An Analysis of the Time-of-day Choices of the Elderly for Non work Travel

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Introduction

Population is aging rapidly in the US. According to the US Census Bureau, elderly constituted 14.5% of the US population (46.2 million) in 2014. This population by year 2060 is projected to reach more than double their size in 2014. It is also predicted that old people in the US will represent 19.7% of the population by year 2030.

Worsening physical conditions associated aging can restrict mobility for the elderly population which may further exacerbate the physical and psychological well being of this growing population segment. Therefore, studying transportation of aging population is such a timely and crucial topic. On the light of that, this study investigates time-of-day choices for the elderly as an important aspect of their travel behavior which has not received as much attention as other aspects. Here "elderly" is referred to people with 65 years of age and above.

Background & Objectives

Past research on time-of-day of travel for the elderly has been primarily limited to data descriptive analysis. In this regard, time-of-day patterns have been analyzed and compared for different age groups (within elderly as well as elderly versus other cohorts) and/or different trip purposes. Generally, it has been found that elderly tend to schedule their trips during mid-day, away from peak periods. Also, past studies have observed that daily temporal trip patterns vary by age and trip purpose.

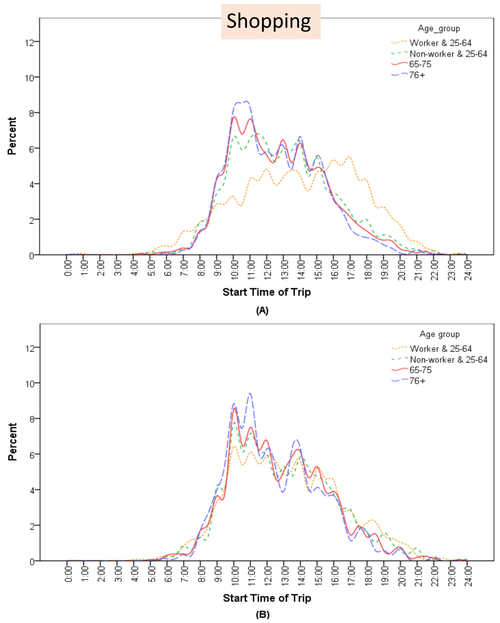
Various modeling frameworks have been used for modeling time-of-day choices in general, from simply use of fixed factors to more sophisticated methods. One of those methods is hazard duration modeling which treats time-of-day as a continuous choice, and has several advantages over discrete choice and fixed factor methods.

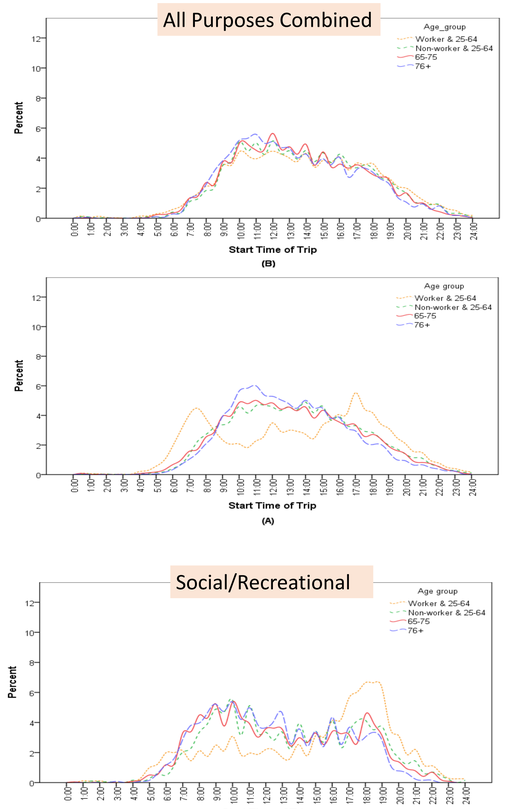
This study attempts to fill up the gap in knowledge in two different ways. First, it highlights nuances of elderly travel behavior in relation to other cohorts, distinguished by work status. Thereby, one can investigate the extent to which time-of-day behavior of the elderly is similar to non-works. Second, the study uses continuous choice modeling framework to *model* time-of-day choices of the elderly. This approach allows for simultaneously considering the impact of several factors, beyond simply age, on time-of-day choices, and can also help predicting time-of-day profiles.

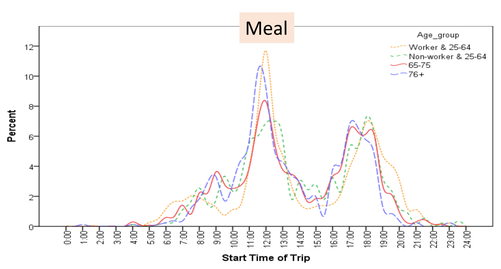
Data Exploratory Analysis

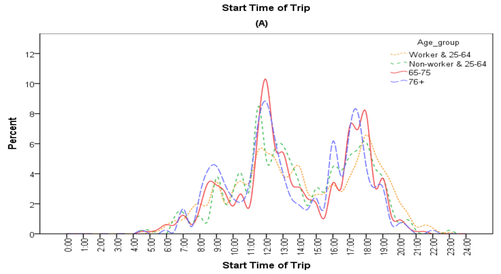
This study uses 2009 NHTS Florida Add-on dataset consisting of 37,824 respondents, of which 11,354 are 65 years old or above, and 139,425 trip records, of which 38,931 are made by the elderly. Data exploratory analysis is conducted to investigate the nuances of travel behavior of the elderly compared to the middle-aged, in particular with respect to their time-of-day choices. The start-time-of-trip profiles provided here correspond to the top four trip purposes of the elderly – shopping, social/recreational, meal and medical trips – separated by weekday versus weekend trips (A and B correspond to weekday and weekends, respectively). The elderly are differentiated by age (65-75 and 75+), and the middle-aged by work status.

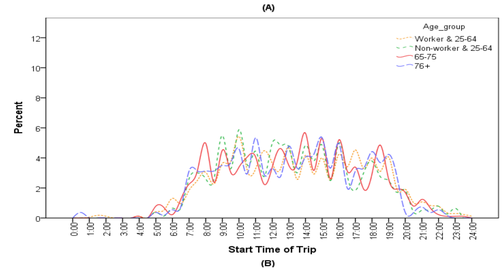
Overall, it can be said that work status more than age affect individual's time-of-day choices, since on weekends all the groups behave closely whereas on weekends, time-of-day patterns of the works are distinctly different for all the four trip purposes.

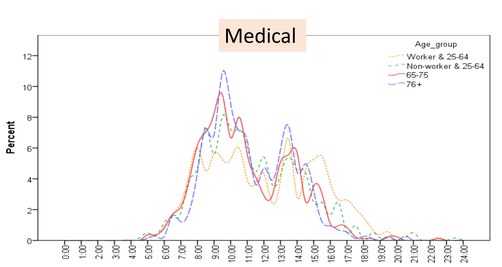












Empirical Results

To develop the models, the trip records corresponding to those four trip purposes were extracted. Next, a total of 1,145 trip records that had missing information on at least one of the variables of interest were deleted, leaving 18,586 records in the sample for developing the models. An exception is income for which the missing records were not deleted, rather considered as a separate category. Attempt was made to test some contextual variables such as Medical Condition (shows whether the traveler has any medical conditions hindering them from making trips), due to having a relatively high share among the elderly population.

Two continuous choice modeling frameworks are used: linear regression and Cox regression, which produced consistent results in terms of sign and relative magnitude of the coefficients. The table lists the variables in the final models. The ☀ symbol indicates that the increase (or existence) of the variable is associated with an earlier start of the trip. The size of the symbol for categorical variables imply the magnitude of the coefficient. The definition of variables are listed below.

Variable	Shopping N=9,558	Social/ Recreational N=9,558	Meal N=3,079	Medical/Dental N=1,551
Individual Socio-demographics				
Age	☀	☀	☀	☾
Male	☀			☀
Worker	☾	☾		☾
Education1	☀	☾	☀	
Education2	☀	☾		
Educcation3	☀			
Household Socio-demographics				
Veh. to Driver	☾		☾	
Home Owner			☾	
Live Alone		☾		
5+ Year Resident		☀		
LOWINC			☀	
MIDINC			☀	
Urban Form Attributes				
Urbsize4	☾			
Urbsize5		☾	☾	
HTPPOPDN	☾			
Trip Attributes				
Monday		☀		
Friday			☾	
2+ Activity		☾		
DA	☀	☀	☀	☀
SR1		☾		
SR2		☾		
SR3	☾	☾	☾	
DWELTIME	☀	☀	☾	☀
TRPMILES	☀	☀	☀	☀

Age	Age of the person	Live Alone	Person lives alone	Friday	Trip is on Friday
Male	Person is male	5+ Year Resident	5 or more years at current residence	2+ Activity	2 or more non-home activities on trip day
Worker	Person is a worker	LOWINC	< 35,000	DA	Drive alone
Education1	Less than high school graduate	MIDINC	35,000-75,000	SR1	Sharing ride with one person
Education2	High school graduate	MISSINC	Not recorded	SR2	Sharing ride with two persons
Education3	Some college degree	Urbansize4	1 million or more without rail	SR3	Sharing ride with 3+ persons
Education4	Bachelor's degree	Urbansize5	1 million or more with rail	WB	Bike or walk
Veh. to Driver	Number of drivers in household to number of vehicles	HTPPOPDEN	Population/mile^2 -Tract level (÷1000)	TRPMILES	Calculated trip distance (miles)
Home Owner	Housing unit owned	Monday	Trip is on Monday	DWELTIME	Calculated time at destination (minutes)

Summary & Conclusion

The study tries to portray travel behavior of the elderly with regard to their time-of-day choices for most common trip purposes, using 2009 NHTS Florida Add-on, and continuous choice modeling framework. The data exploratory analysis indicated generally close time-of-day trip patterns for the elderly and non-workers. Furthermore, the models, developed separately for each trip purpose, found correlations between time-of-day and several variables categorized to four groups including personal characteristics such as age, educational level and employment status, household socio-demographics such as home ownership and income level, urban form such as size of urban area, and finally trip-related attributes such as activity duration and trip distance.

The future research may address the limitations of this study in a few different ways. First, the current methodology does not allow for capturing time-varying impact of the covariates. To address this issue, non-proportional hazard duration modeling framework can be used in lieu of Cox regression. Alternatively, by developing separate models for different time-of-day periods, one may find that a variable decreases the hazard rate in one period but increases it in the other. Second, this study is unable to recommend either of the modeling frameworks used over the other. Such recommendation can be made by conducting a predictive assessment for the two methods and comparing the results. Finally, no intuitive interpretation could be found for correlation of some of the socio-demographic variables (e.g. education) in the models with time-of-day. It is speculated that these variables may be proxy of some urban form variables. Examining these potential spatial correlations may help interpreting the model results more concretely.