Travel Behavior of the Lone Rangers:
An Application of Attitudinal Structural Equation Modeling to Intercity Transportation Market Segmentation

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ABSTRACT

Travel behavior information is valuable to transportation policymakers, planners, and service providers. While aggregate data is helpful, segmenting a market into smaller groups allows for more targeted planning, promotion, operation, and evaluation. In this study, intercity market segments based on traveler attitudes are identified using structural equation modeling (SEM). The study focuses on rural and small urban areas, using survey data for residents of North Dakota and west central and northwest Minnesota. Attitudes toward travel time, flexibility, and privacy are found to have the strongest explanatory power. The socioeconomic profile of each market segment is identified. Individuals living in the study's upper Midwest market area are assigned to market segments based on their socioeconomic characteristics to determine market segment size. Mode shares for automobile, air, intercity bus, intercity rail, and van service are estimated for each market segment. Intercity bus and train mode shares are predicted to double in each market segment when travel speeds are increased to those experienced by automobile travelers.

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1. INTRODUCTION

Travel behavior information is valuable to transportation policymakers, planners, and service providers. While aggregate data is helpful, segmenting a market into smaller groups allows for more targeted planning, promotion, operation, and evaluation.

Market segmentation has long been used in transportation. Traditionally, segments have been constructed on the basis of demographic differences (Hanson and Hanson 1981, Hensher 1976, Zerillo and Neveu 1980). However, more recent efforts have relied on dividing markets using traveler attitudes (Anable 2005, Outwater et al. 2003, Proussaloglou and Koppelman 1989). While many studies have focused on urban travel, market segmentation of intercity transportation has also been conducted (Zerillo and Neveu 1980, Bhat 1995, Bhat 1997, Pas and Huber 1992). Fewer studies have been conducted, though, on intercity travel between small cities and rural areas, where attitudes may differ from those in large urban areas.

To be practical, market segments must have certain characteristics. Individuals within a segment must have characteristics distinct from those in other segments but similar to those within their own. Individuals in the same market segment are expected to react similarly to changes in prices and product characteristics. They are also expected to be able to be reached by market stimulus.

Construction of attitude-based market segments has often relied on structural equation modeling (SEM) (Outwater et al. 2003, Proussaloglou and Koppelman 1989, Shiftan et al. 2008). This method provides considerable control in determining model structure. Most importantly, it allows for investigating the role of unobserved or latent variables. This is particularly important when modeling attitudes as they are not directly measurable. The use of SEM in travel behavior research is surveyed by Golob (2003).

The contemporary importance of travel behavior information is elevated as transportation is currently at a crossroads. The next transportation reauthorization legislation must address many challenges. It needs to provide the vision, structure, and financial mechanisms for the nation's transportation system so that system can remain a foundation of its economic vitality and its citizen's personal wellbeing. At the same time, travel behavior is changing. A weak economy and shifting demographics have impacted how and when the nation travels. Finally, private firms, including those that provide passenger transportation, are delaying strategic decisions until there is greater certainty in the markets.

Estimates of the impact of changes in federal transportation policy and ridership changes resulting from new or modified transportation services are valuable. Segmenting markets should lead to improved estimates. New and existing federal programs should be designed so that the nation's transportation system is efficient and effective. The same is true for private firms who must make capital and operating decisions. These issues exist in both urban and rural areas and for both local and intercity trips.

The objectives of the study are to construct attitude-based market segments to assist transportation policy makers and service providers in making policy, investment, and service design decisions and to determine the suitability of attitude-based markets in estimating travel demand.

In this paper, we identify intercity transportation market segments based on traveler attitudes. SEM is applied to travel attitude and behavior data for residents of North Dakota and northwest and west central Minnesota collected by a previous survey. The size of market segments are found by assigning individuals to each market segment. Mode shares for automobile, air, intercity bus, intercity rail, and van service are estimated and the impacts of changes on the quality of service of intercity transportation modes on travel behavior are investigated.

2. INTERCITY TRAVEL ATTITUDE AND BEHAVIOR DATA

Data for determining attitude-based market segments using structural equation modeling was collected by mail survey. The market area surveyed included all of North Dakota and the northwest and west central area of Minnesota with zip codes 562XX-567XX. This area of Minnesota is similar to North Dakota in terms of geography, demographics, and travel behavior. This region was chosen because it is a predominantly rural area with a few small urban centers, but no major metropolitan areas. This study focuses on rural and small urban areas because fewer studies have been conducted in these areas and individuals in non-urban areas may have different attitudes and travel preferences than urban residents.

A random list of 2,000 names and addresses of individuals aged 18 or older for this region was obtained from AccuData. Of the 2,000 surveys mailed, 106 were returned undeliverable because the addresses were out of date. Of the 1,894 surveys presumed to be delivered, 237 were completed resulting in a response rate of 12.5%.

The survey asked questions on individual socioeconomic characteristics, travel attitudes, and travel behavior. Survey participants were asked to identify their gender, age, education level, household size, income, automobile ownership, ability to operate an automobile, marriage status, employment status, and area of residence as defined by their five-digit zip code. Travel attitudes were measured by asking the degree to which the participant agreed with a statement using a Likert-type scale. These statements, derived from Outwater et. al. (2003), include statements concerning the environment, travel time, flexibility, safety, stress, comfort, reliability, privacy, and convenience. Detailed descriptive statistics of participants' demographic characteristics, travel behavior and attitudes are available in Mattson et al. (2010a, 2010b). The complete survey can be found in Mattson et al. (2010b).

Compared to the total population of the market area, survey participants were more likely to be older and male. The respondents cover a range of education and income levels, though compared to the general population, a greater percentage have an advanced education and higher income. Two-thirds of the respondents are currently employed. Nearly all of the respondents own (98%) and operate (99%) an automobile, compared to 93% of the market area population that owns a vehicle.

3. SEGMENTING INTERCITY PASSENGER TRANSPORTATION MARKETS USING ATTITUDINAL DATA

Attitude-based intercity transportation market segments are constructed using confirmatory factor analysis, SEM, and cluster analysis. In this chapter we present the method and results of segmenting the intercity transportation market in North Dakota and northwest and west central Minnesota. The process and presentation closely follows that used by Shiftan et al. (2008).

3.1 Methodology

Confirmatory Factor Analysis (CFA) is used to verify the relationships between endogenous traveler attitudinal variables and latent (unobserved) attitudinal factors. CFA requires the modeler to predetermine variables and factors as well as the model structure. CFA is used as there is a strong theoretical foundation between the factors and variables as well as evidence from previous studies (Outwater et al. 2003, Shiftan et al. 2008).

SEM is used to simultaneously estimate the relationship between traveler attitudes and exogenous socioeconomic characteristics. SEM allows for the identification of the structural model and estimation of the relationship between socioeconomic characteristics and travel attitudes. Like CFA, the structure of the model is determined a priori. This step allows for the critical link between latent travel attitudes and socioeconomic data which is readily available for the entire market area.

Cluster analysis is used to identify intercity transportation market segments. The number of clusters is determined by the kink in the R-square value. Market segment profiles can be identified by assigning observations, in this case market area residents, to clusters and comparing their relative socioeconomic characteristics.

Market segment sizes of the entire market area are determined by assigning residents to segments based on their socio-economic characteristics. 2008 Public Use Microdata Sample (PUMS) data collected by the U.S. Census is used. Assignment relies on the SAS FASTCLUS procedure.

3.2 Verifying Attitudinal Variables

CFA is used to verify the relationship between six latent attitudinal factors - environmental concern, productivity/reliability, sensitivity to time, flexibility, privacy, and comfort - and 22 attitudinal variables. Variances are standardized by fixing the variance of the first latent variable to 1. The results from the CFA are presented in Table 3.1.

Table 3.1 Confirmatory Factor Analysis Results

Attitudinal Variable	Coefficient	Std. Error	t-stat.
Factor 1. Environmental Concern			
People who travel alone should pay more to help improve the environment.	1		
I would be willing to pay more when I travel if it would help the environment.	-0.27	0.14	-1.98
I would switch to a different form of transportation if it would help the environment.	0.72	0.072	10.01
Factor 2. Productivity/Reliability			
I would rather do something else with the time that I spend traveling.	1		
I would like to make productive use of my time when traveling.	0.82	0.08	10.19
I prefer a travel option that has a predictable travel time.	0.38	0.05	7.03
When traveling, I like to keep as close as possible to my departure and arrival schedules.	0.33	0.05	6.16
If my travel options are delayed, I want to know the cause and length of the delay.	0.52	0.06	8.71
Factor 3. Sensitivity to Time			
I would change my form of travel if it would save me some time.	1		
I always take the fastest route to my destination even if I have a cheaper alternative.	0.67	0.10	6.65
Factor 4. Flexibility			
I need to make trips according to a fixed schedule.	1		
It's important to be able to change my travel plans at a moment's notice.	0.97	0.09	10.59
Factor 5. Privacy			
I don't mind traveling with strangers.	1		
When traveling, I like to talk and visit with other people.	0.46	0.11	6.65
I prefer to make trips alone, because I like the time to myself.	0.72	0.09	8.26
Having privacy is important to me when I travel.	0.84	0.088	9.62
Factor 6. Comfort			
Having a stress-free trip is more important than reaching my destination quickly.	1		
I don't mind long delays as long as I'm comfortable.	0.72	0.09	8.08
It is important to have comfortable seats when I travel.	0.97	0.09	10.51
I avoid traveling at certain times because it is too stressful.	0.45	0.45	4.11
A clean vehicle is important to me.	0.86	0.86	9.75

The Goodness of Fit Index (GFI) is used to determine the overall fit of the model (that is, to measure how well the data conforms to the theoretical construct). The GFI, like the familiar R-squared measure from multiple regression analysis, measures the amount of variation accounted for by the model. Consequently, values closer to 1 equate to a better fit. The analysis has a GFI of .78, meaning that 78% of the variability in the data is explained by the model. This communicates that there is a relatively good fit.

All individual variables are statistically significant with the absolute value of the t-statistic greater than 1.96 and significant at the 95% confidence level. Many of the variables are highly correlated. These include the flexibility statements: "I need to make trips according to a fixed schedule," and "It's important to be able to change my travel plans at a moment's notice." Also highly correlated are the comfort statements: "Having a stress-free trip is more important than reaching my destination quickly," and "It is important to have comfortable seats when I travel." Interestingly there was a negative relationship between the environmental statements: "People who travel alone should have to pay more to help improve the environment" and "I would be willing to pay more when I travel if it would help the environment."

3.3 Structural Equation Modeling

The relationship between socioeconomic characteristics, latent attitudinal factors, and the responses to the attitudinal questions are modeled as a SEM. Socioeconomic characteristics are considered to impact all latent attitudinal factors. Linear equations with socioeconomic characteristics as explanatory variables and attitudinal factors as latent variables are used.

The latent attitudinal factors productivity/reliability and flexibility are considered to impact time sensitivity. The relationship between attitudinal variables and latent attitudinal factors are modeled according the assignments in Table 3.1 with each factor having multiple attitudinal statements. The relationships between attitudinal factors, attitudinal variables, and socioeconomic characteristics are shown in Figure 3.1.

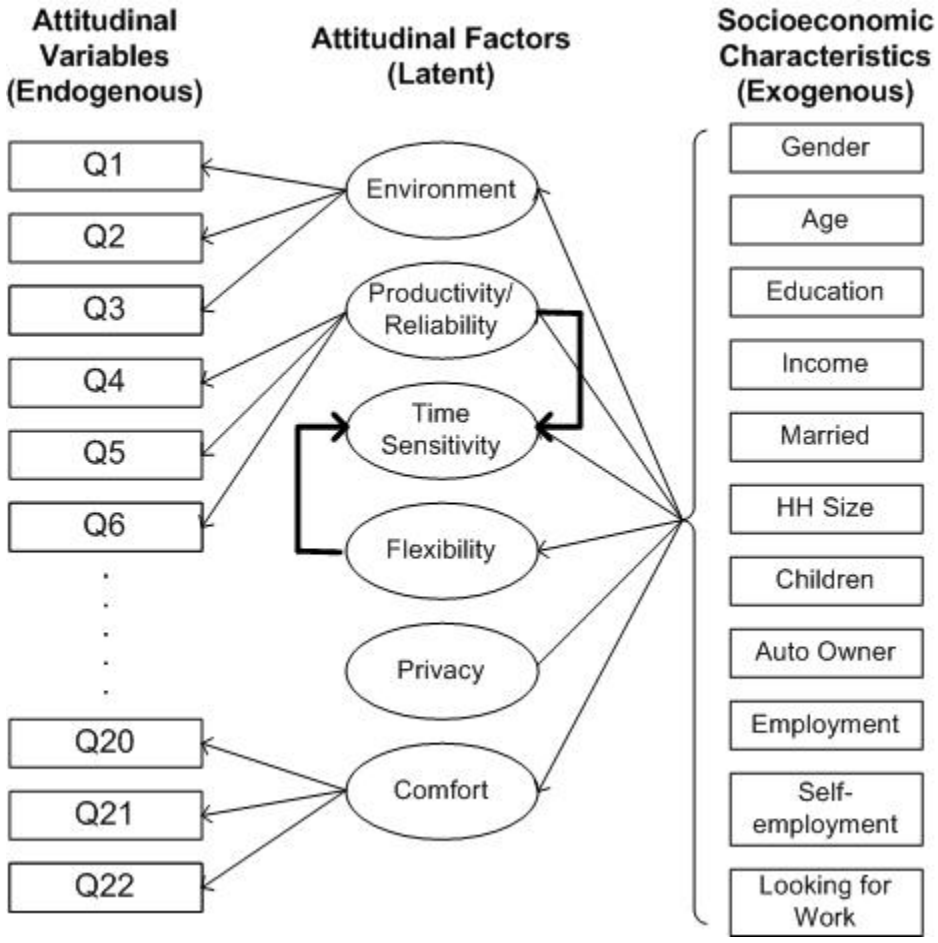

Figure 3.1 Intercity Transportation Structural Equation Model

One can hypothesize the relationship between many of the socioeconomic characteristics and attitudes based on economic and travel behavior theory. Individuals with high levels of education and those with children may be more knowledgeable and concerned with the environmental impacts of transportation. Middle-aged individuals, especially those in the workforce or with children, may feel pressed for time and desire that time spent traveling allows for productive activity. These same groups might also be sensitive to travel time and the ability to change travel plans. Older individuals may have a higher desire for comfort.

Note that attitudinal factors may not be expressed or observed in individual's travel behavior. For example, an individual who prefers comfort may be unable to afford travel with that attribute. At the same time, an individual may not be highly sensitive to travel time, but, due to their high income, may take trips with shorter travel times. These phenomena are not limited to economics. Parents may highly value privacy, but must make trips with their children and other riders.

The intercity transportation SEM model has a GFI of .83. Parameter estimates for the socioeconomic variables impact on each of the latent attitudinal factors are presented in Table 3.2. The base group were females, age 65 and up, with a graduate degree, and with incomes over $150,000.

Table 3.2 Intercity Transportation SEM Estimates

	Environment	Productivity/ Reliability	Time Sensitivity	Flexibility	Privacy	Comfort
Gender						
Male	0.07	-0.03	0.14	-0.08	-0.05	0.01
Age						
18-24	-0.09	0.05	-0.14	0.05	-0.13	0.05
25-34	-0.33 **	0.05	0.02	-0.13	-0.34 **	-0.11
35-44	-0.21 *	0.19 *	0.13	0.03	-0.19	0.13
45-54	-0.33 **	0.21 *	0.12	0.06	-0.39 **	0.27 **
55-64	-0.08	0.02	0.16	0.05	-0.12	0.01
Education						
High School or less	0.05	0.11	-0.06	-0	0.01	0.32 **
Some College	0.01	-0.06	-0.24	-0.06	-0.01	0.29 **
College Degree	0.13	0.06	-0.07	0.06	0.15	0.23 **
Income						
<30 K	0.3 **	0.04	0.17	0.04	0.07	-0.08
<60 K	0.15	-0.01	0.04	-0.01	-0	-0.16
<100 K	0.09	-0.02	-0.14	-0.02	-0.09	-0.23
<150 K	0.09	0.04	0.27 *	0.03	-0.18	-0.01
Married	0.23	0.1	-0.06	0.1	0.02	0.11
Number of Children	0.14	0.25 *	0.26	0.27	0.05	-0.1
Household Size	-0.15	-0.48 **	-0.3	-0.18	-0.09	-0.14
Vehicle Presence	-0.12	0.02	0.04	0.02	0.04	0.19 **
Employed	0.21 **	0.17	0.36 **	0.29 **	0.03	0.07
Self-employed	-0.2 **	-0.05	0.11	0.06	0.14	-0.13
Looking for Work	0.07	0.06	0.28 **	-0.001	-0.05	0.11

* $p<0.1$ ** $p<0.05$

Middle-aged and self-employed individuals are found to be less sensitive to the environment, while employed individuals and those with low incomes are found to be more sensitive to the environment. Middle-aged individuals in large families or with children value the opportunity to use travel time productively. Those with higher incomes are found to be more sensitive to travel time, which may be supported by considering the value of time for higher-income individuals. Those who are self-employed are found to be less sensitive to travel time. Individuals that are middle-aged are less sensitive to privacy. Individuals with lower education find comfort more desirable.

3.4 Attitude-based Market Segmentation

The number of market segments is determined using cluster analysis. The kink method identifies eight clusters as the number of market segments to be used. Market segments are constructed using the three attitudinal factors with the highest exploratory power: time sensitivity, flexibility, and privacy. These align with those found by Outwater et al. (2003) for urban travelers. Figure 3.2 presents the combinations of the attitudinal factors and market segment names.

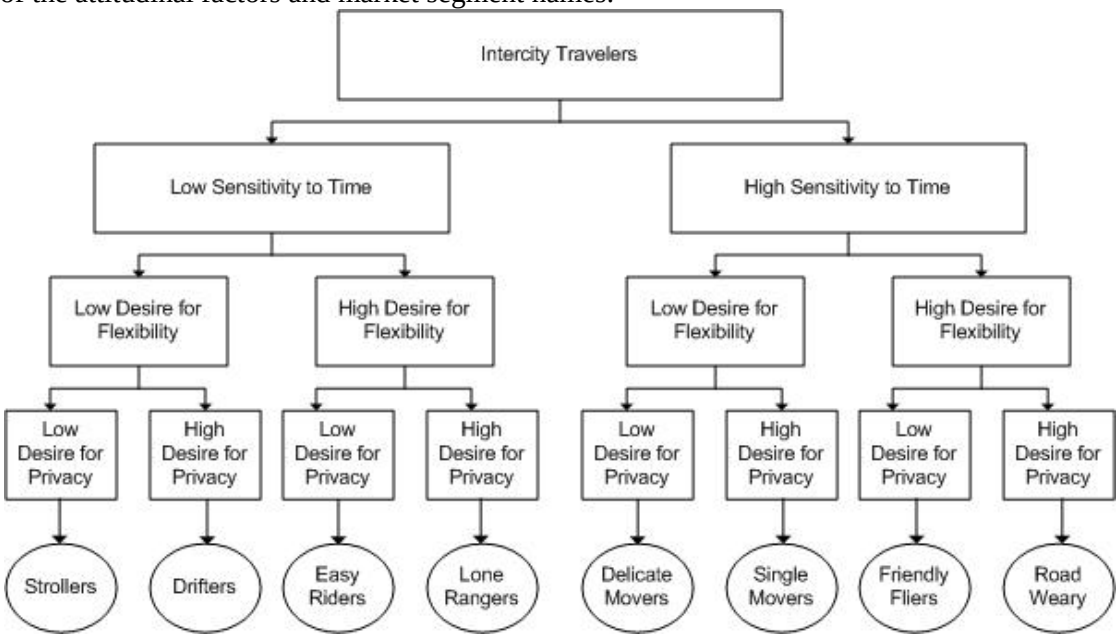

Figure 3.2 Intercity Transportation Market Segments

By assigning individual residents to each market segment based on their socioeconomic characteristics, the profiles of each entire market segments can be identified. The name, travel attitudes, travel behavior, and socioeconomic characteristics of each of the eight segments are as follows:

Strollers have a low sensitivity to travel time and schedule as well as a low desire for privacy. They tend to be male, married, and part of larger households, and they have, on average, the highest income of all the groups.

Drifters have a low sensitivity to travel time and flexibility but prefer privacy. They have, on average, a higher income and are more likely to be male, middle-aged, and married. They are most likely to be self-employed.

Easy Riders have a low sensitivity to time, a high desire for flexibility, and a low desire for privacy. They are more likely female and older with moderate incomes.

Lone Rangers have a low sensitivity to time but highly desire flexibility and privacy. They tend to be older and male.

Delicate Movers are highly sensitive to travel time but not to schedule or privacy. They tend to be seniors with lower education, lower income, and smaller household size. Delicate movers are more likely than others to travel by train, bus, and shuttle van.

Single Movers have a high sensitivity to time, but not to schedule, and desire privacy. They are more likely to be unmarried and male, with low to middle incomes, less education, and kids.

Friendly Fliers have a high sensitivity to travel time and schedule and a low desire for privacy. They are more likely to be working age, members of households with children, more highly educated, and with moderate to high incomes. They are also more likely to be female. This group is most likely to make regional trips by air.

Road Weary travelers are similar to the Friendly Fliers but are more sensitive to privacy. They are also likely to be male, married, members of larger households, and have middle incomes.

The demographic characteristics of these clusters are described in more detail in Table 3.3.

Table 3.3 Demographic Characteristics of Market Segments

Market Segment	Male	Married	Children in Household	Household Income over $60,000	Over age 65	Attended at least some college	Employed	Average household size
	----------Percentage----------							
Strollers	82	80	77	78	7	54	99	2.8
Drifters	66	65	69	52	6	55	97	2.8
Easy Riders	28	77	14	36	62	72	36	2.2
Lone Rangers	61	57	34	6	35	35	90	2.1
Delicate Movers	42	60	2	5	81	29	24	1.7
Single Movers	71	48	75	10	4	26	99	2.7
Friendly Fliers	35	65	74	67	8	74	86	3.3
Road Weary	56	77	88	45	5	60	97	3.0

3.5 Market Segment Size

The size of each market segment is calculated by assigning residents in the market area to the eight market segments based on their socioeconomic characteristics. Population data from the 2008 Public Use Microdata Sample (PUMS) are used. Each individual included in the 2008 data set was assigned to one of the market segments based on their sociodemographic characteristics. The boundaries for this dataset do not align perfectly with the zip-code based system used for the survey. A map of the shaded zip code areas is overlayed with the PUMS boundaries in Figure 3.3. All PUMS areas from North Dakota were used as were areas 00100, 00200, 00600, 00700, and 00800 in Minnesota.

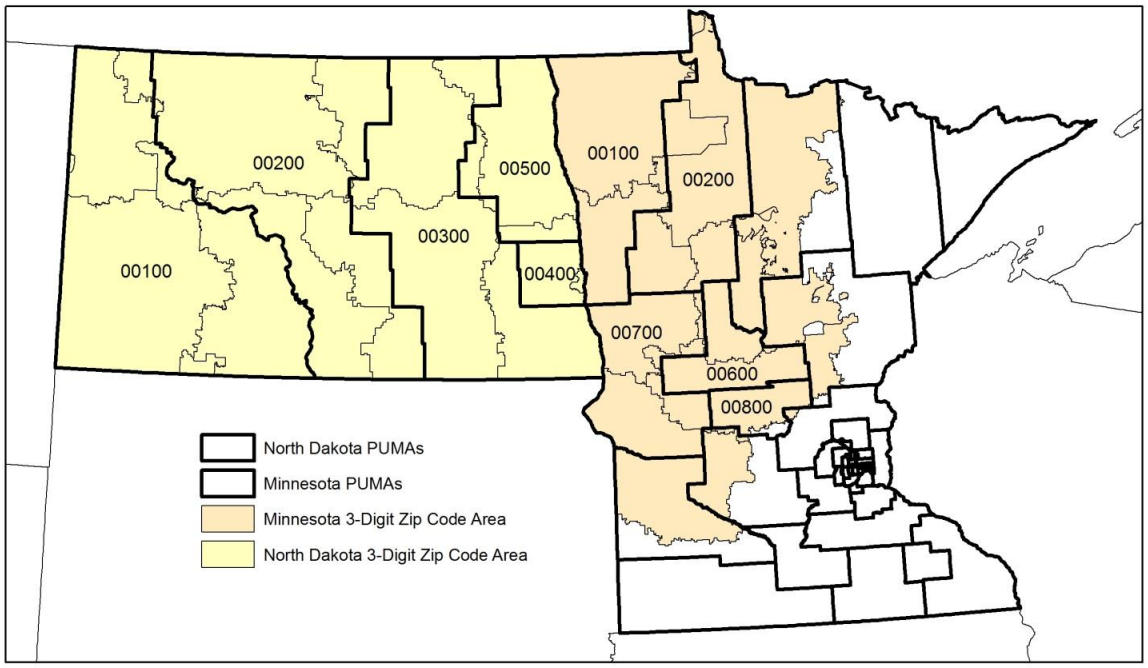

Figure 3.3 Market Area

Individuals with a high sensitivity to travel time and a high desire for flexibility, members of the Road Weary and Friendly Flier segments, make up 50% of intercity travelers in the market area. Strollers, individuals with a low desire for privacy and low sensitivity to travel time and schedule, a target market for intercity rail and bus, are 12% of the population. The relative size of each market segment for the market area is presented in Figure 3.4.

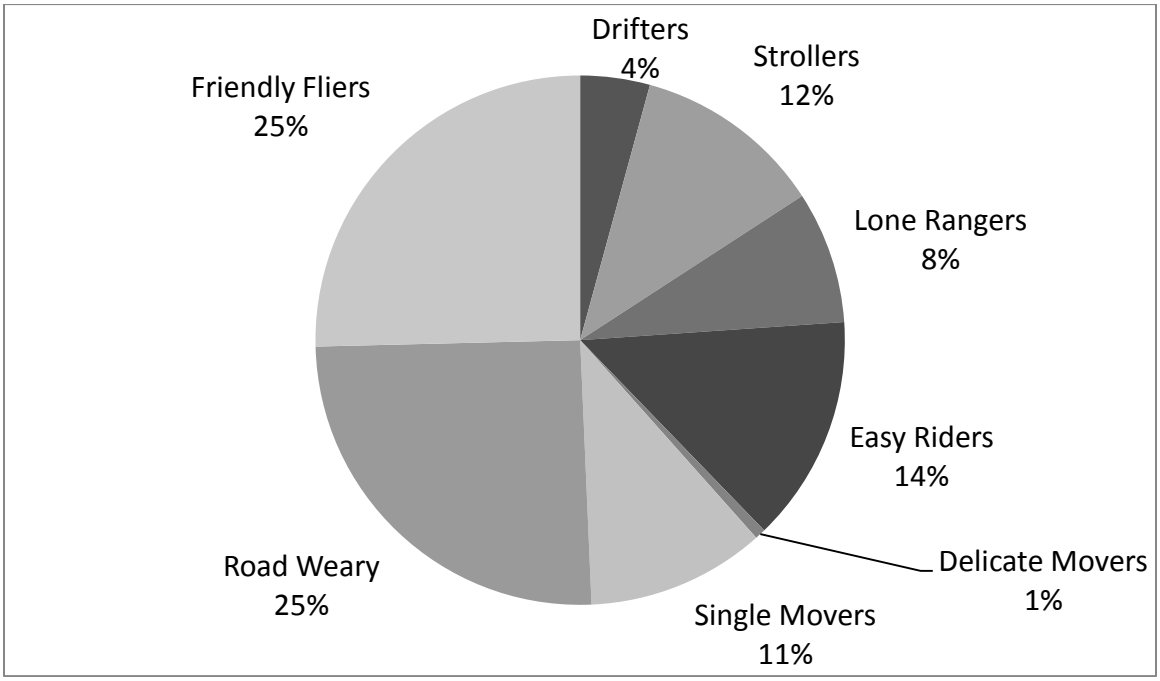

Figure 3.4 Relative Market Segment Sizes

4. INTERCITY TRAVEL BEHAVIOR BY MARKET SEGMENT

Market segments are expected to respond differently to changes in price and product characteristics. In the case of intercity transportation, these differences can be quantified as variations in mode share. Knowledge of market segment profiles and behaviors can also be used as the basis for marketing strategies to increase the share of intercity modes by tailoring or promoting the desirable features of the mode to a specific market segment. In this section we estimate the shares of five intercity transportation modes under varying conditions.

4.1 Estimating Intercity Travel Mode Share

Intercity transportation mode shares by market segment are estimated using socioeconomic characteristics for each market segment in the North Dakota and Minnesota market area and a previously estimated intercity demand model from Mattson et al. (2010a). Demand by market segment is then weighted by the relative size of each segment to determine the total modal share.

The parameter estimates and odds ratios for the intercity transportation demand model from Mattson et al. (2010a) are presented in Table 4.1. The model was fit from stated preference and socioeconomic data collected by the same survey that collected traveler attitudes for this study. The use of stated preference data allowed survey participants to identify choices among modes under circumstances they might not have otherwise been exposed to. Odds ratios can be interpreted as the estimated change in the odds of changing a given mode from a one unit increase in the respective variable.

Table 4.1 Intercity Transportation Demand Estimates

Independent variable	Parameter estimate	Odds ratio
Auto	1.402**	4.05
Air	1.023	
Bus	-0.841	
Rail	-1.109	
AgeAuto	-0.056	
AgeAir	-0.374**	0.69
AgeBus	0.163	
AgeRail	0.096	
MaleAuto	0.563**	1.74
MaleAir	0.551	
MaleBus	0.038	
MaleRail	0.171	
Income-Auto	0.264*	1.29
Income-Air	-0.047	
Income-Bus	-0.287	
Income-Rail	0.088	
Alone-Auto	0.241	
Alone-Air	0.957**	2.58
Alone-Bus	0.479	
Alone-Rail	0.507	
Personal-Auto	0.473*	1.59
Personal-Air	-0.863**	0.42
Personal-Bus	-0.723	
Personal-Rail	-0.101	
Transit Exp-Auto	-0.647**	0.52
Transit Exp-Air	0.233	
Transit Exp-Bus	-0.098	
Transit Exp-Rail	0.186	
Travel Time	-0.429**	0.65
Travel Price	-0.024**	0.984
Travel Price*Inc2	0.013**	1.009
Travel Price*Inc3	0.011**	1.010
Travel Price*Inc4	0.014**	1.012
Transfer	-0.141	
Frequency	0.027	

* $p<0.1$ ** $p<0.05$

Based on the odds ratio estimates from the estimated intercity transportation model, travel by automobile is more likely than other modes. Seniors are less likely than others to travel by air. Men are more likely than others to travel by automobile as are individuals with higher income. Individuals traveling alone are more likely to fly, while those who are traveling for personal reasons are less likely to do so by air. Travelers with experience using transit are less likely to make intercity trips by automobile. As expected, the longer the travel time and the higher the cost of travel the less likely an individual is to choose that mode.

The intercity transportation demand equation and the socioeconomic characteristics for each profile allow for the estimation of mode shares for automobile, air, bus, rail, and shuttle van. The mode shares for personal trips made as a group by individuals are presented in Table 4.2. It includes estimates for medium-range regional trips 120 miles in length and long-range regional trips 480 miles in length.

Table 4.2 Intercity Transportation Mode Shares

	120-Mile Trip					480-Mile Trip				
	Auto	Air	Bus	Train	Van	Auto	Air	Bus	Train	Van
Strollers	0.86	0.01	0.03	0.07	0.03	0.86	0.07	0.02	0.04	0.02
Drifters	0.88	0.01	0.02	0.05	0.03	0.82	0.13	0.01	0.03	0.02
Easy Riders	0.75	0.00	0.08	0.09	0.09	0.82	0.04	0.05	0.05	0.05
Lone Rangers	0.74	0.00	0.11	0.09	0.06	0.85	0.00	0.06	0.05	0.03
Delicate Movers	0.68	0.00	0.12	0.09	0.10	0.81	0.00	0.07	0.06	0.06
Single Movers	0.80	0.00	0.07	0.08	0.05	0.84	0.05	0.04	0.04	0.03
Friendly Fliers	0.87	0.02	0.02	0.04	0.06	0.74	0.21	0.01	0.02	0.03
Road Weary	0.82	0.00	0.06	0.07	0.05	0.83	0.07	0.03	0.04	0.03
Total Market	0.82	0.01	0.05	0.07	0.05	0.81	0.10	0.03	0.04	0.03

Travel by automobile is the dominant mode for medium- and long-range trips, with 82% and 81% of the mode share respectively. Air travel has a negligible share for 120 mile trips, but a 10% share of 480 mile trips. Intercity bus, rail, and van travel see a significant drop in modal share from medium- to long-range trips as air takes a greater market share for the longer trips. These mode shares can vary with changes in prices. The estimates in this base case assume the price of gasoline at $4 per gallon and the fares for other modes at similarly high levels. The air fare is set at $500 per passenger. Reducing this fare would result in significant increases in the shares for air travel for 480-mile trips. The base case also assumes individuals are traveling with others rather than alone. The mode share for air for longer trips would increase significantly for those traveling alone. The main objective of this analysis is to identify those market segments that are most likely to choose a given mode.

The Delicate Movers, Lone Rangers, and Easy Riders are the most likely to travel by bus, rail, or van. The Delicate Movers and Easy Riders have a lower desire for privacy, explaining why they may be more likely to use these alternative modes, and the Easy Riders and Lone Rangers also have a low sensitivity to travel time. The Delicate Movers also do not require a flexible schedule, making them more likely to choose an alternative to the automobile, but they are sensitive to time. These groups also all have middle-to-low-incomes, making the travel by non-automobile modes, especially intercity bus transportation, more appealing. Furthermore, these three groups have the highest percentages of seniors and older adults are less likely to travel by air, as shown in the intercity demand model, or to drive themselves.

Friendly Fliers are the most likely to fly. Although they desire flexibility, Friendly Fliers have a high sensitivity to time and a low desire for privacy. They also tend to have higher incomes and higher education and are younger.

4.2 Changes to Intercity Transportation Modal Characteristics

Changing costs of travel and mode characteristics can impact the market share of intercity transportation modes. For example, increasing the level of service provided by a mode would address the issue of flexibility as travelers would have more choices. Increasing the speed of transportation modes will increase modal share by reducing travel time. Increasing the actual or perceived level of privacy might be accomplished by redesign of vehicles.

To demonstrate this capability, the relative speed of intercity bus and passenger rail modes are increased to that experienced by automobile travelers. Such changes could occur due to increased investment in higher speed rail infrastructure and technology or by increasing subsidies to intercity bus service

providers. The mode share by market segment under higher speed intercity bus and rail service are presented in Table 4.3 and Table 4.4. In the high-speed scenario, the travel times for bus and rail equal travel time for automobile. For bus and rail travel time to equal that of the automobile, buses and trains may actually have to travel at greater speeds than the automobile because intercity bus and train providers often need to make other stops along the way. Such a scenario may be implausible, especially for intercity bus. Therefore, an additional medium-speed scenario is considered where bus and rail travel time is 10% greater than that for the automobile. Access and egress times would further increase the time disadvantages for bus and rail, but those are not included this analysis.

Table 4.3 Intercity Bus Shares at Different Travel Speeds

	120-Mile Trip			480-Mile Trip		
	Low-Speed	Medium-Speed	High-Speed	Low-Speed	Medium-Speed	High-Speed
	----------Percentage----------					
Strollers	3.1	3.5	3.7	1.6	2.6	3.5
Drifters	2.1	2.3	2.5	1.0	1.6	2.2
Easy Riders	8.0	8.8	9.3	4.5	6.9	8.9
Lone Rangers	10.9	12.0	12.7	6.3	9.5	12.3
Delicate Movers	12.5	13.6	14.3	7.4	11.0	13.9
Single Movers	6.9	7.6	8.1	3.7	5.8	7.6
Friendly Fliers	1.8	2.0	2.2	0.8	1.3	1.8
Road Weary	5.7	6.3	6.7	3.0	4.7	6.2
Total Market	5.2	5.7	6.1	2.8	4.3	5.7

Table 4.4 Intercity Rail Shares at Different Travel Speeds

	120-Mile Trip			480-Mile Trip		
	Low-Speed	Medium-Speed	High-Speed	Low-Speed	Medium-Speed	High-Speed
	----------Percentage----------					
Strollers	7.1	8.0	8.5	3.7	5.9	8.0
Drifters	5.4	6.1	6.5	2.6	4.2	5.8
Easy Riders	8.7	9.5	10.1	4.9	7.5	9.6
Lone Rangers	8.7	9.6	10.2	5.0	7.6	9.8
Delicate Movers	9.3	10.1	10.7	5.5	8.2	10.4
Single Movers	8.0	8.8	9.4	4.3	6.7	8.8
Friendly Fliers	4.0	4.5	4.8	1.8	2.8	3.9
Road Weary	7.0	7.8	8.3	3.7	5.8	7.7
Total Market	6.7	7.4	7.9	3.5	5.5	7.3

The impact of a decrease in travel time for intercity bus and rail has a significant positive impact on mode share. The market shares for 120-mile trips increased by 15 to 20 percent for higher-speed intercity bus and intercity rail service. The shares for long-distance trips approximately double across all market segments. Smaller increases in travel speeds also have positive impacts on market shares for intercity bus and rail.

4.3 Strategic Marketing and Service Design

Travelers with certain attitudes toward travel may be attracted to non-automobile modes. Strollers, with their low sensitivity to time, flexibility, and privacy would be a target market for intercity bus or rail service. This group makes up 12% of the population of the market area. However, they are less likely to be bus or rail users than other groups. Members of this group might be drawn to using bus or rail through strategic marketing instead of significantly increasing the level of service.

Either of these changes would result in an increase in capital and operation costs. A full accounting of benefits from increased use of these modes, including fare revenue, increased economic activity, and impacts on the environment would require more detailed expense information. Determining the full social cost and benefit would require additional information.

5. IMPLICATIONS FOR INTERCITY PASSENGER TRANSPORTATION POLICY AND INDUSTRY

Knowledge of intercity travel behavior is valuable to transportation policy makers and industry leaders facing long-term strategic decisions. The attitudes of intercity travelers can be used to estimate changes in mode share. They can also be used to develop marketing strategies to increase the market share of non-automobile intercity travel modes by tailoring or expanding existing service as well as to identify market segments that might be attracted to alternative modes with effective promotion and education.

At the federal level, there is considerable discussion over the direction of national transportation policy. Planning for high speed rail systems that will require billions in investment has begun. At the same time, changes in the level and type of incentives and subsidies provided to transportation providers, both public and private, is part of the discussion on the new transportation bill.

Federal programs that subsidize the level of service provided by intercity transportation modes may see increases in funding. Knowledge of travel behavior by market segment can determine what the response of system users will be to proposed changes. The analysis in the previous section notes that a decrease in travel time for intercity bus or rail service would result in these modes capturing a much larger market share. Regardless of the level of funding, an improved understanding of the impacts of federal spending on transportation results in better stewardship of taxpayer funds.

Similarly, there has been discussion of internalizing the environmental costs of many daily activities including travel by automobile using a "carbon tax." Such a tax would increase the relative cost of travel by personal automobile, making other modes more desirable. The study's confirmatory factor analysis verifies environmental sensitivity as a significant attitudinal factor which supports such a change in policy. The demand model can be used to estimate the changes in travel behavior resulting from changing the travel cost associated with each mode.

Changing demographics will also likely influence demand for different modes of travel. As the analysis shows, those market segments with higher percentages of seniors were most likely to travel by bus, train, or van for intercity trips, and they were less likely to travel by air for the longer trips. The size of these market segments will continue to grow as the population ages.

Like government, firms in the intercity passenger transportation industry need marketing information to design and promote their service. Accurate estimates of ridership and revenue help these firms determine which investments to make. Many intercity passenger transportation firms serving the market region, like other sparsely populated parts of the country, are relatively small. They may not have the resources to conduct large marketing studies on their own. However, the results of this paper may be helpful.

While government support for intercity bus and rail may be included in the next transportation bill, the increase in ridership predicted using the demand model may justify increases in service outside of that supported with taxpayer funds. At the same time, knowledge of the relative size of market segments that find bus and rail attributes appealing is provided by the study as well. If intercity bus and rail are able to provide more reliable, more frequent service they may be able to attract riders from all segments except those most sensitive to privacy, which includes 38% of the residents of the market area.

While attitude-based market segmentation can play a useful role, the travel behavior of some individuals may not reflect their attitudes. This is most evident for travelers with low incomes. These individuals may prefer transportation alternatives but may be unable to afford them. In this respect, traveler attitudes may not help estimate demand but may be especially useful in developing policy. For example, shared

attitudes and unmet demand for intercity transportation services may justify increased government support. This could take the form of favorable government regulations or subsidies.

This study identified the three most powerful characteristics in differentiating intercity travelers: privacy, time sensitivity, and flexibility. The relative size of eight markets with different combinations of attitudes for a market region was determined. The modal share under current and hypothetical scenarios was estimated. The results have implications for transportation policymakers and industry leaders.

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