Relationship between specific (dis)utility and the frequency of driving a car

RELATIONSHIP BETWEEN SPECIFIC (DIS)UTILITY AND THE FREQUENCY OF DRIVING A CAR

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22th March 2005

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Submitted to: 84th TRB Annual Meeting, subcommittee ADB10A

Submission date: July 30, 2004
Revised: November 10, 2004 and March 22, 2005

Word count: 6493

ABSTRACT

An interesting issue in contemporary travel behavior research is whether the transportation demand has to be considered purely derived from underlying activity patterns, or if there is also a utility associated to the activity of traveling per se. In the latter case, substantial amendments of current planning models would be needed to adequately represent this phenomenon. Earlier researches consistently gave evidence of the existence of this specific utility, but its quantification is hindered by a specific measurement problem, given by the fact that survey respondents tend to mingle the utility of traveling and the utility of reaching a destination. In the present work we define a methodology to quantify the decrement in the specific utility of driving a car due to the presence of difficulties and self-limiting behaviors. This is in turn responsible for an alteration of the driving frequency. A structural equation modeling technique is employed for the analysis. The structural submodel represents the complex relationships between socioeconomic variables, specific utility and driving frequency. The measurement submodel defines the specific utility on the basis of reported self-evaluations concerning physical fitness and self-limiting behaviors while driving. We present an application of our method based on data collected in the 2002 National Transportation Availability and Use Survey. The results show that the decrement of specific utility (that can be seen as a disutility) of driving a car has an important impact on the frequency of performing this activity, compared to the derived utility that is customarily modeled through socioeconomic variables.

INTRODUCTION AND AIMS

There has been a considerable debate over the last decades concerning the true nature of the utility of traveling, which is reflected in the corresponding evolution of the research on transportation planning models. Earlier methodologies developed in the Sixties, including the classical four-step model, were based on a trip-based framework that was exclusively focused in studying traffic flows. The subsequent development of the activity-based approach represented a great improvement in understanding and forecasting mobility-related phenomena (*1*, *2*). The basic assumption of this approach is to consider travel as a derived demand that is simply induced by the utility of reaching a particular destination.

A strict interpretation of the activity-based paradigm, which would lead to the negation of any utility of traveling when it is not correlated to another activity, has been recently explicitly questioned (*3-4*), but the long-dating debate on the existence of constant travel time budgets (*5-9*) represents another implicit challenge to this theory. Mokhtarian and Salomon (*3*) carried out an attitudinal survey whose results give useful insights concerning the utility of traveling per se. They conclude that a non-negligible proportion of the total travel demand could be undirected, so that the corresponding trips are done for their own sake, the destination being more or less irrelevant. Overlooking this phenomenon could thus lead to biased results, or to difficulties in adequately modeling some of the behaviors commonly being observed. The analyst might have the frustrating feeling of facing a sort of "irrational" behavior that cannot possibly be captured. Disposing of targeted analytical tools to study the effect of the specific utility of a trip could be of help in those cases, but a major obstacle is given by the difficulty of estimating the fraction of the utility that is given by the travel itself. In fact a very challenging measurement problem must be faced, since survey respondents tend to blur the distinction between the utility of traveling and the utility of getting to destination, particularly concerning recreational trips.

Several different mechanisms are at the basis of this phenomenon, but their analysis is beyond the scopes of our research. Our aim is instead to figure out whether it is possible to overcome this measurement problem, or at least to diminish its effects. For this, we firstly revisit the notion of primary utility, or specific utility of travel, underlining the fact that it is often linked to the utilization of a specific transportation mode. We introduce the notion of mode-related specific utility of travel as a complement of the notion of undirected travel discussed in (*3*). We focus then our attention on the specific utility of travel for people that report difficulties and self-limiting behaviors when using a given mode. We infer that in this particular case it is easier to overcome the above mentioned measurement problem. In this way, we can quantitatively evaluate the impact of the specific utility on travel behavior (namely, the driving frequency) through the selected analysis technique.

The remainder of the paper is as follows. A more detailed discussion of the underlying theoretical issues and of the proposed methodological approach will follow. Then we present the case study and the dataset that will be considered in our research. The successive step is to select the appropriate analytical technique on the basis of the aims of the research and of the available information. Then we describe the model, showing that its structure is based on both the mentioned theoretical considerations and findings of earlier researches, and we present the results of its estimation. The final step is to interpret the numerical results of the model, in order to give a meaningful response to our problem statement. Our concluding remarks will summarize the most important findings and will describe possible extensions of the present work.

THEORETICAL BACKGROUND AND PROPOSED METHODOLOGY

Broadly speaking, we think that we should consider the specific utility of travel as the portion of the total utility that is not dependent on the fact of reaching a given destination. In order to correctly model the specific utility, we have then to identify the possible mechanisms that are originating it. One possible explanation makes reference to the benefits that an individual can enjoy**,** mainly at the psychological level, from the fact of moving in a given environment under given conditions. These have various sources, that are discussed at length in (*3*), and include for example the joy of riding, the sensation of power and speed, the satisfaction of exploring a territory and, most remarkably, the pleasure of using a specific transportation mean.

For our purposes it is however useful to consider the phenomenon of the specific utility of travel from the perspective of a transportation planner. Considering this point of view, it has already been observed that the specific utility can foster a generic desire of travel and thus plays a role at the demand generation stage. In this sense, we can conclude that the phenomenon of undirected travel mainly affects travel demand and travel patterns. However we already said that the use of a specific transportation mode is among the mechanisms that could trigger the specific utility. This implies that the specific utility deeply impacts also the mode choice process, and suggests us the idea of separately studying this factor. Possible examples of its importance are the persistent utilization of a given transportation mode despite its low relative performance under any possible point of view (cost, travel times, level of service etc.) or abnormally high mobility levels, associated with specific modes, that simply cannot be explained considering the corresponding activity patterns (including recreational ones). To sum up, in this study we will focus our attention on the notion of specific utility linked to the use of a particular transportation mode, more than considering the more general notion of undirected travel. Our methodology aims at quantifying the influence of the mode-related specific utility on the level of use of the mode itself, beyond the socioeconomic characteristics of the traveler and the related travel patterns.

The following step is to find a way to overcome the above mentioned measurement problem, given by the fact that it is practically difficult to separately assess specific and derived utility. The idea is to focus our attention on the eventual presence of self-reported difficulties and self-limitations for people using a given transportation mode. These can be generated by objective conditions such as physical or psychological impairments, but it is likely that they are also the result of more subtle specific attitudes and personal tastes. Considering for example car driving, two people with the same impairments would probably evaluate their abilities and limit themselves in different ways if one likes the activity of driving more than the other. The interesting point is that survey respondents (or even proxies in some cases) can more easily estimate and report difficulties and self-limiting behaviors concerning the use of a transportation mode, since these are often factual data. It is often easier to observe the outcome of an attitude than the attitude itself. Modeling the specific utility on the basis of these data could then be a way to overcome the above defined measurement problem (but of course we do not intend to say that these data are not affected by any measurement error at all), indirectly keeping into consideration personal tastes and attitudes, at least partly. The outcome of this analysis would be the assessment of the effect of the mode-specific utility decrement (that can be seen as a disutility) on the level of use of the mode itself.

The methodology that we propose does not look at the effects of the presence of mode usage difficulties and self-limitations on the derived utility of getting to destination. This is because we assume that that these difficulties and self-limitations chiefly affect the pleasantness of carrying out this activity, thus having a major impact on the specific utility of using a mode, compared to potential effects on the derived utility. In other words, we suppose that for each trip it is the component of undirected travel for the mode being used that is mainly concerned, whereas travel patterns that are more linked to specific purposes, including recreational activities, are much less influenced.

Our goal is to offer a preliminary method to quantitatively assess the influence of the specific utility on travel behavior. Of course, our method cannot be employed when we are not in presence of stated self-limiting behaviors concerning mode utilization, thus representing only a first step to shed some light on the topic. To the best of our knowledge, an attempt of evaluating the proportion of travel demand for a particular mode that is due to the specific utility has never been addressed in previously published research.

CASE STUDY AND ANALYTICAL TECHNIQUE

In this research we considered the public use datasets of the National Transportation Availability and Use Survey (NTAUS, *10*). The general purpose of that study was to shed some light on the transportation attitudes and behaviors of people with disabilities. 5,019 surveys were completed between July and September 2002, 2,321 with persons with disabilities and 2,698 without. The sample is representative of the geographical distribution of the households across the U.S., although of course disabled persons are over-represented. Their proportion in the sample is in fact of about 46%, whereas the Census Bureau estimates that the true value for U.S. residents is around 19% (*10*).

Interviews have been collected mainly through CATI (Computer Assisted Telephone Interviewing) techniques, but mail out-mail back and Internet options were also available to overcome specific difficulties of disabled persons or refusals. Covered topics that are relevant for our study include the frequency of travel outside the home and of use of different modes, household motor vehicles ownership and personal use, experiences and difficulties when using various transportation modes, as well the customary socioeconomic and demographic data of the respondent and of his/her household. Since this is not a classical mobility survey, no information has been collected concerning specific trips. It is important to underline that the sample included both disabled and not disabled persons, and that both groups were asked about their difficulties in using different modes. Our aim is not to compare behaviors of disabled and not disabled persons, but to put in evidence the effect of difficulties in mode usage, regardless the person that has reported them. Of course the consideration of a sample with a high number of disabled is likely to ease the statistical analysis, since the recorded difficulties are likely to be many more.

The NTAUS dataset makes possible to study how socioeconomic characteristics on one hand, and experiences or difficulties when using a kind of transportation on the other affect the demand for a specific mode of transport. We need to separately assess the two effects, but one arguable complication is given by the fact that the above mentioned experiences and difficulties are themselves correlated to socioeconomic characteristics. Furthermore, we would like to define the specific utility on the basis of these quantities, in order to meaningfully interpret the results of our analysis. We can thus conclude that a structural equation modeling technique is best suited for our purposes, allowing for the definition of a structural submodel that depicts the above mentioned intertwined relationships and of a measurement submodel that identifies a statistically sound latent construct to represent the specific utility. Interested readers are referred to a recently published introductory presentation of the technique, along with a review of its applications in travel behavior research (*11*). Moreover, a recent study employs a structural equation model to analyze elderly mobility and it has in common with our research some of the explanatory variables being considered (*12*).

Although the NTAUS takes into consideration several different transportation means, preliminary analyses showed that it is best to focus on the car driver mode. This is because the number of respondents that reported using other modes is much smaller, thus giving problems related to sample size requirements for the selected analytical technique. An even greater concern was on the results of exploratory factor analyses aimed at building meaningful and statistically sound latent constructs on the basis of reported problems when using modes different from driving a car. It turned out that the low correlations among the variables associated to these problems prevent from having unidimensional constructs, even when considering only three or four factors at a time. This of course would be a potential problem in the measurement submodel, affecting both the overall fit and the interpretation of the results and not allowing for a clear definition of the notion of primary utility. To sum up, we chose to focus our attention on car drivers, since an extension to other modes would probably imply the design of a more focused survey. Only those respondents that declared to drive a car, i.e. a subsample of 3,415 surveys from the original NTAUS, thus constitute the dataset we will analyze.

RATIONALE OF THE PROPOSED MODEL

The objectives of the modeling activity are to define the specific utility on the basis of variables included in the dataset and to understand the separate effects of socioeconomic characteristics and of the specific utility of driving a car on the frequency of performing such an activity.

Measurement submodel

Following the theoretical arguments in the second section, we need to specify a measurement submodel to define what we called “self-reported difficulties and self-limitations”. This is in fact a construct that is in relationship with several different variables of the NTAUS dataset that cannot directly been considered in the model, since they would both overcomplicate computations and jeopardize the interpretation of the results. NTAUS data contain two different sets of variables relevant for the definition of the measurement submodel. The first set contains six ordinal variables in which the respondent evaluates if his/her fitness concerning six different physical abilities related to driving are worse, the same or better than five years before. The second set contains ten binary variables that detect whether the respondent avoids driving in potentially challenging situations.

Table 1 lists the considered variables for the measurement submodel, along with the results of preliminary exploratory factor analyses aimed at verifying whether it was appropriate to distill one construct from each set. We will name these constructs “driving-related fitness” and “driving self-limitations”. Our primary concern is thus to predict the minimum number of factors needed to adequately represent the variability of the data, in order to check the unidimensionality of each construct. Hence, a principal component analysis has been performed, in which total variance and not only communalities (that is, the portion of the total variance that is common among all the variables) have been considered. Table 1 shows that the measure of sampling adequacy (MSA) of both the overall datasets and the single variables are well above the generally accepted threshold of 0.50, thus indicating that factor analysis is an appropriate exploratory technique in our case.

Moving to the interpretation of the results of the principal component analysis, evidence of unidimensionality has been found considering both eigenvalues and scree plots. Factors of a principal component analysis are a linear combination of the observed variables. The eigenvalue of a factor is then the sum of the squared coefficients of the observed variables in the linear combination and it represents the amount of variance accounted for by the factor. The criterion is to keep only those factors with eigenvalue greater than one, since they account for the variance of at least one variable. Scree plots are obtained by representing eigenvalues in decreasing order. The point at which the resulting segmented line approximately becomes horizontal indicates the right number of factors to consider, since the amount of unique variance dominates the communality of the subsequent factors. In our case, both these criteria indicated that taking only one factor into consideration is adequate in our case. The definition of these two latent constructs has thus been validated and in the following we will consider them as indicators of the intrinsic disutility of driving a car for the considered sample.

Finally we point out that the measurement submodel has been re-estimated together with the structural one in the final analysis, thus running a second confirmatory factor analysis. The results presented in the remainder of the paper were derived from this joint estimation.

Structural submodel

The general structure of the model is based on earlier researches on the interrelationships between socioeconomic characteristics, perceptions, attitudes, behavior and choice (*13-18*). This has been done to respect the confirmatory nature of the selected analysis technique. A very promising research direction to improve the measurability of the specific utility consists in establishing links with travel behavior researches that make use of psychometric and cognitive psychology analysis techniques. Under very general terms, the common assumption of the mentioned works is that attitudes influence behaviors along with socioeconomic characteristics, and are influenced by socioeconomic characteristics themselves. This is the simplest structure that we will retain in our analysis. We will consider then three main kinds of causal relationships: between the set of socioeconomic variables and the latent factors that have been defined in the preceding subsection; between the latent factors and the driving frequency; and between the socioeconomic variables and the driving frequency. The mentioned researches also stress on the importance of taking into consideration feedbacks from choices and experiences to attitudes, in order to adequately represent influential phenomena such as learning processes and cognitive dissonance. However in the following we will not model these loops, thus defining a hierarchical and recursive model. This helps in preventing identification problems and simplifies the interpretation of the results, since no variable can affect itself, and a relatively straightforward assessment of the effects might be desirable given the preliminary nature of the present work.

Given this general model structure, the retained exogenous socioeconomic and demographic variables, among those available in the NTAUS dataset, are gender, age, income (less than $15,000, between $15,000 and $50,000, and above $50,000) and household kind (living alone, with his/her spouse, with kids under 18, with parents and/or with other persons). Education level was not found to be significant in subsequent analysis and was thus eliminated in the final model formulation, whereas other perhaps interesting variables such as the occupational status of the respondent and the location of the household (urban, rural…) were not available in NTAUS public use data files. We also consider three variables related to the respondent healthiness: a subjective evaluation of eventual impairments that make difficult to perform basic activities, the need of special assistance or equipments to travel outside home, and difficulties in getting the needed transportation. The former one is an ordinal variable of four levels (absence of impairments, mild, moderate or severe impairments) whereas the latter two are binary (yes/no). Non-metric variables (i.e. all of the above but age) were coded as dummies in the analysis.

Our structural submodel foresees five endogenous variables: three manifest and two latent. The three manifest endogenous variables are the number of vehicles globally available in the household, the number of days per week in which the respondent drives and the eventual presence of vehicles that are modified with adaptive devices for use by persons with disabilities; this latter is a binary (yes/no) variable. The two latent constructs "driving-related fitness" and "driving self-limitations" have been defined in the preceding subsection.

It is worthwhile saying that the final specification of the model is the result of some iterations, in which causal relationships where slightly modified each time, without altering the general model structure, that has its roots in the above mentioned theoretical considerations. It is in fact well known that only occasionally the first model being considered is the best possible one. For example, we tried not to consider the influence of the presence of modified vehicles and of the driving-related fitness on driving self-limitations, and we also considered a greater number of relationships among socioeconomic and endogenous variables. For briefness we only described the best specification that we found.

Causal relationships among variables were set as follows. The set of socioeconomic variables potentially influencing the number of household vehicles and the respondent driving frequency can be deduced from several published works on car ownership and use (e.g. *17, 19-21*). Considering these works is also important to check if our model predicts the right sign of the influence. Concerning car ownership at household level, only the most important relationships have been considered, in order to improve the overall model parsimony. On the other hand, it is postulated that all the above mentioned variables directly affect car driving frequency. The other three endogenous variables are clearly influenced by the health conditions of the respondent and, concerning the presence of modified vehicles, of other household members. We finally suppose that the "driving self-limitations" construct is also influenced by the presence of modified vehicles and by the "driving-related fitness". To sum up, the complete path diagram for the described structural submodel is shown in figure 1. Broken lines represents relationships that were not found to be statistically significant at the 1% level in the final estimation. Manifest variables are indicated in rectangles and latent ones in ovals.

MODEL ESTIMATION AND DIRECT EFFECTS EVALUATION

The CALIS procedure within the SAS package has been used to estimate the model. Most of variables that we consider are non metric, and those that are metric (age, number of vehicles and driving frequency) are not normally distributed in the considered sample. Hence the assumptions required to use the maximum likelihood estimation method are not met. Finding data transformation in order to achieve normality is not a viable solution, given the massive presence of categorical or even binary variables, so that we preferred to use an estimator that does not require normality, namely the asymptotically distribution free-weighted least squares (ADF-WLS) method. Sample size requirement for ADF-WLS (at least 1000 observations) are in fact satisfied in our case. Estimation results show that the proposed model fits satisfactorily well the dataset. In particular, the Adjusted Goodness-of-Fit Index is 0.9996, the Normed Fit Index is 0.9683 and the estimate of the Root Mean Square Error of Approximation (RMSEA) is 0.0447, its 90% confidence interval being [0.0429-0.0465]. The likelihood-ratio χ^2 has a quite large value of 2155.88, thus potentially indicating large differences between the observed and the estimated parameters. However this statistic is sensitive to sample size, that is quite large in our case, so that it is advisable to compute also the sample size that corresponds to a 5% significance level for the given χ^2 value. This critical *N* value is 468 in our case, well above the generally accepted threshold of 200.

Estimated direct effects are reported in table 2, together with their level of significance. Effects on car ownership at the household level agree with those usually found in earlier researches, with detectable positive influences when the number of persons in the household and the income increase. The presence of modified vehicles to meet the driving needs of disabled persons is positively related to age, to the fact of needing help to travel and, maybe surprisingly, to income. On the other hand, the estimated effects on the presence of modified vehicles given by the presence of impairments are quite odd (negative relationship for mild impairments, non significant effect for moderate impairments and positive relationship for severe impairments, the comparison group being the absence of impairments). This could be explained by the fact that the dataset does not specify whether the eventually modified vehicle is used by the respondent or by other household members; on the other hand, this probably also explains why the effect of the presence of modified vehicles does not significantly affect the "driving self-limitations" construct and the driving frequency.

The variable "needs help to travel" has a negative direct effect on "driving self-limitations". This result seems surprising, but looking at the questionnaire we realize that the word "help" needs to be correctly interpreted. A subsequent question asked the 532 persons that answered affirmatively to specify what kind of *assistance* or *specialized equipment* they needed. 198 of these answered that they need the assistance of another person and 478 that they make use of specialized equipments to get around, from wheelchairs to automotive adaptive aids. It is likely that the use of such equipments can help people to overcome difficulties and perhaps to increase self-confidence, thus having an inverse relationship with the "driving self-limitations" construct.

The negative relationships between "unavailable transport" and "driving self-limitations" could be seen as an indication of the existence of "captive drivers", that is of persons that perhaps would avoid driving in less comfortable conditions, if valid alternatives were provided. This could be an interesting indication for at least two different policy ambits. As regards the implementation of ADA (American with Disabilities Act) policies, the offer of transportation services is probably not yet covering all the needs of specific population segments. On the other hand, considering road safety issues, it could be possible to convince people with lower driving skills to avoid performing this activity under "difficult" conditions, if they were given viable alternatives. Of course, both the economical and the technical feasibility of the implementation of an offer of alternative transportation services that are effective in capturing these market segments needs an attentive evaluation.

"Driving-related fitness" is strongly negatively related to age and to the presence of physical impairments, and negatively affects self restrictions that respondents reported concerning their driving activities. Males and older drivers seem to be less likely to adopt such limitations, the latter result probably being due to the fact that the less cautious behavior that we would expect in younger drivers is offset by a lack of confidence in the mean. Finally, the driving frequency is higher for males, for young individuals and for those living with kids, and without their spouse, their parents or other persons. Driving frequency is also positively related to vehicle ownership at household level, a phenomenon whose impact on mode choice has recently been investigated (*22-23*). The direct effect of driving-related fitness was not found to be significant, whereas on the contrary the presence of driving self-limitation has a deep impact in reducing driving frequency.

COMPETING MODEL SPECIFICATIONS

For our purposes it is very important to demonstrate that the considered latent constructs can give a real added value concerning the prediction of the driving frequency. This can be done comparing the above described "complete" model to a base model, in which the latent variables representing the specific utility have been removed. The base model then considers the driving frequency only as a function of the socioeconomic variables and of the two endogenous variables “number of household vehicles” and “presence of modified vehicles”. We estimated this model, with the same causal relationships represented in figure 1, except those that go to or start from the two latent constructs “driving-related fitness” and “driving self-limitations”.

Estimation results are as follows. The likelihood-ratio χ^2 of this model is of 116.77, but this value cannot be directly comparable to the previously reported one. The degrees of freedom of the base model, that is the difference between the number of correlations among variables and the number of estimated coefficients, are much less (16 against 369 of the complete model) and thus the level of significance practically does not change. Other absolute or incremental fit measures such as the Adjusted Goodness of Fit Index, the Normed Fit Index and the Root Mean Square Error of Approximation do not allow to neatly identify the best model, since their values are quite close the previously reported ones (0.9998, 0.9971 and 0.0491 respectively) and moreover because those measures cannot be used to compare different models when the number of degrees of freedom is so different. It is thus advisable to look at fit indicators related to the degrees of freedom, such as the Parsimonious Normed Fit Index and the Parsimonious Goodness-of-Fit Index. Both those values are much higher for the model including the effects of the primary utility (0.6767 versus 0.1173 and 0.6987 versus 0.1176, respectively). This is likely to indicate the superiority of the latter over the base model. A closer inspection of these results allows us to conclude that the base model most probably “overfits” the data considering too many relationships, and that for this it can reach absolute fit values that are similar (but not comparable) to those of the complete model.

INTERPRETATION OF THE RESULTS WHEN CONSIDERING THE TOTAL EFFECTS

We report the total effects of both exogenous and endogenous variables on driving frequency in table 3. Our interpretation scheme is based on the theoretical framework discussed in the second section. Hence, the total effects of the socioeconomic and of the two endogenous manifest variables (number of household vehicles and presence of modified vehicles in the household) can be regarded as the expression of the utility of travel that is derived from underlying activity patterns. On the other hand, the total effects of the “driving-related fitness” and “driving self-limitations” constructs can represent the influence of the specific utility.

Looking at the most influential explanatory factors reported in table 3, the importance of the eventual presence of impairments is apparent. However it is interesting to point out that the specific utility-related constructs have a greater influence on driving frequency than the usually considered socioeconomic variables. In particular, the fact of not driving in particular conditions has a decisive negative impact on driving frequency, whereas the absence of driving-related physical problems has a positive effect. Furthermore, all the other variables show a smaller influence; among these, the most relevant total effects are due to gender (males drive more) and to the household composition. Driving frequency is in particular negatively related to living either with his/her spouse or with parents. Age and income effects are all detectable and consistent with earlier research results but are quite small compared to those of the other variables.

The signs of the influence of “driving related fitness” and “driving self-limitation” on driving frequency are not surprising, but it is interesting to appreciate their importance, compared to that of the socioeconomic variables. According to our interpretation, these results allow to assess the relative influence of the specific and of the derived utility of travel on the level of use of the considered mode.

The analysis of the effects of the “needs help to travel” and “unavailable transport” variables is quite interesting and shows us the importance of adopting an analysis technique such as structural equation modeling in order to keep into account the intertwined relationships among variables in behavioral models. Table 2 shows us that the direct effect of these two variables on driving frequency is negative, as it is quite intuitive to foresee. However when considering the more complex but hopefully more realistic behavioral pattern that includes the effects of the specific utility of driving, the signs of these two effects become positive (table 3, lines 5 and 6 in the fourth column). An analysis of the structural equation coefficients can show us why this happens. The latent construct “driving self-limitations” is negatively related with the variables “needs help to travel” and “unavailable transport” and negatively affects the driving frequency. This explains the overall positive influence of these two variables, that could not have been detected using multiple regression techniques.

The overall inspection of the coefficients listed in table 3 allows us to conclude that the importance of the utility pertaining to the use of the considered transportation mode under investigation is not negligible, compared to that of the derived utility, given the definitions of specific and derived utility that we adopted. In this sense, these results seem to support the conclusions that were qualitatively inferred in previous researches (*3*).

CONCLUSIONS

The aim of the presented research has been to understand whether it is possible to assess, at least in a particular case study, the specific utility of a transportation mode, and the corresponding impact on its levels of use. Taking into consideration the decrement of primary utility induced by the presence of driving-related difficulties and self limitations helped us to overcome the measurement problems of the specific utility. The results have shown that the demand for transportation cannot be considered as purely derived, and that a non negligible portion is determined by the utility that people have when driving. Earlier results from qualitative researches seem thus to be confirmed, at least within the considered framework.

Further research efforts will be mainly aimed at removing some limitations that where imposed by the utilization of the NTAUS dataset. In particular, the development of an adequate measurement submodel to identify the specific utility of modes different than car driving could help in clarifying the question of the overall influence of the specific utility on mode choice. The final development would be to set up a survey to collect both the attitudinal data for the definition of this submodel and classical information on trips, in order to be able to include the effects of the specific utility of travel in the overall transportation planning process. Another promising extension would be to allow for loops in the chain of effects and causal relationships in both directions, thus defining a non-recursive model. This improvement could represent the cognitive and behavioral processes that should be considered in order to improve the assessment of the phenomenon of the specific utility of traveling.

ACKNOWLEDGEMENTS

The analyses here reported are based on 2002 National Transportation Availability and Use Survey public use files, that have been made available by the U.S. Department of Transportation, Bureau of Transportation Statistics through its website. Thanks are due to anonymous referees for their useful comments on an earlier version of this paper.

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List of figures

List of tables

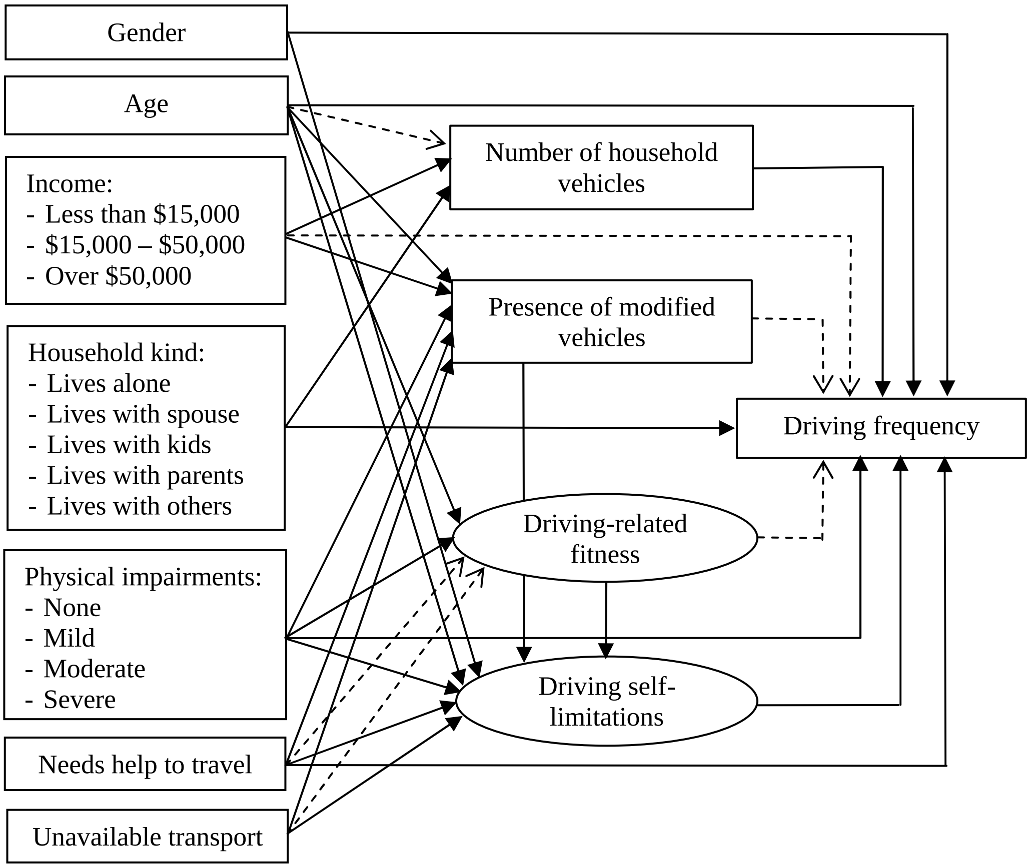

FIGURE 1 Path diagram of the proposed structural submodel. Broken lines represents relationships that were estimated but that are not significant at the .01 level.

TABLE 1 Exploratory Factor Analyses Results for the Latent Constructs "Driving-related Fitness" and "Driving Self-Limitations", MSA Values in Brackets

	Driving-related fitness	Driving self-limitations
"The following is worse/same/better than 5 years ago:"		
Eyesight or night vision	0.504 (0.758)	
Attention span	0.655 (0.840)	
Hearing	0.573 (0.865)	
Coordination	0.755 (0.768)	
Reaction time to brake or swerve	0.750 (0.753)	
Depth perception	0.685 (0.789)	
"Do you usually…"		
Drive less than you used to		0.533 (0.880)
Avoid driving at night		0.673 (0.882)
Drive less in bad weather		0.616 (0.896)
Avoid high-speed roads and highways		0.696 (0.874)
Avoid busy roads and intersections		0.650 (0.839)
Drive slower than the posted speed limits		0.371 (0.898)
Avoid left-hand turns		0.371 (0.906)
Avoid driving during rush hour		0.615 (0.853)
Avoid driving on unfamiliar roads or to unfamiliar places		0.690 (0.871)
Avoid driving distances of over 100 miles		0.679 (0.870)
Overall MSA	**0.788**	**0.872**

TABLE 2 Direct Effects, t-values in Brackets

	Number of vehicles	Modified vehicles	Driving-related fitness	Driving self-limitations	Driving frequency
Male				-0.0796 (-6.90)	0.0648 (4.73)
Age	*	0.0579 (5.23)	-0.1598 (-17.33)	-0.0925 (-4.28)	-0.0966 (-4.87)
Income: $15,000-$50,000 [a]	0.0577 (2.84)	0.1424 (7.25)			*
Income: over $50,000 [a]	0.2154 (9.67)	0.1467 (6.93)			*
Lives alone	-0.1089 (-4.39)				*
Lives with spouse	0.1879 (6.82)				-0.1004 (-4.55)
Lives with kids	0.0726 (3.64)				0.0497 (2.99)
Lives with parents	0.2030 (9.30)				-0.0951 (-5.47)
Lives with others	0.1368 (6.87)				*
Mild impairments [b]		-0.0430 (-4.14)	-0.0366 (-4.63)	0.6403 (5.91)	*
Moderate impairments [b]		*	-0.0655 (-8.13)	0.5439 (3.19)	-0.0940 (-4.55)
Severe impairments [b]		0.0624 (3.07)	-0.0741 (-8.49)	1.1285 (10.78)	-0.0971 (-4.46)
Needs help to travel		0.2203 (8.46)	*	-0.2997 (-10.49)	-0.0898 (-4.42)
Needed transport not avail.		0.0444 (2.87)	*	-0.1643 (-8.63)	-0.0464 (-3.36)
Number of vehicles					0.0448 (2.97)
Modified vehicles				*	*
Driving-related fitness				-0.1432 (-4.64)	*
Driving self-limitations					-0.6126 (-17.78)

Note: an asterisk indicates that the corresponding effect was estimated but is not significant at the .01 level
[a] Contrast: income below $15,000.
[b] Contrast: absence of impairments.

TABLE 3 Total Effects on Driving Frequency

Male	0.1136	Mild impairments [b]	-0.4164
Age	-0.0657	Moderate impairments [b]	-0.4375
Income: $15,000-$50,000 [a]	0.0000	Severe impairments [b]	-0.7998
Income: over $50,000 [a]	0.0758	Needs help to travel	0.0955
Lives alone	0.0345	Needed transport not avail.	0.0523
Lives with spouse	-0.0920	Number of household vehicles	0.0448
Lives with kids	0.0530	Presence of modified vehicles	0.0049
Lives with parents	-0.0860	Driving-related fitness	0.1575
Lives with others	-0.0340	Driving self-limitations	-0.6126

[a] Contrast: income below $15,000.
[b] Contrast: absence of impairments.