include allowing virtual social activities for solitary individuals. Kenyon et al. (*47*) also suggest that ICT may be able to serve as an alternative to face-to-face meetings and suggest that lack of mobility and the associated social exclusion could be resolved by providing virtual access to information and social networks while acknowledging its potential drawbacks. While ICTs utility in addressing the needs of those with mobility constraints is appealing conceptually, more empirical evidence is needed to understand in what ways and to what extent it addresses social and leisure activity needs of people with mobility limitations.

Broadly the literature acknowledges the importance of mobility and social networks to life satisfaction, social engagement, and the health of the elderly. It also highlights the reliance of the elderly population on the personal automobile and the potential that ICT holds in overcoming some of the challenges that limited mobility may impose. This study will look at the interrelationship between mobility, disability, and time use and how these may affect people's life satisfaction.

DATA

This study uses the 2013 Disability and Use of Time (DUST) data from the University of Michigan. The DUST data is supplementary data to the Panel Study of Income Dynamics (PSID), a survey that has been collected since 1968 from original households and their descendants. The respondents to the 2013 DUST are couples who were 50 years old or above at the survey time. The data used here is for all urban respondents whose time use is collected over two 24-hour periods.

We divide the activities that respondents were engaged in during this period, into mandatory and discretionary activities following the typology discussed in Yamamoto and Kitamura (*48*). Discretionary time is also further divided into time allotted to social, leisure and other activities. Mandatory activities include sleep, eating, work (if employed), education (if a student) and personal care and childcare for household members. Remaining activities are categorized as discretionary activities. Of the discretionary time, we mainly focus on the time allocated for face-to-face social meetings, which is defined as time spent socializing with non-household members at home or socialization with others outside of home. We also separate leisure activities into active leisure (including sports, entertainment, etc.) and passive leisure (including reading, watching TV, playing games, etc.). In addition, travel time for social and leisure activities are also evaluated.

The DUST data also provides additional information about people's physical conditions to evaluate disability. Three sets of questions in the DUST relate to people's physical status: the first set of questions asks if the respondent has impairments that may limit their daily activities based on the definition of the International Classification of Functioning, Disability, and Health (ICF). These questions ask if a person experiences impairments along eight dimensions (breathing, hearing or circulation, stomach, back or neck, shoulder or hands, legs or knees, low energy, and difficulty remembering problems) and how often these were experienced in the previous 7 days. A second set of questions ask if the respondent has impairments based on the American Community Survey (ACS) disability series which ask if a person has hearing, vision, or mobility limitations, memory/mental functioning difficulties, and difficulties with personal care activities and household activities. The respondents are also asked if they need a mobility device to move inside and outside of home.

Table 1 summarizes the socio-demographic characteristics of the respondents. The average age of respondents used in this analysis is 67. The majority of the respondents are married or have a partner (69.7%). Only 18% of the respondents report living alone. More than half are still working and vehicle ownership levels are very high (91.8%). Just over 70% of respondents report at least one of the impairments as measured by the ICF.

We employ principal component analysis using the ICF and ACS disability metrics to reduce the disability dimensions captured by the series of 15 questions. The analysis yields four principal components using an eigenvalue of 1 as a cutoff point. The results of the principal component analysis is shown in Table 2. The four components roughly fall into (1) physical mobility related impairments in PC1, which mainly captures upper and lower limb impairments, difficulties in walking and running errands and impairments that affect the back, neck, knees, legs etc.; (2) memory or sensory problems such as difficulty hearing, seeing and remembering in PC2; (3) PC3 captures people with breathing, heart and stomach problems when its large and negative or individuals having difficulty running errands and requiring the use of a mobility device on the positive end; and (4) PC4 captures individuals with back, neck, upper or lower limb limitations on the negative end or individuals with difficulty seeing, difficulty running errands alone, and requiring assistance on the positive end. We use PC1 in the following discussion to represent the disadvantaged physical mobility status.

Table 3 summarizes the time use for three different age groups: 50 to 64, 65 to 74, and 75 or older. As people get older, their time allocation for mandatory activities shows a decline going from approximately 14.4 hours per day for the 50-64 group to about 13.2 hours for the above 75 group. Leisure time on the other hand shows an increase of approximately 1 hour per day. As Table 3 shows much of the increase in leisure time comes from what is termed passive leisure time which encompasses things like reading and watching TV. The average passive leisure time spent alone increases from 354 minutes over the course of two days (5.9 hours of 48 hours) for the 50-65 group, to 510 minutes (8.5 hours) for the 75+ group.

Social time on the other hand only shows a very small increase in the average time. The increases in social time also appear to come largely from social meetings that are mediated by ICT. Small increases in social time spent at home are also observed (i.e. social time spent with non-household members at home) while average social time outside of the home remains the same across the different age groups. A higher percentage of the 50-64 group reported having engaged in face-to-face social time than the 65-74 or 75+ groups (83% vs 76% and 78% respectively). The elderly population almost equally distribute their social time inside and outside of home, with slightly more time spent at home. The oldest elderly respondents spent almost 50 minutes less time

on travel across the two days compared to 50-64 age group and 30 minutes less than the 65-74 age group. Average number of trips across the two days also declines from 7.8 to 7.1 and 5.6 as one moves from the youngest group to the oldest.

With aging, an important pattern appears to be that people are spending more and more of their discretionary time alone. Both disability and vehicle ownership appear to be factors that are closely associated with these increases in passive leisure alone time as shown in Table 4. Looking at the changes in this time category across the four quartiles of the principal component 1 (PC1) (which principally is linked to physical mobility related impairments), we observe that average time spent alone over the two days increases from 5.6 hours to 7.7 hours for individuals falling in the first quartile (those with fewer on no PC1 related disabilities) vs. those in the fourth quartile of PC1 (those with higher levels of disabilities, likely across multiple categories). The average time spent in passive leisure alone time is also much larger for individuals with no vehicles across the four disability quartile categories. For instance, those in the first quartile with vehicles have about 5.4 hours of leisure alone time as compared to the 10.2 hours for the no-vehicle group. Those with no vehicles and in the fourth quartile report on average 10.8 hours of alone leisure time over the course of two days.

Additional questions in the survey asked respondents to rate their life satisfaction, health satisfaction and activity satisfaction on a seven-point scale. The majority of the respondents rate their life satisfaction at scales of 5 or higher for all three measures (medium satisfaction to very satisfied). In particular, a life satisfaction of 4 or less was reported by only 8.3% of respondents, while that of 7 was reported by 37.8% of respondents. The comparable proportions for health were 18.7% with a rating of 4 or less and 20.8% reporting a rating of 7. For activity satisfaction, ratings ranged from 12.1% with a rating of 4 or less and 29.7% indicating a rating of 7. In what follows, the life satisfaction and health satisfaction ratings along with time use in activity participation are used in looking at the relationship between activity time use, health, and life satisfaction.

ANALYSIS

In this section we estimate a model that relates life satisfaction with the level of social and leisure activity engagement that people report while controlling for disability and activity satisfaction variables. Our underlying assumption is that social and leisure activities are key components of the life satisfaction. However, life satisfaction can also be reduced by impairments that place limitations on physical activities, or require reliance on others. Beyond physical mobility limitations that arise from different impairments, we hypothesize that vehicle availability/ownership may also impact these ratings. Interactions between physical limitations and different activity engagements are also possible, as are interactions between vehicle availability and disability type. In the analysis below, we control for satisfaction levels that individuals report for their daily activity levels. The dependent variables for life satisfaction and activity satisfaction are re-categorized into four ordered ratings, with a rating of 1 corresponding to ratings of 4 or less in the original 7-point scale, and new ratings of 2, 3, and 4 corresponding to ratings of 5, 6, and 7 in the original scale.

We expect that different types of disability may also have varying impacts on life satisfaction. We use the values of the four principal components for each individual in this analysis to control for these different disability types. In addition, we also hypothesize that increased time in mandatory activities or in alone passive time are likely to lead to lesser life satisfaction all other factors being equal, and that more social engagement and leisure time with others is likely to add to life satisfaction. The model also controls for different demographic, social, and economic factors

as well as the number of trips that people made over the course of the two days during which time use was collected.

Since the life satisfaction rating is an ordered variable, we use an ordinal logistic regression model to estimate the relationship between these variables and life satisfaction. The estimated model is shown below for life satisfaction category j:

$$logit\left(P(Y \leq j)\right) = \log\left(\frac{P(Y \leq j)}{1 - P(Y \leq j)}\right) = f(D, A, S, T, N, P, R)$$

where:

D: socio-demographic variables of the respondent, including person's age, household size, number of vehicles divided by household size;

A: a categorical variable indicating if the respondent's activity satisfaction rating is greater than 2 (1 to 4 scale, 4 being most satisfied);

S: self reported rating of how outgoing/sociable a respondent is (1 to 4 scale, 4 being very outgoing/sociable);

T: a matrix respondent's time use variables in minutes (log scaled), including mandatory time (excluding work time), in-person social time, ICT based social time, passive leisure alone time, work time, travel time for mandatory activities (excluding travel for work), and categorical variables indicating if respondent had zero social time use and if the respondent had no travel;

N: Number of trips respondents made over the course of the 2 days;

P: Principal component ratings from principle component analysis; and

R: Residence location indicating if respondent lives in fringe counties of metropolitan areas of 1 million population or more.

Results of the estimated model are reported in Table 5. In general, all variables have the expected signs and the model provides a reasonable fit for the data. People's activity satisfaction is highly significant and has a large estimate indicating the close relationship between activity satisfaction and life satisfaction. A 1 unit shift in activity satisfaction (moving from a 1 or 2 - coded 0, to a 3 or 4 rating - coded 1) leads to a 6.4 higher odds of being in a rating of 4 in life satisfaction as compared to the combined 1-3 life satisfaction ratings, all other factors being equal.

Among socio-demographic variables, age, household size and vehicle availability are significant in explaining life satisfaction and all have positive estimates. All other factors being equal, those that are older tend to report higher level of life satisfaction. Larger household sizes increase the odds of a higher life satisfaction rating and more vehicles availability per household size also increase the odds of a higher life satisfaction. On the other hand, there appears to be no association between the reported life satisfaction and gender and household income, and these variables were removed from the model.

We took the log transformation among all time use variables. The model suggests that increased time allocation to mandatory activities decreases life satisfaction. While those that reported no social face-to-face time were no more likely to report lower or higher life satisfaction, we find that among those that did have social time, higher times appear to have a positive impact on life satisfaction (p=0.095). Among these respondents, time spent in ICT mediated social activity was associated with a decreasing life satisfaction rating (p=0.000). This variable is robust to different specifications of the model and suggests that ICT mediated social engagement is not an ideal substitute for the age group that we are considering in this study. More time allotted to alone

time in passive leisure activities such as reading and watching TV also reduces the odds of a higher life satisfaction rating as does increasing work time. In terms of scale, a similarly sized increase in the amount of time across these three categories would have the highest negative impact if it was applied to ICT based social activity, followed by alone leisure time, and finally work. However, it is important to note that average time expenditures in ICT based social activities is far smaller than average time expenditures in the other categories.

The estimates for travel related variables were mixed. Those that had no travel over the two-day period had a higher odds of life satisfaction ratings. In addition, higher number of trips decreased the odds of a higher life satisfaction rating, all other things equal. While both of these appear consistent to with the idea of travel as a disutility, the amount of travel time that people allot to non-work mandatory activities (such as travel for grocery shopping, eating or health care) is positively associated with higher life satisfaction ratings. We interpret this "being out and about" is desirable as per the psychological benefits proposed by Metz (*36*), but multiple trips over the course of two days may be viewed negatively as travel becomes a chore on its own rather than a form of getaway.

The model also included the four principal components identified in the PCA to capture disability dimensions. Among the four principal components, PC1, which captures physical mobility barriers, was significantly associated with lower life satisfactions. PC2 was not important and dropped from the model. PC3 and PC4, both of which had negative estimates, were not on their own important in explaining life satisfaction (p-values > 0.10), but had an impact when interacted with the activity satisfaction variable. The model suggests that those scoring higher on these components and having higher activity satisfaction levels had a positive odds of higher life satisfaction. It suggests that increasing activity satisfaction may work well to increase life satisfaction for those with specific types of disabilities. There was no interaction effect between the physical mobility based impairments and the activity satisfaction.

Finally, those who reside in fringe counties around large metro areas tended to have lower life satisfaction. This variable also had an interaction with respondents that had no travel. Though no travel had a positive effect on life satisfaction, for residents of fringe counties, this variable decreased the odds of better/higher life satisfaction ratings. A possible but speculative reason for this is that the decision to have no travel may not be entirely voluntary for this group or that the decision to not travel may arise from a low-density of activity destinations. Other interactions including between disability and social time use were removed from the model because they were not important in explaining life satisfaction ratings.

SUMMARY AND DISCUSSION

This paper examines how mobility, disability and social interactions affect people's life satisfaction using the 2013 DUST data. Dividing respondents into three age groups, we observe that as people get older, their time allocation for mandatory activities and for travel decrease, social time remains stable, and leisure time that is passive and spent alone (activities such as watching TV) increase considerably. We also observe that alone leisure passive time is especially large for those with no vehicles and with high levels of physical mobility disabilities.

We study how disability, mobility, and different time uses affect overall life satisfaction using an ordinal logit model. We find that age, household size, vehicle availability, and people's perceptions of their own sociability have positive impacts on life satisfaction. Individuals who express satisfaction with their daily activity level also tend to report higher life satisfactions, all other things equal. On the other hand, time allocations on mandatory activities, on work, on leisure

passive alone time, and on ICT mediated social activities were all negatively associated with life satisfaction. The latter is particularly interesting in light of some optimism about the potential for ICT to address mobility disadvantage that may arise in old age, for those with disabilities, or among others experiencing social exclusion. Given that technologies change rapidly, future ICT breakthroughs may prove more useful for the group being studied despite these findings.

The paper also captures the different types of disabilities that respondents report using principal component analysis based on disability related questions asked of respondents. Use of these measures in the logit model suggests that different disability types have different impacts on life satisfaction. In particular, those impairments that affect physical mobility and occur along with back/hips/legs/exhaustion problems tend to negatively influence ratings of life satisfaction. On the other hand, disability principal components that capture the use of a mobility device, difficulty seeing, and difficulty running errands, without the back/hips/legs/exhaustion problems captured by the physical mobility component, appear to not have a statistically significant negative effect on life satisfaction ratings. Those that have these latter types of disabilities also tend to report higher life satisfaction if they also have higher activity satisfaction.

These findings suggest that for people experiencing some disability types, life satisfaction levels may be raised by providing the assistive services that can increase activity satisfaction. In addition, it is also possible that these different impacts may be due to how long the respondent may have lived with a particular disability type. If, for example, the mobility related disabilities are age induced, those adjusting to these new realities may be less inclined to provide higher life satisfactions. On the other hand, if a disability has been long lived, respondents may have adjusted to these circumstances and may provide life satisfaction ratings that are less tied to these disability measures, and may also positively respond to an increase in activity level satisfaction.

We also find that social activity time had a weak positive impact on life satisfaction, far less than we had anticipated at the outset. Overall average time spent in this category has remained stable in older age despite additional discretionary time available to our respondents associated with aging. Unfortunately, this additional time seems to be spent, almost by default, in alone passive activities, which show a negative relationship with life satisfaction. While this does raises the question why these times are not spent in social activities which are at least neutral or weakly positive on life satisfaction, it is possible that the scheduling effort and additional travel and associated costs may be prohibitive in increasing social time. While facilitating such time uses may be important from the perspective of life satisfaction, more needs to be done to understand why gains in discretionary time do not translate into social activity time.

Finally, mobility appears in the life satisfaction analysis in different ways. The availability of higher numbers of personal vehicles in a household on a per capita basis is associated with positive life satisfaction. It highlights the importance of having the option to travel among our respondents. Not travelling over the two-day activity diary was positively associated with life ratings (except for those living in suburban fringe counties), and number of trips was associated with lower life satisfaction. Surprisingly, travelling for non-work mandatory activities was positively associated with life satisfaction but it is conceivable that people enjoy the opportunity to travel on occasion from a psychological perspective, while also disliking making numerous trips.

Over all, our findings suggest that there are a variety of important relationships between mobility, disability, time use, and overall life satisfaction. These include the large allocation of time to passive alone activities when individuals have significant physical mobility disability and are car-less, and the subsequent impact of these variables on life satisfaction. Given the anticipated increase in the older population over the coming decades in the U.S. and the likely increase in age

related disabilities, more needs to be done to understand how policies and programs can respond to these challenges.

REFERENCES

[1] Aging Statistics. Administration on Aging (AoA). U.S. Department of Health and Human Services. https://aoa.acl.gov/Aging_Statistics/Index.aspx. Accessed March 14, 2017.

[2] He, W., and L. J. Larsen. *Older Americans with A Disability: 2008- 2012.* US Census Bureau, American Community Survey Reports, Washington, DC: US Government Printing Office, 2014.

[3] US DOT. *Safe Mobility for A Maturing Society: Challenges and Opportunities.* Washington, DC. Last Accessed, 7(31):2010, 2003.

[4] Lynott, J., and C. Figueiredo. *How the travel patterns of older adults are changing: Highlights from the 2009 national household travel survey*. No. Fact Sheet 218. 2011.

[5] Rosenbloom, S.. Sustainability and Automobility Among the Elderly: An International Assessment. *Transportation*, 28(4), 2001, pp. 375–408.

[6] Granovetter, M. S.. The Strength of Weak Ties. *American Journal of Sociology*, 78(6): 1360–1380, 1973.

[7] Granovetter, M. S.. The Strength of Weak Ties: A Network Theory Revisited. *Sociological Theory*, 1, 1983, pp. 201–233.

[8] Lin, N.. Social Networks and Status Attainment. *Annual Review of Sociology*, *25*(1), 1999, pp. 467-487.

[9] Cattell, V.. Poor People, Poor Places, and Poor Health: The Mediating Role of Social Networks and Social Capital. *Social Science & Medicine*. 2001.

[10] Pescosolido, B., and J. Levy. The Role of Social Networks in Health, Illness, Disease and Healing: The Accepting Present, the Forgotten Past, and the Dangerous Potential for A Complacent Future. *Social networks and health*, 2002, pp. 3-25.

[11] Unger, J. B., G. McAvay, M. L. Bruce, L. Berkman, and T. Seeman. Variation in the Impact of Social Network Characteristics on Physical Functioning in Elderly Persons: Macarthur Studies of Successful Aging. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, 54(5), 1999, pp. 245–251.

[12] Carlos F Mendes de Leon, T. A. Glass, L. A. Beckett, T. E. Seeman, D. A. Evans, and L. F. Berkman. Social Networks and Disability Transitions Across Eight Intervals of Yearly Data In the New Haven EPESE. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, 54(3), 1999, pp.162–172.

[13] Erickson, B.. Social Networks: The Value of Variety. *Contexts*, 2(1), 2003, pp.25–31.

[14] Teresa E Seeman, Martha L Bruce, and Gail J McAvay. Social network characteristics

and onset of ADL disability: Macarthur studies of successful aging. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, 51(4):S191–S200, 1996.

[15] Santos, A., N. McGuckin, H. Y. Nakamoto, D. Gray, and S. Liss. *Summary of Travel Trends: 2009 National Household Travel Survey.* Technical report, 2011.

[16] Fernandez, C., and A. S. Sanz. Social norms and household time allocation. 2006.

[17] Lee,Y., M.Hickman, and S. Washington. Household Type and Structure, Time-Use Pattern, and Trip-Chaining Behavior. *Transportation Research Part A: Policy and Practice*, 41(10), 2007, pp. 1004–1020.

[18] Lu, X., and E. I. Pas. Socio-demographics, Activity Participation and Travel Behavior. *Transportation Research Part A: Policy and Practice*, 33(1), 1999, pp. 1–18.

[19] Golob, T. F.. A Model of Household Demand for Activity Participation and Mobility. *Center for Activity Systems Analysis*, 1996.

[20] Golob, T. F., and M. G. McNally. A Model of Activity Participation and Travel Interactions Between Household Heads. *Transportation Research Part B: Methodological*, 31(3), 1997, pp. 177–194.

[21] Axhausen, K. W.. Activity Spaces, Biographies, Social Networks and Their Welfare Gains And Externalities: Some Hypotheses and Empirical Results. *Mobilities, 2(1)*, 2007 pp. 15–36.

[22] Farber, S., and A. Páez. My Car, My Friends, and Me: A Preliminary Analysis of Automobility and Social Activity Participation. *Journal of Transport Geography*, 17(3), 2009, pp. 216–225.

[23] Tilahun, N., and D. Levinson. Work and Home Location: Possible Role of Social Networks. *Transportation Research Part A: Policy and Practice*, 45(4), 2011, pp. 323–33.

[24] Carrasco, J., and E. J. Miller. The Social Dimension in Action: A Multilevel, Personal Networks Model of Social Activity Frequency Between Individuals. *Transportation Research Part A: Policy and Practice*, 43(1), 2009, pp. 90–104.

[25] Ohnmacht,T., K. Götz, and H. Schad. Leisure Mobility Styles in Swiss Conurbations: Construction and Empirical Analysis. *Transportation*, 36(2), 2009, pp. 243–265.

[26] Páez, A., and D. M. Scott. Social Influence on Travel Behavior: A Simulation Example of The Decision To Telecommute. *Environment and Planning A*, 39(3), 2007, pp. 647–665.

[27] Dugundji,E., and J. L. Walker. Discrete Choice with Social and Spatial Network Interdependencies: An Empirical Example Using Mixed Generalized Extreme Value

Models with Field and Panel Effects. *Transportation Research Record: Journal of the Transportation Research Board*, 1921(1), 2006, pp. 70–78.

[28] Larsen, J., J. Urry, and K. W. Axhausen. *Mobilities, Networks, Geographies.* Routledge, 2006.

[29] Urry, J., Social Networks, Travel and Talk. *British Journal of Sociology*, 54(2), 2003, pp. 155–175.

[30] Frei, A., and K. Axhausen. Modelling the Frequency of Contacts in A Shrunken World. 2009.

[31] Tilahun, N., and M. Li. The Geography of Close Contacts & Face-To-Face Meetings: An Empirical Study. Presented at the World Symposium on Transport & Land Use Research. delft, the Netherlands. 2014.

[32] Habib, K. M. N., J. Carrasco, and E. J Miller. Social Context of Activity Scheduling: Discrete-Continuous Model of Relationship Between "with Whom" and Episode Start Time and Duration. *Transportation Research Record: Journal of the Transportation Research Board*, 2076(-1), 2009, pp. 81–87.

[33] Carrasco, J., E. J. Miller, and B. Wellman. How Far and with Whom Do People Socialize?: Empirical Evidence About Distance Between Social Network Members. *Transportation Research Record: Journal of the Transportation Research Board*, 2076(-1), 2009, pp. 114–122.

[34] Tilahun, N., and D. Levinson. Contacts and Meetings: Location, Duration and Distance Traveled. *Travel Behavior and Society*. Volume 6, 2017, pp. 67-74.

[35] Lee,Y., S. Washington, and L. D Frank. Examination of Relationships Between Urban Form, Household Activities, and Time Allocation in the Atlanta Metropolitan Region. *Transportation Research Part A: Policy and Practice*, 43(4), 2009, pp. 360–373.

[36] Metz, D. H.. Mobility of Older People and Their Quality Of Life. *Transport policy*, 7(2), 2000, pp. 149–152.

[37] Spinney,J.E., D. M. Scott, and K. B. Newbold. Transport Mobility Benefits and Quality Of Life: A Time-Use Perspective of Elderly Canadians. *Transport Policy*, 16(1), 2009, pp. 1-11.

[38] Banister, D., and A. Bowling. Quality of Life for the Elderly: The Transport Dimension. *Transport policy*, 11(2), 2004, pp.105–115.

[39] Tacken, M. Mobility of the Elderly in Time and Space in the Netherlands: An analysis of the Dutch National Travel Survey. *Transportation*, 25(4), 1998, pp. 379–393.

[40] Everard,K.M., H. W. Lach, E. B. Fisher, and M. C. Baum. Relationship of Activity and

Social Support to the Functional Health of Older Adults. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, 55(4), 2000, pp. 208–212.

[41] Newbold,K.B., D. M. Scott, J. Spinney, P. Kanaroglou, and A. Páez. Travel Behavior within Canada's Older Population: A Cohort Analysis. *Journal of Transport Geography*, 13(4), 2005, pp. 340–351.

[42] Berg, P.V., T. Arentze, and H. Timmermans. Estimating Social Travel Demand of Senior Citizens in the Netherlands. *Journal of Transport Geography*, 19(2), 2011, pp. 323–331.

[43] Sweeney,M.. Travel Patterns of Older Americans with Disabilities. *Washington, DC: US Bureau of Transportation Statistics*, 2004.

[44] Alsnih,R., and D. A. Hensher. The Mobility and Accessibility Expectations of Seniors in an Aging Population. *Transportation Research Part A: Policy and Practice*, 37 (10), 2003, pp. 903–916.

[45] Schmöcker,J., M. Quddus, R. Noland, and M. Bell. Estimating Trip Generation of Elderly and Disabled People: Analysis of London Data. *Transportation Research Record: Journal of the Transportation Research Board*, 2005, pp. 9–18.

[46] Mokhtarian, P. L., I. Salomon, and S. L. Handy. The impacts of ICT on Leisure Activities and Travel: A Conceptual Exploration. *Transportation*, *33*(3), 2006, pp. 263-289.

[47] Kenyon,S., G. Lyons, and J. Rafferty. Transport and Social Exclusion: Investigating the Possibility of Promoting Inclusion through Virtual Mobility. *Journal of Transport Geography*, 10(3), 2002, pp. 207–219.

[48] Yamamoto,T. and R. Kitamura. An Analysis of Time Allocation to In-Home and Out-Of-Home Discretionary Activities Across Working Days and Non-Working Days. *Transportation*, 26(2), 1999, pp. 231–250.

LIST OF TABLES

TABLE 1 Sociodemographic Summary

Variable	Mean	SD	Median
Age	67.9	8.3	66
HH size	2.3	1.2	2
Number of vehicles	1.8	1.1	2
Number of children in household	0.1	0.4	0
Age group			
50 to 64		42.7%	
65 to 74		36.0%	
75 and over		21.2%	
Gender (Male = 1)		41.2%	
Vehicle ownership		91.8%	
Lives alone		17.9%	
Married or have partner		69.5%	
Still working		60.5%	
Difficult walking		29.5%	
At least one impairment		71.1%	
Number of Observations		1619	
Percent of weekday responses		50.0%	

TABLE 2 Principal Component Analysis Based on Disability Questions (Only Loads Above 0.25 in Magnitude Shown)

	PC1	PC2	PC3	PC4
Breathing problems			-0.44	
Heart or circulation problems			-0.47	
Stomach problems			-0.53	
Back or neck problems	0.27			-0.48
Shoulders, arms or hands problems	0.28			-0.27
Hips, legs, knees or feet problems	0.33			-0.27
Low energy, exhaustion problems	0.34			
Memory problems		-0.53		
Difficulty hearing		-0.35		
Difficulty seeing		-0.32		0.42
Difficulty concentrate and remember		-0.55		
Difficulty bathing and dressing	0.27			
Difficulty walking and climbing	0.34			
Difficulty running errands alone	0.28		0.27	0.33
Use mobility device	0.27		0.32	0.31
EigenValues	4.42	1.31	1.13	1.03
Importance of components:				
SD	2.10	1.14	1.06	1.02
Proportion of variance	0.29	0.09	0.08	0.07
Cumulative proportion	0.29	0.38	0.46	0.53

TABLE 3 Summary of Time Use and Travel Over the Course of 48 Hours (Times Reported in Minutes)

Time use activity category	50 to 64yr			65 to 74yr			75+yr		
	Mean	SD	Median	Mean	SD	Median	Mean	SD	Median
Mandatory activities	1723.9	350.3	1720	1624.4	338.5	1630	1589	319.9	1580
Leisure activities	634.3	363.6	570	741.2	369.7	695	759.0	356.8	735
Leisure (active)	48.0	94.3	0	55.1	101.2	0	36.4	80.7	0
Leisure (active, alone)	15.6	52.9	0	17.7	48.3	0	14.9	38.4	0
Leisure (passive)	586.3	363.3	520	686.1	374.9	630	722.5	355.4	699.5
Leisure (passive, alone)	335.9	348.1	230	396.4	358.6	300	463.1	375	395
Social activities	109.7	125.8	65	116.5	125.3	80	119.1	141.4	77.5
Social (F2F)	85.4	115.3	35	81.2	108.3	30	83.2	123.8	40
Social (F2F>0)	132.2	120	100	126.2	112.1	90	132.3	133.7	90
Social (ICT)	24.1	44.8	0	35.1	55.6	0	35.8	72	0
Social at home	57.9	83.7	21	63.8	92	30	65.2	99.9	30
Social outside	42.8	87.7	0	40.1	79.3	0	43.8	97.7	0
Percent of respondents with a face-to-face meeting		83%			76%			78%	
Travel time	162.7	138.3	135	143.9	123.3	120	113	112	90
Number of trips	7.8	5.1	7	7.1	5.1	7	5.6	4.8	5

TABLE 4 Average Time Use on Passive Leisure Alone Activities by Physical Mobility Related Principal Component (PC1) Quartile and Vehicle Ownership

	Disability principal component 1 (physical mobility related) scores falling in (quartile 1 has subjects that are least impacted, and quartile 4 has subjects that are the most impacted by this disability)			
Leisure alone passive time	Quartile 1	Quartile 2	Quartile 3	Quartile 4
All respondents (N=1619)	336.8	350.2	385.9	463.9
Those that own vehicle(s) (N=1493)	323.7	337.5	371.4	436.3
Those that don't own a vehicle (N=126)	612.8	541.3	574.3	646.9

TABLE 5 Ordinal Logistic Regression Model Results for Life Satisfaction (Rated 1-4, From Lowest to Highest)

	Estimate	Std. Error	z value	Pr(>|z|)	
Age	0.024	0.007	3.598	0.000	***
HH. Size	0.163	0.060	2.697	0.007	**
Vehicle (per capita)	0.207	0.097	2.124	0.034	*
Sociable	0.205	0.057	3.593	0.000	***
log(Mandatory)	-0.472	0.200	-2.365	0.018	*
log(Social F2F)	0.089	0.053	1.671	0.095	.
No social F2F time (1=Yes)	0.345	0.300	1.152	0.250	
log(Social ICT)	-0.103	0.024	-4.205	0.000	***
log(Leisure passive, alone)	-0.087	0.031	-2.825	0.005	**
log(Work)	-0.040	0.021	-1.933	0.053	.
log(non-work mandatory travel)	0.085	0.029	2.979	0.003	**
No Travel (Yes=1)	0.637	0.207	3.072	0.002	**
# Trips	-0.036	0.012	-2.971	0.003	**
PC1	-0.146	0.034	-4.305	0.000	***
PC3	-0.093	0.061	-1.533	0.125	
PC4	-0.045	0.071	-0.625	0.532	
Activity Satisfaction (>2)	1.865	0.117	15.966	0.000	***
Activity Satisfaction (>2):PC1	-0.046	0.049	-0.940	0.347	
Activity Satisfaction (>2):PC3	0.239	0.091	2.623	0.009	**
Activity Satisfaction (>2):PC4	0.229	0.098	2.344	0.019	*
Resides in fringe county of a metro area with pop. >1m (1=Yes)	-0.183	0.130	-1.408	0.159	
No Travel: Resides in fringe county of Metro area (pop. >1m)	-1.125	0.456	-2.466	0.014	*
Life satisfaction rating 1|2	-2.6233	1.6231	-1.616		
Life satisfaction rating 2|3	-0.9859	1.621	-0.608		
Life satisfaction rating 3|4	1.0478	1.6218	0.646		
Goodness of fit					
Observations: 1608 Log likelihood: -1739.21 AIC: 3528.43 Significance codes: 0 *** 0.001 ** 0.01 * 0.05 .					

* All time use variables are in hours.