

The Satisfaction Gap: Explaining Consonance and Dissonance Between Transportation and Life Satisfaction

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ABSTRACT

This study examines the relationship between satisfaction with transportation options and overall life satisfaction, with particular emphasis given to explaining consonance and dissonance between the two domains. It investigates how transportation conditions, socioeconomic characteristics, built-environment attributes, and psychosocial orientations jointly shape these satisfaction outcomes. The study uses data from the Transportation Heartbeat of America Survey conducted in 2024 (N = 8,030). A Generalized Heterogeneous Data Model (GHDM) was employed to jointly model transportation and life satisfaction while incorporating four stochastic latent psychosocial constructs: Value Alignment, Social Inclination, Positive Travel Experience, and Desire for Mobility Control. The model further accounts for the endogenous relationship between the two satisfaction domains, incorporates response-specific threshold shifters that capture consonance and dissonance patterns, and furnishes conditional treatment effects that quantify transitions across consonance and dissonance states. Transportation satisfaction is positively associated with life satisfaction, supporting the notion that transportation is an important contributor to overall well-being. However, approximately 28% of respondents exhibit dissonance between transportation and life satisfaction, indicating that favorable transportation experiences do not always translate into broader life satisfaction, and vice versa. Psychosocial orientations significantly influence both outcomes, while income, driving capability, vehicle sufficiency, and pedestrian-oriented environments are found to be important determinants of satisfaction. The results further suggest that transportation improvements are most effective in enhancing overall well-being among individuals who are satisfied with life but dissatisfied with their transportation options. This study introduces a joint modeling framework that explicitly represents consonance and dissonance between transportation and life satisfaction while integrating latent psychosocial constructs and response-specific threshold shifters within a unified behavioral model system. The findings suggest that transportation planning should complement traditional performance measures with subjective well-being indicators and target mobility improvements toward populations with unmet transportation needs to maximize societal well-being.

Keywords: Transportation satisfaction, life satisfaction, user experience, travel perceptions, behavioral modeling

1. INTRODUCTION

Life satisfaction has emerged as an important indicator of individual and societal well-being because it reflects how people evaluate their lives as a whole. It is commonly understood as a cognitive assessment of one's overall life circumstances, based on the experiences, conditions, and priorities that the individual considers important (Pavot, 2007). Unlike objective measures of well-being, life satisfaction allows individuals to assess their own quality of life without requiring researchers to impose a predetermined set of external criteria. This subjective perspective can reveal unmet needs or concerns that may not be fully captured through conventional indicators of income, health, housing, or access to services (Badri, 2022). Higher life satisfaction has been associated with favorable mental and physical health outcomes, greater workplace productivity, longevity, social trust, a stronger sense of belonging, and greater resilience during periods of hardship (Kim, 2021; Guo, 2022). At the societal level, life satisfaction is increasingly viewed as a meaningful complement to traditional social and economic indicators because it offers insight into how individuals experience and evaluate the conditions in which they live (Kim, 2021; Haim-Litevsky, 2023).

Transportation represents an important domain through which public infrastructure and services may contribute to life satisfaction. Transportation systems enable access to employment, education, health care, shopping, recreation, and social interaction, thereby shaping whether individuals can participate fully in economic and community life. Beyond facilitating movement between origins and destinations, transportation conditions can influence feelings of freedom, autonomy, safety, connectedness, and inclusion (Delbosc, 2012). Satisfaction with transportation options may therefore reflect the extent to which individuals perceive that their mobility needs are being met. This assessment may depend on accessibility, affordability, reliability, safety, convenience, comfort, and the availability of travel options that are compatible with individual needs and circumstances. Prior research on transportation barriers, transportation insecurity, and mobility disadvantage has documented how limitations in access and mobility can affect daily participation, social inclusion, and broader well-being (Murphy et al., 2022; Razon et al., 2022; McDonald-Lopez et al., 2023; Robbennolt et al., 2026). Subjective transportation satisfaction complements these more objective measures by allowing individuals to evaluate transportation conditions according to their own needs and lived experiences (Badri, 2022).

Despite growing interest in transportation satisfaction and life satisfaction, the relationship between the two remains insufficiently understood. Existing research has examined how transportation-system attributes and travel experiences, including access, affordability, safety, reliability, and travel time, relate to quality of life and well-being (Delbosc, 2012; Murphy et al., 2022; Razon et al., 2022; McDonald-Lopez et al., 2023). However, transportation satisfaction and life satisfaction are often analyzed separately, or transportation satisfaction is represented through evaluations of individual modes, trips, or service attributes. Consequently, limited evidence exists regarding whether overall satisfaction with one's transportation options constitutes a meaningful component of overall life satisfaction. This distinction is important because high transportation satisfaction does not necessarily imply high life satisfaction, just as dissatisfaction with transportation does not necessarily translate into dissatisfaction with life as a whole.

Individuals may exhibit either consonance or dissonance between the two satisfaction domains. Some may be satisfied with both their transportation options and their lives, while others may be dissatisfied with both. These cases represent consonant states in which the two evaluations are aligned. Other individuals may report high life satisfaction despite dissatisfaction with transportation, perhaps because favorable conditions in other life domains offset transportation-

related deficiencies. Conversely, some may report high transportation satisfaction but low life satisfaction because difficulties related to health, employment, housing, relationships, or other circumstances outweigh favorable transportation experiences. These dissonant states are important from a transportation planning perspective because they reveal that transportation is neither a uniformly dominant nor an inconsequential component of well-being. Individuals with low transportation satisfaction may have unmet mobility needs even when they remain broadly satisfied with life. For others, transportation improvements may enhance mobility and transportation satisfaction but yield only limited changes in overall well-being because their primary sources of dissatisfaction lie outside the transportation domain.

Understanding these patterns requires consideration of both transportation circumstances and the ways individuals interpret those circumstances. Satisfaction is inherently subjective, and people facing similar transportation conditions may evaluate them differently because they vary in their attitudes, preferences, values, and psychosocial orientations. Two broad perspectives have been advanced to explain differences in life satisfaction. The bottom-up perspective suggests that overall life satisfaction is shaped partly by satisfaction within specific life domains, including employment, relationships, housing, health, and transportation (Campbell et al., 1976; Lambert, 2018). The top-down perspective emphasizes the role of personality and relatively enduring psychosocial characteristics in shaping how individuals interpret their circumstances and experiences (Heller et al., 2004; Lachmann et al., 2017). Prior studies have shown that personality traits such as neuroticism, extraversion, agreeableness, and conscientiousness are systematically associated with life satisfaction, even among individuals facing different circumstances (Brickman et al., 1978; Heller et al., 2004; Lachmann et al., 2017). These perspectives are not mutually exclusive. Rather, life satisfaction is widely understood to reflect both the conditions individuals face and the subjective lens through which those conditions are evaluated (Brief et al., 1993; Buhler et al., 2023).

This study examines the relationship between transportation satisfaction and life satisfaction using data from the Transportation Heartbeat of America Survey, a large national survey conducted in the United States in 2024. The analysis focuses on two ordered outcomes: self-reported satisfaction with one's transportation options and self-reported satisfaction with life overall. These outcomes are modeled jointly while accounting for individual and household characteristics, transportation behaviors, transportation-system conditions, and built-environment attributes. The framework also incorporates four stochastic latent constructs representing important psychosocial orientations: Desire for Mobility Control, Positive Travel Experience, Social Inclination, and Value Alignment. These constructs capture differences in the importance individuals place on autonomy and flexibility, their interpretation of travel time, their preference for social interaction, and the extent to which transportation choices align with broader personal values. By jointly examining the two satisfaction domains, the study seeks to identify the factors associated with transportation satisfaction, life satisfaction, and consonant or dissonant evaluations across the two outcomes.

The remainder of this paper is organized as follows. Section 2 reviews the literature on life satisfaction, transportation satisfaction, and the conceptual pathways linking the two. Section 3 describes the survey data, study sample, satisfaction outcomes, and latent psychosocial constructs. Section 4 presents the modeling framework and estimation methodology. Section 5 discusses the model estimation results while Section 6 presents conditional treatment effects. Finally, Section 7 summarizes the key findings, discusses their implications for transportation planning and policy, and identifies directions for future research.

2. CONNECTING LIFE SATISFACTION AND TRANSPORTATION SATISFACTION

Life satisfaction is generally conceptualized as a cognitive evaluation of life as a whole, rather than a direct assessment of any single circumstance or life domain (Pavot, 2007). This distinction is important because individuals evaluate their lives according to the conditions and priorities they personally consider meaningful. Subjective assessments may therefore capture aspects of well-being that are not fully represented through objective measures of income, health, housing, or access to opportunities (Badri, 2022). At the same time, the subjective nature of life satisfaction makes its determinants difficult to isolate because individuals experiencing similar circumstances may evaluate their lives quite differently.

Two complementary perspectives have been used to explain these differences. The top-down perspective emphasizes the role of personality and relatively enduring psychosocial orientations. According to this view, individuals interpret circumstances through dispositional tendencies that shape satisfaction across multiple life domains. Research has found systematic associations between life satisfaction and personality traits such as neuroticism, extraversion, agreeableness, and conscientiousness (Heller et al., 2004). Such traits may continue to influence satisfaction even when individuals experience adversity or changing life circumstances (Brickman et al., 1978; Lachmann et al., 2017). The bottom-up perspective instead holds that overall life satisfaction is constructed partly from evaluations of specific life domains. Satisfaction with employment, relationships, housing, health, and other circumstances may collectively contribute to an individual's broader assessment of life (Campbell et al., 1976; Lambert, 2018). These perspectives are not mutually exclusive. Life satisfaction is increasingly understood as reflecting both the circumstances individuals experience and the psychosocial lens through which those circumstances are interpreted (Brief et al., 1993; Buhler et al., 2023).

Transportation represents a particularly relevant life domain because it supports participation in nearly every other domain. The ability to travel enables access to employment, education, health care, shopping, social interaction, and recreational opportunities. Transportation conditions may also shape feelings of autonomy, freedom, safety, connectedness, and inclusion (Delbosc, 2012). In this sense, transportation contributes to well-being both instrumentally, by enabling activity participation, and experientially, through the quality of daily travel and the degree of control individuals perceive over their mobility.

A growing body of transportation research has examined how access, affordability, safety, reliability, travel time, and mobility limitations affect quality of life and social participation. Studies of transportation disadvantage and transportation insecurity have documented the consequences of limited mobility, including difficulty reaching essential destinations, reduced participation in social and economic activities, and diminished well-being (Murphy et al., 2022; Razon et al., 2022; McDonald-Lopez et al., 2023; Robbennolt et al., 2026). These studies often rely on observable indicators such as missed trips, inaccessible opportunities, mobility barriers, or resource constraints. Such measures are essential for identifying transportation disadvantage, but they do not fully reveal whether individuals believe that their transportation needs are being met.

Transportation satisfaction provides a complementary subjective assessment. It reflects how individuals evaluate the adequacy of their transportation options in relation to their own needs, expectations, and circumstances. Two individuals with similar travel times, modal options, and neighborhood conditions may report different levels of satisfaction because they differ in their tolerance for delay, preference for autonomy, enjoyment of travel, or expectations regarding service quality. Transportation satisfaction may therefore capture both system performance and the individual interpretation of that performance.

Prior studies connecting transportation and well-being have generally focused on particular travel experiences, transportation attributes, or mobility constraints. Research has examined, for example, whether accessibility, safety, affordability, travel burden, and transportation insecurity are associated with broader measures of well-being (Delbosc, 2012; Murphy et al., 2022; Razon et al., 2022; McDonald-Lopez et al., 2023). However, considerably less attention has been devoted to the relationship between overall satisfaction with transportation options and overall satisfaction with life. The two outcomes are often modeled separately, or transportation satisfaction is treated only as an evaluation of a specific trip, mode, or service attribute. This limits understanding of whether transportation satisfaction constitutes a meaningful pathway to life satisfaction and whether the relationship varies across individuals.

A further limitation is that a positive association between the two outcomes does not imply that they are always aligned. Four distinct states are possible. Positive consonance occurs when transportation satisfaction and life satisfaction are both high, while negative consonance occurs when both are low. Negative dissonance refers to low transportation satisfaction accompanied by high life satisfaction, whereas positive dissonance refers to high transportation satisfaction accompanied by low life satisfaction. These patterns are substantively different and may reflect distinct transportation circumstances, compensating conditions in other life domains, or differences in how individuals evaluate their experiences. Individuals in a state of negative dissonance may remain satisfied with life despite transportation deficiencies because favorable circumstances elsewhere offset unmet mobility needs. Conversely, individuals in a state of positive dissonance may be satisfied with transportation but dissatisfied with life because difficulties related to health, employment, housing, finances, or relationships dominate their overall evaluation. These patterns cannot be understood fully through separate models or a single consonance or dissonance measure. The four states are operationalized empirically in the next section based on the joint distribution of transportation satisfaction and life satisfaction.

Psychosocial orientations may help explain this heterogeneity. Individuals who place a high value on mobility control may respond particularly strongly to restrictions on modal choice or schedule flexibility. Those who enjoy travel or use travel time productively may evaluate similar travel conditions more favorably. Socially inclined individuals may value transportation options that facilitate interaction, while those who consider environmental, safety, or status-related consequences may assess transportation according to its alignment with broader personal values. These orientations may influence transportation satisfaction directly and may also moderate its connection to life satisfaction.

This study builds on the existing literature by jointly examining transportation satisfaction and life satisfaction within a framework that incorporates observed transportation circumstances, individual and household characteristics, and latent psychosocial orientations. It also explicitly represents consonant and dissonant evaluations across the two outcomes. In doing so, the study seeks to clarify not only whether transportation satisfaction is associated with life satisfaction, but also how and why the relationship differs across individuals and circumstances.

3. DATA DESCRIPTION

This section presents a detailed overview of the data used in the study.

3.1. Survey Overview and Sample Characteristics

The data used in this study were collected through the first wave of the Transportation Heartbeat of America (THA) Survey, administered from October 2024 through January 2025 to a broadly

representative sample of adults across the United States by a commercial survey firm to an online respondent panel using a quota-based sampling approach. Quotas were established to achieve target distributions by gender, age, race, ethnicity, educational attainment, household income, urban or rural residence, and U.S. Census division. The survey collected extensive information on transportation behaviors, emerging travel trends, mobility choices, and a wide range of attitudes and perceptions related to transportation and daily life.

The data were further enriched by appending built-environment measures at the residential ZIP-code level, including population density, employment density, walkability, pedestrian-oriented design, and land-use characteristics obtained from the U.S. Environmental Protection Agency Smart Location Database (Chapman et al., 2021). The original survey dataset included 8,212 respondents. After appending the geographic variables and completing the necessary data cleaning, the final analysis sample consisted of 8,030 individuals. Table 1 presents the socio-economic and demographic characteristics of the sample alongside corresponding estimates from the 2024 American Community Survey five-year data (U.S. Census Bureau, 2025). The survey and ACS distributions are generally well aligned across the characteristics considered, reflecting the effectiveness of the quota-based sampling design in producing a sample that broadly represents the U.S. adult population.

The sample is relatively balanced by gender, with women comprising 53.1 percent of respondents. It also spans the adult age distribution, although older adults are somewhat more prominent, with 23.2 percent aged 65 years or older. About 45 percent of respondents are full-time workers, while a similar share are not employed. Educational attainment is broadly distributed, with approximately one-third reporting a high school education or less and 37.5 percent holding at least a bachelor's degree. The sample is also diverse with respect to race and ethnicity: 14.9 percent identify as Black, 7.5 percent as Asian or Pacific Islander, and 20.1 percent as Hispanic. Across most of these individual characteristics, the sample estimates are reasonably close to the corresponding ACS distributions.

The household characteristics likewise reflect considerable variation. Nearly 40 percent of respondents reside in households earning less than \$50,000 annually, while 30.3 percent report household incomes of \$100,000 or more. Almost one-half live in households with three or more members, 66.6 percent reside in stand-alone homes, and 59.2 percent are homeowners. Vehicle ownership varies substantially, with 8.5 percent of respondents living in zero-vehicle households and 16.8 percent in households with three or more vehicles. The sample includes respondents from all nine Census divisions and encompasses both urban and rural settings, although rural residents are represented at a higher rate than in the ACS benchmark. Overall, the sample captures substantial variation across socio-economic, demographic, household, geographic, and vehicle-ownership attributes, rendering it well suited for the multivariate modeling analysis undertaken in this study.

TABLE 1 Socio-Economic and Demographic Characteristics of the Sample

<i>Individual characteristics (N = 8,030)</i>			<i>Household characteristics (N = 8,030)</i>		
Variable	Sample (%)	ACS (%)	Variable	Sample (%)	ACS (%)
Gender			Annual household income		
Female	53.1	51.2	Less than \$25,000	17.1	14.6
Male	46.9	48.8	\$25,000 to \$49,999	22.1	19.7
Age category			\$50,000 to \$99,999	30.5	29.1
18 to 24 years	9.7	11.9	\$100,000 to \$149,999	19.3	18.6
25 to 34 years	15.1	17.4	\$150,000 to \$199,999	7.0	9.6
35 to 44 years	19.3	16.9	\$200,000 or more	4.0	8.4
45 to 54 years	17.1	15.6	Household size		
55 to 64 years	15.6	16.2	One	19.4	28.7
65 years or older	23.2	22.0	Two	32.8	33.8
Employment status			Three or more	47.8	37.5
Full-time worker	44.7	45.6	Housing unit type		
Part-time worker	9.6	14.6	Stand-alone home	66.6	62.4
Non-worker	45.6	39.8	Attached home/apartment	27.1	32.4
Educational attainment			Other	6.3	5.2
High school or less	33.0	36.4	Homeownership status		
Some college or technical school	29.5	27.9	Own	59.2	60.0
Bachelor's degree(s)	22.7	21.6	Rent	35.5	34.8
Graduate degree(s)	14.8	14.1	Other	5.3	5.2
Race			Residential location type		
Asian or Pacific Islander	7.5	9.8	Urban	72.5	86.3
Black	14.9	12.2	Rural	27.5	13.7
White	63.0	61.0	Vehicle ownership		
Other	14.6	17.0	Zero	8.5	8.4
Ethnicity			One	40.6	33.1
Hispanic	20.1	19.3	Two	34.1	36.6
Non-Hispanic	79.9	80.7	Three or more	16.8	21.9
Census division					
New England	8.3	4.7	East South Central	9.4	5.8
Middle Atlantic	13.3	12.8	West South Central	13.2	12.1
East North Central	13.1	14.2	Mountain	8.6	7.6
West North Central	8.2	6.4	Pacific	13.0	16.0
South Atlantic	12.9	20.4	--	--	--

3.2. Endogenous Outcomes

The analysis considers two endogenous outcomes: satisfaction with transportation options and satisfaction with life overall. Survey respondents were asked to indicate their level of agreement with the statements, “I am generally satisfied with my transportation options” and “I am generally satisfied with my life,” using a five-point scale ranging from strongly disagree to strongly agree. Table 2 presents the joint distribution of responses to the two statements. The row totals show that 75.3 percent of respondents somewhat or strongly agree that they are satisfied with their transportation options, while 12.4 percent somewhat or strongly disagree and 12.3 percent express a neutral response. The corresponding distribution for life satisfaction is similar: 73.1 percent somewhat or strongly agree that they are satisfied with their lives, 11.1 percent somewhat or strongly disagree, and 15.8 percent neither agree nor disagree.

Although the marginal distributions are broadly similar, they do not reveal whether individual respondents evaluate the two domains in the same manner. The joint distribution provides a more nuanced picture by distinguishing between consonant and dissonant evaluations.

For this purpose, somewhat agree and strongly agree responses are classified as high satisfaction, while strongly disagree, somewhat disagree, and neither agree nor disagree responses are classified as low satisfaction. This classification yields four distinct states. Positive consonance refers to high transportation satisfaction accompanied by high life satisfaction (the green colored part of Table 2), while negative consonance refers to low satisfaction in both domains (the pink colored part of Table 2). Negative dissonance occurs when transportation satisfaction is low, but life satisfaction is high (the yellow part of Table 2), while positive dissonance occurs when transportation satisfaction is high but life satisfaction is low (the grey part of Table 2). This definition was adopted due to the focus of this study on transportation satisfaction and its role in shaping life satisfaction.

Positive consonance is the most prevalent state, accounting for 60.0 percent of the sample. An additional 11.5 percent exhibit negative consonance, indicating dissatisfaction or neutrality in both domains. The remaining respondents fall into one of the two dissonant states. Specifically, 13.0 percent report low transportation satisfaction despite high life satisfaction, while 15.4 percent report high transportation satisfaction despite low life satisfaction. Overall, 28.4 percent of respondents exhibit dissonance between their evaluations of transportation and life. Thus, even though the marginal distributions suggest generally high levels of satisfaction in both domains, more than one-quarter of the sample does not evaluate transportation and life consistently.

These patterns underscore the value of examining the two outcomes jointly. Respondents in the negative consonant and negative dissonant groups share a common feature: they do not report high satisfaction with their transportation options. Their evaluations may therefore signal unmet mobility needs or transportation conditions that warrant attention, even when overall life satisfaction remains high. By contrast, respondents in the positive dissonant group are satisfied with transportation but not with life overall, suggesting that their broader dissatisfaction may be rooted primarily in circumstances outside the transportation domain. The joint distribution therefore reveals important heterogeneity that would be obscured if transportation satisfaction and life satisfaction were analyzed independently.

TABLE 2 Relationship Between Transportation Satisfaction and Life Satisfaction (N = 8,030)

Joint Distribution (%)		I am Satisfied with my Life					Total
		Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree	
I am satisfied with my Transportation options	Strongly disagree	1.0	0.7	1.0	1.1	0.9	4.8
	Somewhat disagree	0.5	1.4	1.5	2.8	1.3	7.6
	Neither agree nor disagree	0.6	1.2	3.6	4.6	2.3	12.3
	Somewhat agree	0.9	2.2	5.7	18.9	7.6	35.3
	Strongly agree	1.0	1.6	4.0	13.7	19.8	40.0
	Total	4.0	7.1	15.8	41.2	31.9	100.0

Note: Colored cells represent the four psychological states: ■ Negative consonant = 11.5%; ■ Negative dissonant = 13.0%; ■ Positive dissonant = 15.4%; ■ Positive consonant = 60.0%.

3.3. Stochastic Latent Constructs

The THA Survey included an extensive battery of attitudinal statements that captured respondents' values, preferences, perceptions, and opinions related to transportation and daily life. These indicators were used to develop four stochastic latent constructs for inclusion in the modeling framework: Value Alignment, Social Inclination, Positive Travel Experience, and Desire for

Mobility Control. The constructs were informed by theory from the transportation and psychology literatures and refined through an empirical process that began with exploratory factor analysis and concluded with confirmatory factor analysis. The final specification was selected based on evidence in prior literature, model fit, construct reliability, and the degree of within-construct coherence and between-construct distinction. Figure 1 presents the response distributions for the indicators defining each construct.

Value Alignment captures the extent to which individuals evaluate transportation choices and investments in relation to broader personal and societal values. The construct is defined by six indicators reflecting the importance of transportation safety, support for walking, bicycling, and public transportation, acceptance of automated enforcement to reduce dangerous driving, commitment to less-polluting travel and environmentally friendly lifestyles, and the status associated with vehicle ownership. Respondents exhibit especially strong support for safety-oriented transportation priorities and enforcement measures, with more than two-thirds agreeing that additional cameras should be used to address speeding, distracted driving, and impaired driving. Support is also substantial for encouraging walking, bicycling, and public transportation. Views are more mixed regarding personal environmental behavior and the status associated with particular vehicles, indicating meaningful variation in the extent to which respondents translate broader values into their own transportation preferences and choices.

Social Inclination represents the value individuals place on opportunities for social interaction and in-person engagement. It is defined by three indicators capturing preferences for mixed-use neighborhoods, enjoyment of browsing in stores even without making a purchase, and appreciation of the social interaction available in a conventional workplace. Nearly two-thirds of respondents agree that they favor having stores, restaurants, and offices mixed among homes, and similarly large shares report enjoying both browsing in stores and interacting with others in a conventional workplace. These patterns suggest that many respondents value environments and activity settings that facilitate face-to-face contact. The construct provides a basis for examining whether transportation options that enable access to such settings are associated with higher transportation or life satisfaction among socially inclined individuals.

Positive Travel Experience reflects the extent to which individuals view travel time as enjoyable, useful, or productive rather than solely as a burden. The construct is represented by three indicators: whether travel provides a useful transition between activities, whether time spent traveling or waiting is used productively, and whether the individual enjoys the act of traveling itself. More than one-half of respondents agree that travel provides a useful transition between activities, while roughly two-thirds express enjoyment of travel itself. Responses are more evenly distributed regarding productive use of time spent in or waiting for transportation vehicles, with a comparatively large neutral share. Overall, the indicators suggest considerable heterogeneity in how people experience travel time. Some view it as a source of enjoyment or useful separation between activities, while others appear less able or inclined to derive value from the time devoted to travel.

Desire for Mobility Control captures the importance individuals place on autonomy, personal safety, flexibility, and self-direction in mobility and daily scheduling. It is defined by three indicators concerning the importance of owning a car, feeling safer when driving oneself rather than being driven by others, and wanting flexibility to decide when and where to work. This construct receives particularly strong endorsement across the sample. More than four-fifths of respondents agree that owning a car is important, and approximately two-thirds feel safer when driving themselves. A similarly large majority value flexibility over work location and timing.

These response patterns underscore the central role of perceived control in transportation and activity choices and suggest that constraints on automobile access, schedule flexibility, or self-directed mobility may be especially consequential for individuals who strongly value autonomy.

Collectively, the four constructs represent psychosocial orientations that cannot be observed directly through any single survey question. They enable the analysis to distinguish between the transportation circumstances individuals face and the attitudes through which those circumstances are interpreted. Incorporating these constructs into the joint model makes it possible to examine whether values, social preferences, interpretations of travel time, and desire for control influence transportation satisfaction, life satisfaction, or the relationship between the two.

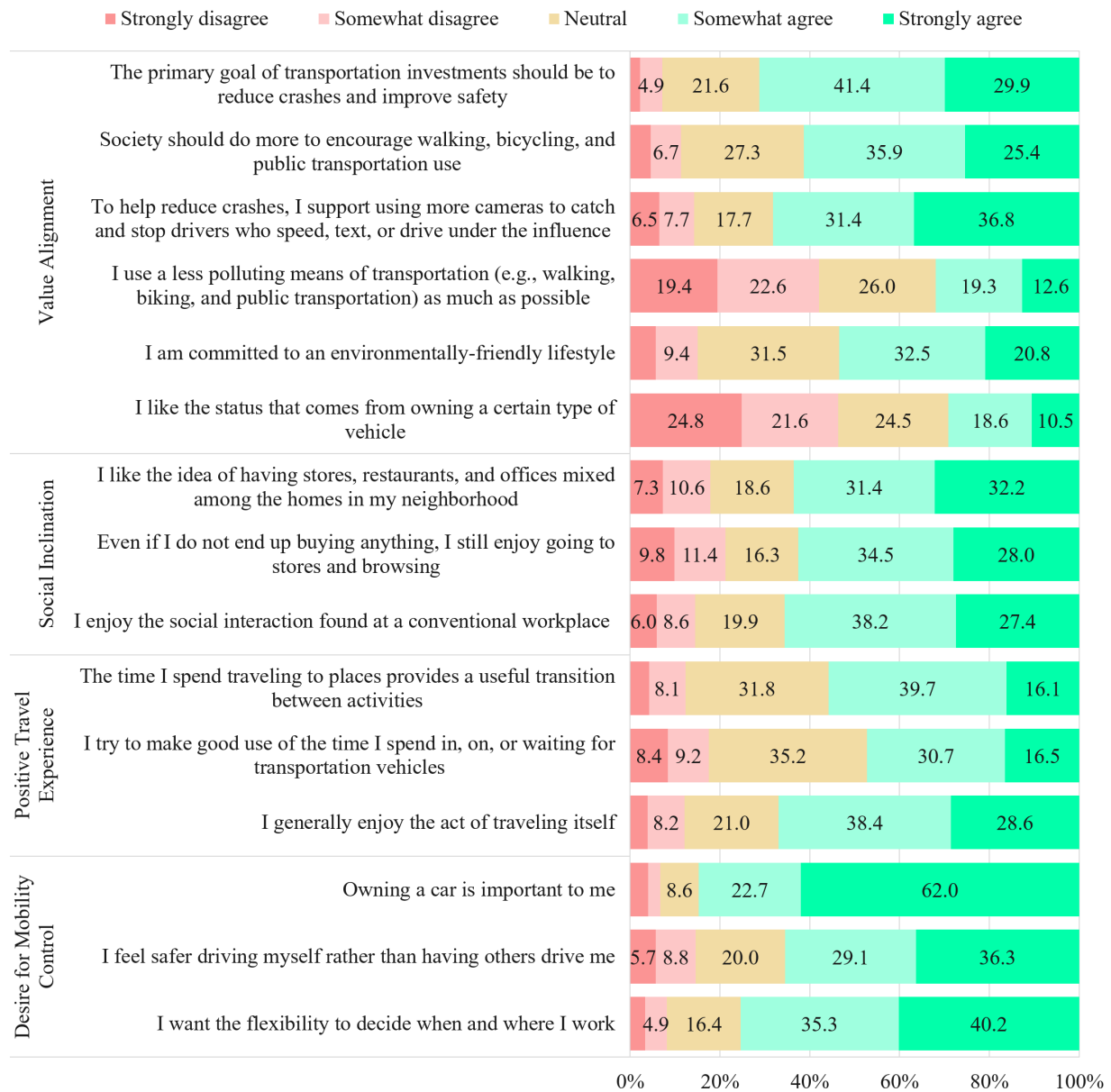


Figure 1 Agreement with Attitudinal Indicators Defining Latent Constructs (N=8,030)

4. MODELING FRAMEWORK

This section presents the model structure adopted in this paper together with the methodological formulation.

4.1. Model Structure

The modeling framework is designed to represent the multiple pathways through which observed transportation circumstances and unobserved psychosocial orientations may shape transportation satisfaction and life satisfaction. Consistent with the conceptual discussion presented earlier, the framework combines bottom-up and top-down perspectives. The bottom-up component captures the effects of observed individual, household, travel, and built-environment attributes, while the top-down component represents latent attitudes and psychological orientations that influence how individuals interpret those circumstances. The model also allows transportation satisfaction to enter the life satisfaction equation directly, recognizing transportation as one life domain that may contribute to broader well-being.

The empirical framework is formulated as a special case of the Generalized Heterogeneous Data Model developed by Bhat (2015), as illustrated in Figure 2. Individual and household characteristics may influence transportation satisfaction and life satisfaction through several pathways. They may exert direct effects on the two outcomes, affect them indirectly through the four latent constructs, and moderate the influence of those constructs through interaction effects. Transportation-context variables, including travel and built-environment attributes, are also allowed to affect the satisfaction outcomes directly and through interactions with the latent constructs. These contextual variables are not specified as determinants of the constructs themselves because the constructs are treated as relatively intrinsic psychosocial orientations rather than attitudes generated by the immediate transportation environment.

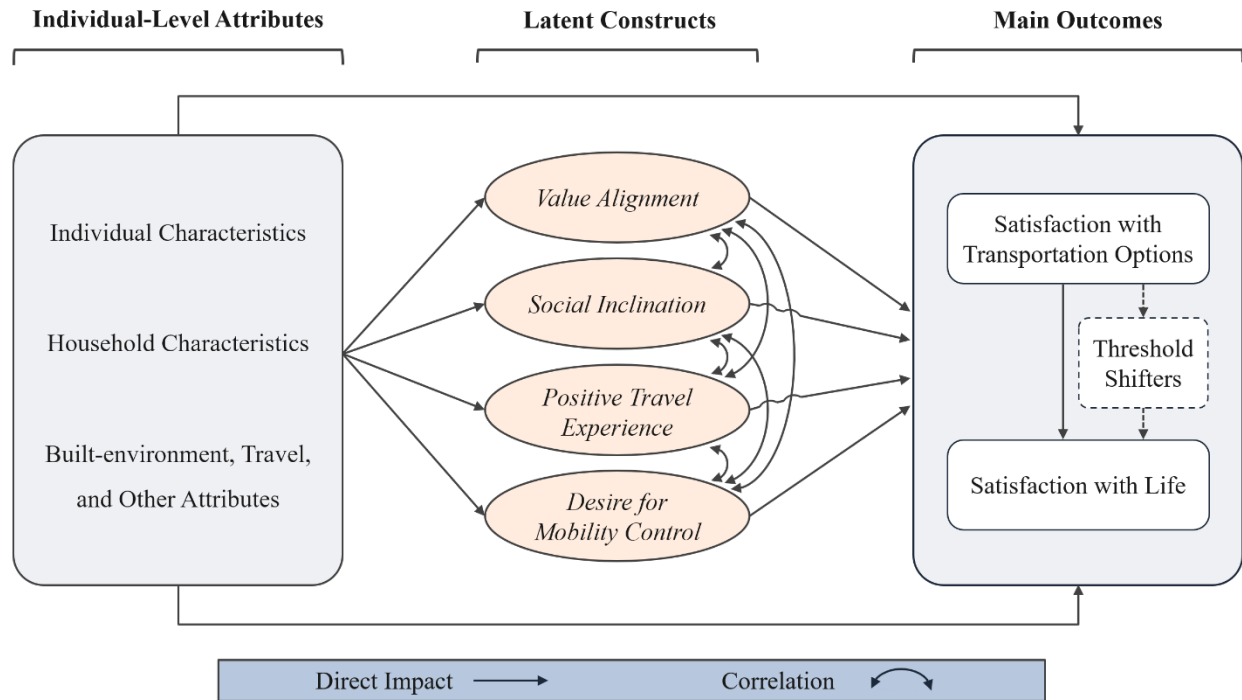


Figure 2 Model Framework

The four latent constructs – Value Alignment, Social Inclination, Positive Travel Experience, and Desire for Mobility Control – are identified through the ordinal attitudinal indicators presented in Figure 1. Each construct is modeled as stochastic, allowing unobserved variation across individuals, and correlations are accommodated among the constructs. These correlations are important because the same unobserved orientation may influence multiple dimensions of satisfaction simultaneously. For example, an individual who generally views travel positively may report higher satisfaction with transportation and with life more broadly. The observed association between the two outcomes may therefore reflect both a direct endogenous relationship between transportation satisfaction and life satisfaction and shared unobserved influences operating through the latent constructs. Accounting for these pathways provides a more careful basis for estimating the conditional relationship between the two satisfaction domains than would be possible through separate ordered-response models.

In addition to representing the general relationship between the latent propensities underlying transportation satisfaction and life satisfaction, the framework incorporates category-specific threshold shifters. In an ordered-response model, each observed response category – from strongly disagree to strongly agree – corresponds to an interval on an underlying continuous satisfaction-propensity scale. The boundaries separating these intervals are referred to as thresholds. A conventional ordered-response model assumes that the thresholds remain fixed after accounting for the explanatory variables. The threshold-shifter structure relaxes this assumption by allowing the thresholds for life satisfaction to change conditionally according to the transportation satisfaction category selected by the respondent. The model can therefore represent category-specific interdependence between the two outcomes that extends beyond their general association.

The precise interpretation of a shifter depends on the threshold affected and the direction in which it moves. For life-satisfaction categories other than strongly disagree, the shifter operates on the lower threshold of the target category and moves that threshold, together with all thresholds to its left, by the same amount. Moving these thresholds as a block preserves the widths of the intervening categories while changing the interval associated with the target category. A negative parameter moves the affected thresholds leftward and widens the interval for the target category, thereby increasing the probability of that response, all else being equal. A positive parameter moves the thresholds rightward and narrows the interval. Because all thresholds to the left move together, the offsetting probability change is distributed across the other response categories rather than being concentrated only in the adjacent category.

The strongly disagree category requires a different treatment because its lower boundary is fixed at negative infinity. For this category, the shifter operates on its upper threshold and moves that threshold, together with all thresholds to its right, as a block. A positive shift moves these thresholds rightward and widens the interval associated with strongly disagree, while a negative shift narrows that interval. As in the other cases, the remaining category widths are preserved, and the offsetting probability change is distributed across the other response categories. Thus, the sign of a shifter indicates the direction of threshold movement rather than directly indicating whether the probability of a particular response rises or falls. A related application and graphical explanation of threshold shifters in a bivariate ordered-response setting are provided by Hwang et al. (2026).

Three forms of threshold shifters are incorporated. First, consonance shifters capture systematic tendencies for respondents to select aligned categories across the two satisfaction domains. For example, a respondent who strongly agrees that they are satisfied with their

transportation options may exhibit an additional tendency to strongly agree that they are satisfied with life. The corresponding life satisfaction thresholds are shifted to enlarge the interval for that response category beyond the increase already generated through the general relationship between the two latent propensities. Such consonance may reflect genuine consistency across life domains, but it may also reflect response-style tendencies, dispositional optimism, or a stable affective orientation that produces similar evaluations across domains.

Second, conditional dissonance shifters capture elevated or dampened tendencies toward particular misaligned response combinations. A respondent with low transportation satisfaction may nevertheless have an increased probability of reporting high life satisfaction, or a respondent with high transportation satisfaction may have an elevated probability of reporting low life satisfaction. These combinations may arise because favorable circumstances in other domains compensate for transportation deficiencies or because challenges related to health, employment, housing, finances, or relationships outweigh otherwise favorable transportation conditions. The shifters make it possible to represent these specific combinations without forcing all dependence between the outcomes to operate through a single correlation or structural coefficient.

Third, individual-specific shifters allow the magnitude of consonance and dissonance effects to vary across socio-economic and demographic groups. This flexibility recognizes that the role of transportation within broader life satisfaction may differ across population segments. Certain groups may exhibit stronger alignment between the two evaluations, while others may be more likely to report dissonant outcomes because transportation occupies a different position within their broader scope of needs and circumstances.

Overall, the model distinguishes among three sources of interdependence: shared observed characteristics, correlated unobserved psychosocial orientations, and category-specific threshold-shifter effects. This structure permits a richer characterization of the relationship between transportation satisfaction and life satisfaction while explicitly accommodating the consonant and dissonant response patterns observed in the data.

4.2. Model Estimation Methodology

The final model used in this paper employs Bhat's (2015) Generalized Heterogeneous Data Modeling (GHDM) framework consisting only of ordered-response outcomes. To begin, consider the four stochastic latent constructs as previously described, denoted using the index l ($l = 1, 2, \dots, L$), with $L = 4$. Then, each underlying continuous latent construct z_l^* may be written as a function of covariates as follows:

$$z_l^* = \alpha_l' \mathbf{w} + \eta_l, \quad (1)$$

where $\mathbf{w}$ is a $(D \times 1)$ vector of exogenous variables (excluding a constant), α_l is a corresponding $(D \times 1)$ vector of coefficients for the latent construct, and η_l is a random error term that is assumed to be standard normally distributed. The error term captures unobserved factors that influence the latent construct, after controlling for the observed exogenous variables. Stack each of the components across the latent constructs to obtain the $(L \times D)$ matrix $\alpha = (\alpha_1, \alpha_2, \dots, \alpha_L)'$, and the $(L \times 1)$ vectors $\mathbf{z}^* = (z_1^*, z_2^*, \dots, z_L^*)'$ and $\boldsymbol{\eta} = (\eta_1, \eta_2, \dots, \eta_L)'$. Then, in matrix form, the latent constructs may be written as:

$$\mathbf{z}^* = \alpha \mathbf{w} + \boldsymbol{\eta}. \quad (2)$$

Thus, the vector of random error terms is assumed to have a multivariate normal correlation structure $\boldsymbol{\eta} \sim MVN_L[\mathbf{0}_L, \boldsymbol{\Gamma}]$, where $\mathbf{0}_L$ is an $(L \times 1)$ column vector of zeros, and $\boldsymbol{\Gamma}$ is an $(L \times L)$ correlation matrix.

Next, consider the ordinal outcomes (including both the indicators for the latent constructs the endogenous outcomes for transportation-related and overall life satisfaction). Denote the index for the ordinal outcomes as n ($n = 1, 2, \dots, N$), with $N = 17$ corresponding to the 15 indicators (shown in Figure 2) and the two main outcome dimensions. Further, let J_n be the number of ordinal categories for the n^{th} outcome and denote the corresponding index as j_n ($j_n = 1, 2, \dots, J_n$). In our case, all ordinal indicators and endogenous outcomes have five ordered levels, so $J_n = 5$ for all ordered outcomes. Also, denote the actual outcome level selected by the individual of interest as a_n . Then, following the usual ordered response formation, the ordinal outcomes may be denoted with an underlying latent variable $\tilde{y}_n^*$, whose horizontal partitioning leads to the observed outcome:

$$\tilde{y}_n^* = \tilde{\gamma}_n' \mathbf{x} + \tilde{\mathbf{d}}_n' \mathbf{z}^* + \tilde{\varepsilon}_n, \text{ with } \tilde{\psi}_{n,a_n-1} < \tilde{y}_n^* < \tilde{\psi}_{n,a_n} \quad (3)$$

where $\mathbf{x}$ is an $(A \times 1)$ vector of exogenous variables (including a constant), $\tilde{\gamma}_n$ is a corresponding vector of coefficients, and $\tilde{\mathbf{d}}_n$ is an $(L \times 1)$ vector of latent variable loadings. However, note that the $\mathbf{x}$ vector will only appear in Equation (3) for the ordinal outcomes, not the ordinal indicator variables. The error term $\tilde{\varepsilon}_n$ is again assumed to be standard normally distributed across individuals. Also, the $\tilde{\psi}$ terms represent thresholds partitioning the underlying latent variable based on the ordinal category chosen (a_n) by the individual under consideration. These thresholds must be ordered $\tilde{\psi}_{n,0} < \tilde{\psi}_{n,1} < \tilde{\psi}_{n,2} \dots < \tilde{\psi}_{n,J_n-1} < \tilde{\psi}_{n,J_n}$ for each individual, and we fix the values of $\tilde{\psi}_{n,0} = -\infty$ and $\tilde{\psi}_{n,J_n} = +\infty$.

As discussed in the previous section, we allow the thresholds for life satisfaction to also be shifted based on the chosen level of transportation satisfaction. In doing so, we assume that the thresholds for all the ordinal indicators (label these as outcome $n = 1$ through $n = 15$) as well as the first main outcome (for transportation satisfaction; labeled $n = 16$) remain fixed, while additional shift effects are defined for life satisfaction (labeled outcome $n = 17$). To define these shifts for life satisfaction, we can write the shifted thresholds as:

$$\tilde{\psi}_{17,i} = \psi_{17,i} + \delta_i \text{ for } (i = 1, \dots, J_{17} - 1) \quad (4)$$

where $\psi_{17,i}$ represents a baseline (unshifted) threshold level and δ_i is the total shift effect applied to the i^{th} threshold. This total shift effect may be defined as:

$$\delta_i = \sum_{n=1}^{J_{16}} (\tilde{\lambda}_{n,i} + \lambda'_{n,i} \mathbf{x}) \mathbf{I}(a_{16} = n) \quad (5)$$

where $\mathbf{I}(a_{16} = n)$ is an indicator function taking the value 1 to activate a shifter effect when a specific level is chosen for transportation satisfaction. $\tilde{\lambda}_{n,i}$ is the constant component of the shifter effect that is applied uniformly, regardless of individual characteristics. $\lambda'_{n,i}$ is an $(A \times 1)$ vector of conditional shift effects that generate individual-specific threshold shifts. Note that this set of shift

effects can create consonance effects (when $a_{16} = i$) as well as dissonance effects (when $a_{16} \neq i$). Additional identification conditions are necessary as transportation satisfaction (as well as other exogenous variables and interactions) may already influence the underlying propensity for life satisfaction directly (as part of equation (3)), so shift effects may not also be defined for every threshold based on any individual level of transportation satisfaction. Additional discussion of the necessary identification conditions and the formal derivation of the threshold shifter structure may be found in Anderson et al. (2024).

Next, to develop a reduced form representation, let $\tilde{\psi}_n = (\tilde{\psi}_{n,1}, \tilde{\psi}_{n,2}, \dots, \tilde{\psi}_{n,J_n-1})'$ and $\tilde{\psi} = (\tilde{\psi}_1', \tilde{\psi}_2', \dots, \tilde{\psi}_N')'$. Stack the baseline thresholds $\psi_{17,i}$ into the vector ψ_{17} , the constant components of the shifter effects $\tilde{\lambda}_{n,i}$ into the vector $\tilde{\lambda}$ and the conditional components $\lambda_{n,i}$ into the matrix λ . Then, stack the N underlying continuous variables $\tilde{y}_n^*$ into an $(N \times 1)$ vector $\tilde{y}^*$, and the N error terms $\tilde{\varepsilon}_n$ into an $(N \times 1)$ vector $\tilde{\varepsilon}$. Define the $(N \times A)$ matrix $\tilde{\gamma} = (\tilde{\gamma}_1, \tilde{\gamma}_2, \dots, \tilde{\gamma}_N)'$ and the $(N \times L)$ matrix $\tilde{d} = (\tilde{d}_1, \tilde{d}_2, \dots, \tilde{d}_N)$, and let $IDEN_N$ be an identity matrix of dimension N that represents the correlation matrix of $\tilde{\varepsilon}$. Finally, for each decision maker, stack the N lower thresholds $\tilde{\psi}_{n,a_n-1}$ into an $(N \times 1)$ vector $\tilde{\psi}_{low}$ and the N upper thresholds $\tilde{\psi}_{n,a_n}$ into a vector $\tilde{\psi}_{up}$. Then, in matrix form, the ordinal outcomes may be written:

$$\tilde{y}^* = \tilde{\gamma}x + \tilde{d}z^* + \tilde{\varepsilon}, \quad \tilde{\psi}_{low} < \tilde{y}^* < \tilde{\psi}_{up}. \quad (6)$$

Finally, replace the right side of Equation (2) for z^* in Equation (4) to obtain the following:

$$\tilde{y}^* = \tilde{\gamma}x + \tilde{d}z^* + \tilde{\varepsilon} = \tilde{\gamma}x + \tilde{d}(\alpha w + \eta) + \tilde{\varepsilon} = \tilde{\gamma}x + \tilde{d}\alpha w + \tilde{d}\eta + \tilde{\varepsilon}. \quad (7)$$

Then, $\tilde{y}^* \sim MVN_N(\mathbf{B}, \mathbf{\Omega})$ is the N -dimensional multivariate joint distribution of the main outcomes and indicators where $\mathbf{B} = \tilde{\gamma}x + \tilde{d}\alpha w$ and $\mathbf{\Omega} = \tilde{d}\Gamma\tilde{d}' + IDEN_N$. The set of parameters to be estimated is $\delta = [\text{Vech}(\alpha), \text{Vechup}(\Gamma), \text{Vech}(\tilde{\gamma}), \text{Vech}(\tilde{d}), \tilde{\psi}, \psi_{17}, \tilde{\lambda}, \text{Vech}(\lambda)]$, where $\text{Vech}(\cdot)$ vectorizes all the non-zero elements of the matrix/vector on which it operates and $\text{Vechup}(\cdot)$ indicates strictly upper diagonal elements. Finally, the likelihood function for the individual may be written as:

$$L(\delta) = \Pr \left[\tilde{\psi}_{low} \leq \tilde{y}^* \leq \tilde{\psi}_{up} \right] = \int_{D_r} f_N(r | \mathbf{B}, \mathbf{\Omega}) dr \quad (8)$$

where the integration domain $D_r = \{r : \tilde{\psi}_{low} \leq r \leq \tilde{\psi}_{up}\}$ is the multivariate region of the elements of the $\tilde{y}^*$ vector determined by the observed ordinal outcomes. This likelihood function is evaluated using Bhat's (2018) matrix-based approximation method for evaluating the multivariate normal cumulative distribution function, and the likelihood function for the entire sample is simply the product of the individual-level likelihood functions.

5. MODEL ESTIMATION RESULTS

This section presents model estimation results in detail. The model of latent constructs is presented first and the main model of behavioral outcomes is presented second.

5.1. Latent Constructs

Table 3 presents the estimation results for the latent construct model component. The upper portion reports the effects of observed individual and household characteristics on the four stochastic latent constructs, while the lower portion presents the indicator loadings used to identify them. Men and respondents identifying with another gender exhibit higher levels of Value Alignment, Positive Travel Experience, and Desire for Mobility Control than women. Age is associated with substantial variation in the latent orientations. Relative to adults aged 18–34 years, respondents aged 45 years or older generally exhibit lower Value Alignment and Social Inclination, with the negative effects becoming larger at older ages. Positive Travel Experience also declines with age, particularly among respondents aged 55 years or older. These patterns are broadly consistent with prior evidence that older adults tend to concentrate their social interactions more heavily among close relations and rely more extensively on driving, which can limit opportunities to engage in other activities while traveling (Zhaoyang et al., 2019; Ozbilen et al., 2022). The decline in Value Alignment at older ages may also be consistent with evidence that environmental consciousness rises through middle age and then weakens among older age groups (Morrison and Beer, 2016). Desire for Mobility Control follows a different pattern, with a positive effect among respondents aged 35–44 years and a smaller, marginally significant positive effect among those aged 75 years or older.

Race, education, employment status, and mobility limitations are also associated with the latent constructs. Black respondents exhibit higher Value Alignment, Social Inclination, and Positive Travel Experience than the reference group. Asian or Pacific Islander respondents exhibit higher Value Alignment, Social Inclination and Positive Travel Experience and lower Desire for Mobility Control. Respondents with at least a bachelor's degree show higher Value Alignment and Positive Travel Experience but lower Desire for Mobility Control. The positive association between education and Value Alignment is consistent with prior research linking higher educational attainment to greater environmental awareness and concern (Cabalu et al., 2026). Individuals who are neither working nor studying exhibit lower levels of all four constructs, although the effect on Social Inclination is comparatively modest. This broad pattern is consistent with evidence that unemployment, especially when prolonged, may contribute to social withdrawal and diminished engagement in routine activities (Morrish and Medina-Lara, 2021). Walking limitations are associated with a stronger Desire for Mobility Control, possibly reflecting heightened sensitivity to autonomy when independent movement is constrained. Driving limitations, by contrast, are associated with a substantially lower Desire for Mobility Control, which is consistent with the construct's emphasis on automobile ownership and the perceived safety of driving oneself.

Household circumstances also contribute to differences in these psychosocial orientations. Higher household income is associated with stronger Value Alignment and Positive Travel Experience. The positive income gradient in Value Alignment is consistent with prior evidence that greater financial resources may be associated with stronger environmental awareness and a greater capacity to act on environmentally oriented preferences (Duroy, 2005). Desire for Mobility Control is also higher across all income groups relative to households earning less than \$25,000, although the effect is largest among the middle-income categories and smaller for the highest-income group. Relative to individuals living alone, couples with children exhibit higher levels of all four constructs. The stronger Desire for Mobility Control among households with children is behaviorally plausible given the greater scheduling complexity and trip-chaining demands that often accompany child-related activities; prior research has shown that households with children

are more likely to chain trips (Lee et al., 2007). Couples living with extended family also exhibit a stronger Desire for Mobility Control and a marginally higher Positive Travel Experience. Apartment residents show higher Value Alignment and Social Inclination but lower Desire for Mobility Control, while renters exhibit lower Desire for Mobility Control than homeowners. These housing-related patterns suggest meaningful differences in attitudes and preferences across residential and tenure contexts, and suggest that individuals may be self-selecting into residential built environments that align with their attitudes and values.

The estimated correlations among the four latent constructs are positive and statistically significant. The strongest correlations link Desire for Mobility Control with Value Alignment and Social Inclination, indicating that a preference for mobility autonomy can coexist with strong value-based and social orientations. The measurement equation results are omitted for the sake of brevity. They show statistically significant indicator loadings with signs consistent with the conceptual definitions of the constructs. Overall, the results support the empirical soundness of the latent factor specification for use in the behavioral outcome model.

TABLE 3 Determinants of Latent Variables and Loadings on Indicators (N = 8,030)

Explanatory Variables (base category)		Structural Equations Model Component							
		Value Alignment		Social Inclination		Positive Travel Experience		Desire for Mobility Control	
		Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat
Individual Characteristics									
Gender	Male/Other	0.245	9.90	—		0.222	5.18	0.205	5.05
Age (18 to 34 years)	35 to 44 years	—		-0.127	-1.71	—		0.156	2.20
	45 to 54 years	-0.223	-7.15	-0.331	-5.13	-0.079	-1.70	—	
	55 to 64 years	-0.337	-9.35	-0.441	-6.41	-0.191	-3.22	—	
	65 to 74 years	-0.412	-10.18	-0.507	-6.71	-0.244	-3.54	—	
	75 years or older	-0.406	-7.24	-0.624	-5.91	-0.317	-3.56	0.094	1.67
Race (Native American, White, or multi-race)	Black	0.445	13.05	0.501	7.45	0.442	8.34	—	
	Asian or Pacific Islander	0.576	12.44	0.358	3.90	0.234	2.86	-0.327	-3.97
	Other	—		0.363	4.06	-0.090	-1.67	—	
Education (<bachelor's)	≥ Bachelor's degree	0.186	7.48	—		0.121	2.99	-0.083	-2.08
Employment status (worker or student only)	Worker or student with other roles*	—		-0.206	-2.83	—		—	
	Not a worker or student	-0.230	-8.03	-0.106	-1.83	-0.361	-7.82	-0.155	-3.22
Walking limitation (no)	Yes	—		—		—		0.233	4.82
Driving limitation (yes)	No	—		—		—		-0.755	-14.75
Household Characteristics									
Household income (less than \$25,000)	\$25,000 – \$49,999	—		—		—		0.320	5.57
	\$50,000 – \$99,999	0.119	3.94	—		0.172	3.43	0.451	7.65
	\$100,000 – \$199,999	0.176	5.18	—		0.193	3.36	0.420	6.15
	\$200,000 or more	0.208	3.20	—		0.216	3.15	0.213	1.74
Household composition (live alone / other)	Couple	—		—		—		0.212	3.83
	Couple with children	0.145	5.19	0.181	3.31	0.118	2.68	0.337	5.44
	Couple with ext. family	—		—		0.118	1.73	0.332	2.01
Home tenure (own/rent)	Other	—		—		—		-0.123	-2.32
Housing unit (all others)	Apartment	0.155	5.55	0.346	6.55	—		-0.246	-5.52
Correlations Between Latent Constructs									
Social Inclination		0.766	15.44	1.000	—				
Positive Travel Experience		0.349	10.60	0.505	16.71	1.000	—		
Desire for Mobility Control		0.797	9.13	0.703	14.36	0.430	10.59	1.000	—

Note: (*) Other roles include retired, volunteer or unpaid worker, homemaker or caregiver, not currently employed, and others. Students without paid work are included in the “worker or student only” category.

5.2. Main Estimation Results

This section presents detailed description of model estimation results for the behavioral outcomes model that focuses on determinants of life satisfaction and transportation satisfaction. A description of latent factor effects is provided first, while a discussion of all other exogenous variable effects is provided second. Model estimation results are furnished in Table 4.

TABLE 4 Estimation Results of the Main Outcome Model Components (N = 8,030)

Explanatory Variables (base category)		Transportation Satisfaction		Life Satisfaction	
		Ordinal variables (5-Level): Likert scale			
		Coef.	t-stat	Coef.	t-stat
Endogenous Effects					
Transportation satisfaction (neither agree nor disagree)	Strongly disagree	—		-0.385	-3.22
	Somewhat disagree	—		-0.162	-2.22
	Somewhat agree	—		0.134	1.75
	Strongly agree	—		0.648	4.40
Latent Constructs					
Value Alignment		-0.417	-7.71	0.222	3.98
Value Alignment × Drive at least once a month		-0.089	-3.41	—	
Value Alignment × Transit use at least once a month		0.134	2.27	—	
Value Alignment × Walk at least once a month		0.113	3.77	—	
Value Alignment × High pedestrian density area		0.067	2.79	—	
Value Alignment × \$200,000 or more		—		-0.177	-2.42
Social Inclination		0.158	5.27	0.227	10.31
Social Inclination × Age 65-74		—		-0.125	-2.40
Social Inclination × Transit use at least once a month		0.148	2.42	—	
Social Inclination × Cycle at least once a month		—		0.129	3.59
Positive Travel Experience		0.334	7.59	0.272	5.03
Positive Travel Experience × Male/other		0.123	4.71	—	
Positive Travel Experience × Vehicle deficient		0.152	2.88	—	
Positive Travel Experience × Mixed land use***		0.060	2.85	—	
Desire for Mobility Control		0.108	4.71	0.087	3.34
Desire for Mobility Control × Age 65-74		—		-0.111	-2.86
Desire for Mobility Control × Black		—		-0.068	-1.88
Desire for Mobility Control × Walk at least once a month		0.106	-3.77	—	
Desire for Mobility Control × \$25,000 – \$99,999		0.088	2.60	—	
Desire for Mobility Control × \$100,000 – \$199,999		0.154	3.59	—	
Desire for Mobility Control × \$200,000 or more		0.219	2.67	—	
Desire for Mobility Control × Vehicle deficient		-0.235	-4.70	—	
Individual Characteristics					
Gender (Female)	Male/Other	-0.093	-1.72	-0.131	-2.09
Age (18 to 45 years)	45 to 54 years	—		-0.108	-2.01
	55 to 64 years	0.203	3.42	—	
	65 to 74 years	0.307	4.17	0.221	2.56
	75 years or older	0.392	3.79	0.424	4.30
Education (less than high school)	Bachelor's degree or higher	-0.081	-1.77	—	
	High school or some college	—		0.174	2.02
Employment/student status (all others)	Worker/student with other roles*	-0.262	-1.95	—	
Walking limitations (none)	Has limitations	—		-0.112	-1.95
Driving limitations (none)	Has limitations	-0.281	-3.60	-0.210	-1.84
Household Characteristics					
Household income (under \$25,000)	\$25,000 – \$49,999	0.155	2.62	0.071	1.71
	\$50,000 – \$99,999	0.214	2.84	0.157	2.00
	\$100,000 – \$199,999	0.264	3.01	0.291	3.01
	\$200,000 or more	0.391	2.71	0.558	4.10
Household composition (live alone)	Couple	—		0.109	1.97
	Couple with children	—		0.129	1.68
	Other arrangements	-0.130	-2.82	-0.105	-2.07
Household type (single family)	Apartment/other	-0.074	-1.72	—	

Vehicle sufficiency (sufficient)	Deficient	-0.236	-4.18	—	
Location (urban or suburban)	Rural or small town	—		0.060	1.71
Built-environment Attributes					
Pedestrian density (low)	High**	0.082	2.54	—	
Land use (not mixed)	Mixed***	0.037	1.83	-0.050	-1.83
Mode Use Frequency					
Transit (< once a month)	≥ Once a month	-0.072	-3.23	—	
Walk (< once a month)	≥ Once a month	-0.198	-5.55	—	
Bike (< once a month)	≥ Once a month	—		0.235	5.15
Threshold Shifter Effects (“Transportation satisfaction” – “Life satisfaction” response pairings)					
Consonance Shifters					
“Somewhat disagree” – “Somewhat disagree”		—		-0.227	-2.34
“Neither agree nor disagree” – “Neither agree nor disagree”		—		-0.171	-3.46
“Somewhat agree” – “Somewhat agree”		—		-0.134	-3.47
“Strongly agree” – “Strongly agree”		—		-0.320	-6.09
Dissonance Shifters					
“Strongly disagree” – “Strongly agree”		—		-0.681	-7.07
“Strongly agree” – “Strongly disagree”		—		0.169	2.64
Group-Specific Consonance Shifters					
\$200,000 or more × “Somewhat agree” – “Somewhat agree”		—		-0.213	-1.67
Driving limitations × “Strongly agree” – “Strongly agree”		—		-0.095	-1.80
Thresholds					
1 2		-1.870	-15.39	-1.820	-10.70
2 3		-1.274	-13.51	-1.075	-7.94
3 4		-0.729	-10.00	-0.236	-2.22
4 5		0.356	5.57	1.338	12.17
Data Fit Measures		GHDM	GHDM without threshold shifters	Bivariate ordered model	
Predictive log-likelihood at convergence		-18659.2	-18703.8	-19904.3	
Predictive log-likelihood at constants		-20804.4	-20804.4	-20804.4	
Number of parameters		221	213	194	
Predictive adjusted likelihood ratio index		0.096	0.094	0.034	
Predictive Bayesian Information Criterion (BIC)		19652.7	19661.4	20776.4	
Likelihood ratio test		—	89.26	—	
Informal non-nested likelihood ratio test		—	—	-50.83	

Notes: Coef. = coefficient; “—” = not applicable. (*) Other roles refer to retired, volunteer or unpaid worker, homemaker or caregiver, not currently employed, or other. Respondents reporting student status without paid work are included in the first category. (**) High pedestrian density refers to a value greater than 15 facility miles of pedestrian-oriented links per square mile. (***) Mixed land use refers to an area with an employment and household entropy value over 0.5.

5.2.1. Effects of Latent Constructs and Interactions

The four latent constructs exhibit distinct relationships with transportation satisfaction and life satisfaction, underscoring the importance of psychosocial orientations in shaping subjective evaluations. Also, because these latent constructs are stochastic (see Equation (2)), any stochastic construct that impacts both the transportation satisfaction and life satisfaction outcomes immediately engenders correlations between the two outcomes. Value Alignment is negatively associated with transportation satisfaction but positively associated with life satisfaction. This contrast suggests that individuals who place greater emphasis on safety, sustainability, and other value-based considerations may be broadly more satisfied with life, yet less satisfied with the transportation options available to them. The positive relationship with life satisfaction is consistent with prior psychological research linking value congruence to greater well-being

(Khaptsova et al., 2016). The negative transportation-satisfaction effect may reflect a mismatch between personal values and available mobility options. Consistent with this interpretation, the negative effect is moderated among respondents who use transit or walk at least monthly and among those residing in areas with high pedestrian density. By contrast, driving at least monthly strengthens the negative relationship. These findings suggest that transportation satisfaction is higher when individuals with strong value-based orientations are able to use modes and environments that more closely reflect those values. The positive life-satisfaction effect is smaller among households earning \$200,000 or more, possibly because financial resources already provide substantial autonomy and flexibility.

Social Inclination is positively associated with both transportation satisfaction and life satisfaction. Transit use further strengthens the positive relationship with transportation satisfaction, while cycling strengthens the association with life satisfaction. These results are consistent with the notion that transit, cycling, and the destinations they provide access to may create opportunities for interpersonal contact and social participation. Prior research has linked neighborhood environments that facilitate interaction with stronger social capital and community connectedness (Leyden, 2003). The negative interaction for adults aged 65–74 years indicates that socially inclined individuals in this age group report lower life satisfaction, possibly reflecting unmet needs for social participation or reduced opportunities for engagement. Although the model cannot identify the precise mechanism, the result highlights the potential importance of mobility options that help older adults maintain social connections.

Positive Travel Experience has strong positive associations with both outcomes. Individuals who enjoy travel, make productive use of travel time, or view travel as a useful transition between activities report greater transportation and life satisfaction. The transportation-satisfaction effect is amplified among men and respondents identifying with another gender, vehicle-deficient households, and residents of mixed-use areas. The mixed-use interaction is behaviorally plausible because such environments have been associated with greater walking and bicycling, shorter travel distances, and increased opportunities for social interaction (Leyden, 2003; Mouratidis, 2019; Litman, 2026). These conditions may be especially satisfying for individuals predisposed to view travel positively.

Desire for Mobility Control is also positively associated with both satisfaction outcomes. Its relationship with transportation satisfaction strengthens with household income, suggesting that financial resources may enable individuals to realize the autonomy and flexibility they value. Vehicle deficiency substantially weakens transportation satisfaction among those with a strong Desire for Mobility Control, reflecting a clear mismatch between desired autonomy and available mobility resources. Negative interactions with life satisfaction are observed for adults aged 65–74 years and, more modestly, Black respondents. These patterns may signal barriers to realizing desired mobility independence, although the underlying mechanisms cannot be established from the model alone. Overall, the results show that satisfaction depends not only on transportation conditions, but also on how closely those conditions align with individual values, social preferences, travel orientations, and desire for control.

5.2.2. Effects of Exogenous Variables

Individual characteristics reveal meaningful differences in how transportation and life satisfaction are formed. Men and respondents identifying with another gender report lower satisfaction in both transportation and life domains than women, although the transportation effect is only marginally significant. Age effects are especially instructive. Relative to adults aged 18–45 years, respondents

aged 55 years or older report progressively higher transportation satisfaction, possibly reflecting greater schedule flexibility, more established travel routines, or a closer alignment between mobility resources and daily needs. Life satisfaction follows a different pattern: respondents aged 45-54 years report lower life satisfaction, while those aged 65 years or older report higher levels. The lower life satisfaction observed in middle age is consistent with the considerable work, caregiving, and household responsibilities that often converge during this stage of life, whereas older adults may benefit from reduced work pressures and greater control over daily schedules.

Educational attainment and employment status also affect the two outcomes differently. Respondents with a bachelor's degree or higher exhibit marginally lower transportation satisfaction, perhaps because they have higher expectations for system performance or more demanding activity patterns. By contrast, respondents with a high school education or some college report higher life satisfaction than those with less than a high school education. Workers or students who also occupy another role report lower transportation satisfaction than those who are only working or studying, which may reflect more complex schedules and a greater need to coordinate multiple responsibilities. Mobility limitations have a consistently adverse association with satisfaction. Walking limitations reduce life satisfaction, while driving limitations reduce both transportation satisfaction and life satisfaction. These findings underscore how restrictions on independent mobility can affect not only travel itself, but also participation in daily activities and broader perceptions of well-being.

Household income exhibits one of the clearest patterns in the model. Relative to households earning less than \$25,000, each higher-income group reports greater transportation satisfaction, with the magnitude of the effect increasing steadily across income categories. Life satisfaction follows a similar gradient, particularly among households earning at least \$50,000. Greater financial resources can expand access to reliable vehicles, preferred residential locations, and a wider range of transportation options while also reducing the burden of transportation costs. Household composition is more strongly related to life satisfaction than transportation satisfaction. Couples and couples with children report higher life satisfaction than individuals living alone, although the latter effect is only marginally significant. Respondents in other household arrangements report lower satisfaction in both domains, indicating that household stability and social support may contribute to broader well-being. Vehicle deficiency has a substantial negative association with transportation satisfaction, as would be expected when the number of available vehicles does not fully meet household mobility needs.

Housing and geographic context provide additional insight. Residents of apartments or other multifamily housing report marginally lower transportation satisfaction than those in single-family homes. Multifamily housing is often located in denser settings with better proximity to destinations, but it may also involve parking constraints, congestion, or a mismatch between available travel options and household preferences. Rural or small-town residents report marginally higher life satisfaction than those in urban or suburban areas, which may reflect quieter environments, stronger community ties, or a closer fit between residential preferences and place characteristics. Built-environment attributes show a nuanced pattern. High pedestrian density is positively associated with transportation satisfaction, and mixed land use is also positively related to transportation satisfaction, although the latter effect is marginal. These findings are consistent with prior research showing that pedestrian-oriented and mixed-use environments can improve access to nearby destinations and support walking and bicycling (Leyden, 2003; Mouratidis, 2019; Litman, 2026). Mixed land use, however, is marginally associated with lower life satisfaction,

suggesting that transportation advantages do not necessarily translate into a uniformly more satisfying residential experience.

Mode use also produces contrasting effects. Monthly transit use and walking are associated with lower transportation satisfaction. In many U.S. contexts, these modes may involve longer travel times, limited service coverage, or dependence on infrastructure that does not fully meet users' needs. By contrast, monthly bicycling is strongly associated with higher life satisfaction, a result consistent with prior research linking active travel to physical activity, positive affect, and broader well-being. Overall, the findings show that transportation satisfaction and life satisfaction share some determinants, particularly income and mobility limitations, but differ in their relationships with age, household composition, residential context, and mode use.

5.2.3. Endogenous Effects

The endogenous relationship between transportation satisfaction and life satisfaction constitutes one of the central findings of the study. Rather than imposing a single linear effect across the five-point transportation satisfaction scale, the model includes separate indicators for each response category, with “neither agree nor disagree” serving as the reference. This flexible specification allows the relationship with life satisfaction to vary across levels of transportation satisfaction. However, note that this endogenous effect is after considering the correlation in unobserved characteristics affecting the propensities as engendered through common stochastic latent constructs (as discussed earlier in Section 5.2.1).

The estimated effects follow a clear and behaviorally consistent ordering. Relative to respondents who are neutral about their transportation options, those who somewhat or strongly disagree exhibit a lower propensity for life satisfaction. Respondents who strongly agree that they are satisfied with their transportation options exhibit a higher propensity for life satisfaction, while the positive effect for the somewhat agree category is smaller and only marginally significant. Overall, higher transportation satisfaction is systematically associated with higher life satisfaction.

This finding reinforces the bottom-up perspective discussed in the literature review, under which satisfaction with important life domains contributes to an individual's broader evaluation of life circumstances (Campbell et al., 1976; Brief et al., 1993). Transportation is especially consequential because it enables access to employment, education, services, social interaction, and other activities that sustain daily life. Satisfaction with transportation therefore reflects more than an assessment of travel time, cost, or system performance. It also captures the extent to which available mobility options allow individuals to pursue desired activities and participate in society. The result is consistent with prior research in the manuscript linking transportation conditions, travel satisfaction, and transportation disadvantage to broader well-being and life satisfaction (Delbosc et al., 2011; Delbosc, 2012; Zarabi et al., 2019). Accordingly, improvements that enhance the reliability, accessibility, safety, and suitability of transportation options may have implications that extend beyond the travel domain and contribute to improved quality of life.

5.2.4. Thresholds and Threshold Shifter Effects

The threshold-shifter effects capture response pairings that remain systematically more or less likely after the model accounts for observed characteristics, latent psychosocial orientations, and the endogenous relationship between transportation satisfaction and life satisfaction. They should therefore not be interpreted as additional direct effects on the underlying life satisfaction propensity. Instead, they modify the thresholds that translate this propensity into an observed response category. In practical terms, the shifters identify particular combinations of

transportation- and life-satisfaction responses that occur more frequently than would be expected from the general relationship between the two outcomes alone.

The consonance shifters provide strong evidence of residual alignment between the two satisfaction assessments. Significant negative shifters are observed for the “somewhat disagree,” “neither agree nor disagree,” “somewhat agree,” and “strongly agree” pairings. For each of these life satisfaction categories, a negative shifter moves the left threshold for the category further leftward and widens the interval associated with the matching response. Consequently, respondents are more likely to select the same category for transportation satisfaction and life satisfaction than the other joint elements (that is, the endogenous effects of transportation satisfaction and the error correlations engendered by the latent constructs) of the model would predict. This pattern indicates additional clustering along the diagonal of the joint response distribution. The alignment is evident at negative, neutral, and positive levels, suggesting that consonance is not confined to respondents with uniformly favorable evaluations. Rather, individuals appear to carry a degree of consistency across their assessments of transportation and life, whether those assessments are unfavorable, neutral, or favorable. Such consistency may reflect a common evaluative orientation across domains, stable response tendencies, or a genuine alignment between transportation circumstances and broader life conditions.

The two dissonance shifters show that systematic misalignment also remains after the general endogenous relationship has been accommodated. Among respondents who strongly disagree that they are satisfied with their transportation options, the negative shifter widens the “strongly agree” life satisfaction interval. This increases the likelihood of the most pronounced form of negative dissonance: very low transportation satisfaction occurring alongside very high life satisfaction. This pattern is consistent with the idea that favorable circumstances in other life domains may compensate for dissatisfaction with transportation. Conversely, among respondents who strongly agree with their transportation satisfaction, the positive shifter associated with “strongly disagree” life satisfaction increases the likelihood of the most pronounced form of positive dissonance. Because “strongly disagree” is the lowest life satisfaction category and has an unbounded lower interval, a positive shifter moves its upper threshold rightward and expands the category. Thus, even highly favorable transportation evaluations do not ensure favorable evaluations of life as a whole.

The group-specific shifters add further nuance. For households earning \$200,000 or more, the positive shifter for the “somewhat agree–somewhat agree” pairing narrows the corresponding life satisfaction interval and therefore weakens consonance at this moderately positive level. This effect is only marginally significant, but it suggests that transportation satisfaction may account for a smaller share of broader life evaluations among the highest-income households, whose well-being may draw on a wider range of resources and circumstances. By contrast, respondents with driving limitations exhibit a marginally stronger tendency toward “strongly agree–strongly agree” consonance. For individuals whose ability to drive is constrained, satisfaction with available transportation options may be especially closely connected to the ability to participate in desired activities and maintain independence.

Overall, the shifter effects show that the connection between transportation satisfaction and life satisfaction cannot be represented fully by a single underlying association. There is substantial residual alignment across the response scale, but there are also distinct groups whose assessments of transportation and life diverge sharply. These findings provide the behavioral foundation for the consonant and dissonant segments examined in the subsequent analysis.

5.2.5. Model Goodness-of-Fit

The model-fit measures consistently favor the proposed GHDM specification. Its predictive log-likelihood at convergence is higher than those of both the GHDM without threshold shifters and the conventional bivariate ordered model. The full GHDM also yields the highest predictive adjusted likelihood ratio index and the lowest predictive BIC, despite including more parameters. The likelihood ratio test comparing the full model with the specification that omits the threshold shifters produces a statistic of 89.26, providing strong support for retaining the shifter effects. The conventional bivariate ordered model performs substantially worse, with a considerably lower predictive log-likelihood, a much smaller adjusted likelihood ratio index, and a markedly higher BIC; the reported informal non-nested likelihood ratio test likewise favors the GHDM. Overall, these results indicate that jointly representing latent psychosocial constructs, the endogenous relationship between transportation satisfaction and life satisfaction, and response-specific threshold shifts provides a superior statistical fit than the more restrictive alternatives.

6. CONDITIONAL TREATMENT EFFECTS

Table 5 presents conditional treatment effects (CTEs) that translate the model estimates into probabilities of movement between the consonance and dissonance groups. For each variable, the CTE represents the probability that an individual would be classified in the positive consonant group under the treatment condition (that is, would be in the green zone in Table 2), conditional on being classified in either the negative consonant group (that is, falls in the red zone of Table 2) or negative dissonant group (that is falls in the yellow zone of Table 2) under the base condition. The first transition (from red to green in Table 2) therefore requires improvements in both transportation satisfaction and life satisfaction, while the second (from yellow to green in Table 2) requires an improvement in transportation satisfaction while life satisfaction remains high. The CTEs are consequently much larger for transitions from negative dissonance to positive consonance than for transitions from negative consonance. These effects should be interpreted as model-based counterfactual contrasts associated with changes in observed characteristics rather than as causal effects of policy interventions.

The most consequential contrasts involve mobility resources and household income. Removing a driving limitation yields a 0.117 probability of transitioning from negative consonance to positive consonance and a 0.483 probability of transitioning from negative dissonance to positive consonance. Similarly, moving from an annual household income below \$25,000 to \$200,000 or more produces transition probabilities of 0.209 and 0.416, respectively. These results indicate that mobility capability and financial resources are strongly associated with the likelihood of moving into a state characterized by favorable evaluations of both transportation and life. Achieving vehicle sufficiency also has a substantial effect among those initially in the negative dissonant group, with a 0.261 probability of transitioning to positive consonance. Its effect among those initially dissatisfied with both domains is essentially zero, suggesting that resolving vehicle deficiency alone may improve transportation satisfaction without being sufficient to shift broader life satisfaction.

Employment status, age, and race also produce notable transitions. Moving from a combination of work or study and other roles to being a worker or student only yields a 0.291 probability of transitioning from negative dissonance to positive consonance. The corresponding probability is 0.136 for individuals moving from neither working nor studying to working or studying only. Moving from age 18–34 to age 75 or older produces a 0.267 probability of transition from negative dissonance and a much smaller 0.020 probability from negative consonance. The

Black–White contrast yields probabilities of 0.142 and 0.046, respectively. These differences illustrate how the same characteristic may be associated with a meaningful improvement in transportation satisfaction among individuals whose life satisfaction is already high, yet have a more limited ability to shift both satisfaction domains simultaneously.

Household and built-environment characteristics generally produce smaller but still informative effects. Relative to living alone, living with extended family yields a 0.111 probability of moving from negative dissonance to positive consonance, while living with children yields a probability of 0.091. High pedestrian density produces a 0.122 transition probability from negative dissonance, and mixed land use yields a probability of 0.057. The corresponding transitions from negative consonance are negligible, again indicating that favorable transportation environments may be more effective in improving transportation satisfaction than in simultaneously transforming broader life evaluations.

Overall, the CTEs show that movement into positive consonance is most likely when individuals already report high life satisfaction and experience an improvement in transportation-related circumstances. Transitions from negative consonance are less common because they require favorable movement in both domains. The results therefore reinforce the distinction between improving transportation satisfaction and improving life satisfaction: transportation-related changes may be sufficient to resolve negative dissonance, but broader resources and circumstances appear necessary to move individuals from dissatisfaction in both domains to positive consonance.

TABLE 5 Conditional Treatment Effects (CTEs): Transition Probabilities

Variable	Base	Treatment	Negative Consonant to Positive Consonant	Negative Dissonant to Positive Consonant
Gender	Male/Other	Female	0.0002	0.0402
Age	18 to 34 years	75+	0.0203	0.2668
Race	White	Black	0.0455	0.1424
Education	Higher education	Grade school	0.0000	0.1090
Employment status	Not a worker or student	Worker or student only	0.0233	0.1359
	Worker or student with other roles*	Worker or student only	0.0140	0.2909
Driving limitations	Has limitations	No limitations	0.1172	0.4827
Walking limitations	Has limitations	No limitations	0.0000	0.0330
Household income	Less than \$25,000	\$200,000 or more	0.2094	0.4158
Household composition	Live alone	Couple	0.0025	0.0337
		Couple with children	0.0143	0.0906
		Couple with ext. family	0.0039	0.1114
Vehicle sufficiency	Vehicle deficient	Vehicle sufficient	0.0000	0.2606
Pedestrian density	Low**	High	0.0000	0.1224
Land use	Not mixed use	Mixed use***	0.0000	0.0572
Transit use frequency	≥ Once a month	< Once a month	0.0033	0.0422
Walking frequency	≥ Once a month	< Once a month	0.0025	0.0337

Note: (*) Other roles refer to retired, volunteer or unpaid worker, homemaker or caregiver, not currently employed, or other. Respondents reporting student status without paid work are included in the first category. (**) High pedestrian density refers to a value greater than 15 facility miles of pedestrian-oriented links per square mile. (***) Mixed land use refers to an area with an employment and household entropy value over 0.5.

7. DISCUSSION AND CONCLUSIONS

This study examined the relationship between satisfaction with transportation options and satisfaction with life using data from 8,030 adults participating in the first wave of the Transportation Heartbeat of America Survey. Four possible states were defined for this study. Positive consonance refers to high transportation satisfaction accompanied by high life satisfaction, while negative consonance refers to low satisfaction in both domains. Negative dissonance occurs when transportation satisfaction is low but life satisfaction is high, whereas positive dissonance occurs when transportation satisfaction is high but life satisfaction is low. A generalized heterogeneous data model was estimated to represent the two ordered satisfaction outcomes jointly. The framework incorporated individual, household, travel, and built-environment attributes; four stochastic latent constructs capturing Value Alignment, Social Inclination, Positive Travel Experience, and Desire for Mobility Control; an endogenous relationship from transportation satisfaction to life satisfaction; and threshold shifters representing response-specific patterns of consonance and dissonance in life and transportation satisfaction. Conditional treatment effects were then computed to translate the model results into probabilities of movement among the satisfaction states. Together, these elements provide a richer account of the transportation–well-being relationship than would be obtained by modeling the two outcomes independently.

The motivation for this analysis rests on the central role that transportation plays in daily life. Transportation enables access to employment, education, health care, shopping, recreation, and social interaction. It also shapes autonomy, safety, connectedness, and the ability to participate in desired activities (Delbosc, 2012). Transportation satisfaction is therefore more than an evaluation of travel time, cost, or system performance. It reflects whether individuals believe that their mobility options meet their needs and allow them to pursue the lives they value. At the same time, life satisfaction is formed through many domains and is filtered through personal attitudes and dispositions. The relationship between the two outcomes should therefore be expected to be important, but neither uniform nor deterministic.

The descriptive results present an encouraging overall picture. Positive consonance is the dominant state, with 60.0 percent of respondents reporting high satisfaction with both transportation and life. Another 11.5 percent exhibit negative consonance, reporting low or neutral satisfaction in both domains. The remaining 28.4 percent are dissonant: 13.0 percent report low transportation satisfaction despite high life satisfaction, while 15.4 percent report high transportation satisfaction despite low life satisfaction. Thus, most respondents are doing well on both dimensions, but more than one-quarter do not evaluate transportation and life consistently. This sizeable dissonant share is a central finding because it demonstrates why marginal distributions or separate outcome models provide an incomplete understanding of transportation and well-being.

The endogenous effect included in the joint model provides direct support for the notion that higher transportation satisfaction is systematically associated with higher life satisfaction, after accounting for observed circumstances and latent psychosocial orientations. Transportation is therefore a meaningful life domain and not merely a background service that facilitates movement. Improvements in accessibility, reliability, safety, affordability, convenience, and modal availability have the potential to yield benefits that extend beyond the trip itself. The model specification includes threshold-shifters that add an essential qualification to this finding. Respondents display additional tendencies toward matching evaluations across the two domains, but systematic dissonance also remains after the general endogenous relationship is

accommodated. Some individuals remain highly satisfied with life despite pronounced dissatisfaction with transportation, presumably because favorable conditions in other domains compensate for mobility deficiencies. Others are highly satisfied with transportation but remain dissatisfied with life because challenges elsewhere dominate their overall evaluation. Transportation matters, but its importance is embedded within a broader context of life circumstances.

The latent constructs further show that satisfaction depends on both transportation conditions and the lens through which those conditions are evaluated. Positive Travel Experience is associated with higher satisfaction in both domains, indicating that the experiential quality of travel matters alongside conventional measures of system performance. Social Inclination is also positively related to both outcomes, with transit and cycling appearing especially relevant for individuals who value interaction and engagement. Desire for Mobility Control is positively associated with transportation and life satisfaction, while vehicle deficiency substantially weakens transportation satisfaction among those who strongly value autonomy. Value Alignment presents a particularly revealing result: it is positively associated with life satisfaction but negatively associated with transportation satisfaction. Individuals who seek consistency between transportation choices and broader values may be broadly satisfied with life yet dissatisfied when available mobility options do not support sustainability, safety, or other priorities they hold dear. The positive interactions with transit use, walking, and pedestrian-oriented environments suggest that transportation systems can improve satisfaction not only by reducing generalized travel costs, but also by enabling people to travel in ways that accord with their values.

The observed socio-economic effects reinforce the importance of resources and mobility capability. Income exhibits a strong positive gradient across both outcomes, and driving limitations and vehicle deficiency are associated with lower satisfaction. The conditional treatment effects support this interpretation. Removing a driving limitation and moving from very low to very high income produce the largest probabilities of transitioning from negative consonance to positive consonance. Achieving vehicle sufficiency has a sizeable probability of moving individuals from negative dissonance to positive consonance but essentially no probability of moving them from negative consonance. This distinction is important. Addressing a specific transportation constraint may be sufficient to improve transportation satisfaction among those already satisfied with life, but it may not be sufficient to improve both domains among those facing broader disadvantage.

The policy implication is therefore not simply that transportation should be improved because transportation satisfaction contributes to life satisfaction. Rather, policy should distinguish among the populations occupying different satisfaction states. Individuals in negative dissonance represent a particularly actionable group; they are broadly satisfied with life but report unmet transportation needs. Targeted improvements in accessibility, mobility resources, pedestrian infrastructure, service quality, and modal options may move many of these individuals into positive consonance. Individuals in negative consonance require a broader response. Transportation improvements remain important, but mobility interventions may need to be coordinated with policies addressing income, employment, health, housing, and social participation. Those in positive dissonance should not be viewed as evidence that transportation is unimportant; instead, their experience illustrates the limits of transportation policy when dissatisfaction originates primarily in other life domains.

Overall, the findings support a more people-centered approach to transportation planning. Performance measures such as travel time, delay, reliability, and accessibility remain essential, but they should be complemented by measures of whether transportation systems meet individual

needs, support autonomy and social participation, and align with users values. Transportation investments will not translate uniformly into higher life satisfaction, but they can make a meaningful contribution when they address the constraints, expectations, and psychosocial orientations of the populations they are intended to serve.

AI STATEMENT

Artificial intelligence tools – ChatGPT and Claude – were used to support the preparation of this manuscript, assisting with formatting content and refining language. All AI-assisted output was critically reviewed, revised, and validated by the authors. The study design, analysis, interpretation of results, and conclusions reflect the authors’ academic and professional judgment. AI tools improved efficiency and communication but did not substitute for engineering judgment, technical review, or responsibility for the final content. The authors are solely responsible for all content, including any errors or omissions.

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AUTHOR CONTRIBUTIONS

The authors confirm contribution to the paper as follows: study conception and design: S. Boswell, I. Batur, D. Robbenholt, S.E. Polzin, R.M. Pendyala, C.R. Bhat; data collection: D. Robbenholt, I. Batur, C. Chen, P.L. Mokhtarian, S.E. Polzin, R.M. Pendyala, C.R. Bhat; analysis and interpretation of results: S. Boswell, D. Robbenholt, I. Batur, R.M. Pendyala, C.R. Bhat; draft manuscript preparation: S. Boswell, I. Batur, D. Robbenholt, J.R. Dimas Valle, C. Chen, P.L. Mokhtarian, S.E. Polzin, R.M. Pendyala, C.R. Bhat. All authors reviewed the results and approved the final version of the manuscript.

REFERENCES

- Anderson, S.M., K.E. Asmussen, S. Saxena, I. Batur, R.M. Pendyala, and C.R. Bhat. 2024. "An Investigation of Dissonance in Telework Frequency." *Transportation Research Part C: Emerging Technologies* 166: 104712. <https://doi.org/10.1016/j.trc.2024.104712>.
- Badri, M.A., M. Alkhaili, H. Aldhaferi, G. Yang, M. Albahar, and A. Alrashdi. 2022. "Exploring the Reciprocal Relationships between Happiness and Life Satisfaction of Working Adults: Evidence from Abu Dhabi." *International Journal of Environmental Research and Public Health* 19 (6): 3575. <https://doi.org/10.3390/ijerph19063575>.
- Brickman, P., D. Coates, and R. Janoff-Bulman. 1978. "Lottery Winners and Accident Victims: Is Happiness Relative?" *Journal of Personality and Social Psychology* 36 (8): 917–27. <https://doi.org/10.1037/0022-3514.36.8.917>.
- Brief, A.P., A.H. Butcher, J.M. George, and K.E. Link. 1993. "Integrating Bottom-Up and Top-Down Theories of Subjective Well-Being: The Case of Health." *Journal of Personality and Social Psychology* 64 (4): 646–53. <https://doi.org/10.1037/0022-3514.64.4.646>.
- Bühler, J.L., U. Orth, W. Bleidorn, E. Weber, A. Kretzschmar, L. Scheling, and C.J. Hopwood. 2024. "Life Events and Personality Change: A Systematic Review and Meta-Analysis." *European Journal of Personality* 38 (3): 544–68.

- Cabalu, H., P. Koshy, and V. Valencia. 2026. "The Role of Higher Education in Shaping Attitudes to the Environment and Economic Growth: Evidence from the World Values Survey." *The Journal of Environment & Development* 35 (1): 150–76.
- Campbell, A., P.E. Converse, and W.L. Rodgers. 1976. *The Quality of American Life: Perceptions, Evaluations, and Satisfaction*. 1st ed. New York: Russell Sage Foundation.
- Chapman, J., E. Fox, W. Bachman, and L. Frank. 2021. *Smart Location Database Technical Documentation and User Guide*. Version 3.0. Washington, DC: U.S. Environmental Protection Agency.
- Delbosc, A., and G. Currie. 2011. "Exploring the Relative Influences of Transport Disadvantage and Social Exclusion on Well-Being." *Transport Policy* 18 (4): 555–562.
- Delbosc, A. 2012. "The Role of Well-Being in Transport Policy." *Transport Policy* 23: 25–33.
- Duroy, Q.M. 2005. "The Determinants of Environmental Awareness and Behavior." *The Journal of Environment & Development* 14 (1): 1–26.
- Guo, Q., W. Zheng, J. Shen, T. Huang, and K. Ma 2022. "Social Trust More Strongly Associated with Well-Being in Individualistic Societies." *Personality and Individual Differences* 188: 111451.
- Haim-Litevsky, D., R. Komemi, and L. Lipskaya-Velikovsky. 2023. "Sense of Belonging, Meaningful Daily Life Participation, and Well-Being: Integrated Investigation." *International Journal of Environmental Research and Public Health* 20 (5): 4121.
- Heller, D., D. Watson, and R. Ilies. 2004. "The Role of Person Versus Situation in Life Satisfaction: A Critical Examination." *Psychological Bulletin* 130 (4): 574–600.
- Khaptsova, A., and S.H. Schwartz. 2016. "Life Satisfaction and Value Congruence: Moderators and Extension to Constructed Socio-Demographic Groups in a Russian National Sample." *Social Psychology* 47 (3): 163–73. <https://doi.org/10.1027/1864-9335/a000268>.
- Kim, E.S., S.W. Delaney, L. Tay, Y. Chen, E. Diener, and T.J. Vanderweele. 2021. "Life Satisfaction and Subsequent Physical, Behavioral, and Psychological Health in Older Adults." *The Milbank Quarterly* 99 (1): 209–239.
- Lachmann, B., R. Sariyska, C. Kannen, K. Błaszczewicz, B. Trendafilov, I. Andone, M. Eibes, A. Markowitz, M. Li, K.M. Kendrick, and C. Montag. 2018. "Contributing to Overall Life Satisfaction: Personality Traits Versus Life Satisfaction Variables Revisited—Is Replication Impossible?" *Behavioral Sciences* 8 (1): 1. <https://doi.org/10.3390/bs8010001>.
- Lambert, E.G., S. Jiang, J. Liu, J. Zhang, and E. Choi. 2018. "A Happy Life: Exploring How Job Stress, Job Involvement, and Job Satisfaction Are Related to the Life Satisfaction of Chinese Prison Staff." *Psychiatry, Psychology and Law* 25 (4): 619–636. <https://doi.org/10.1080/13218719.2018.1473174>.
- Lee, Y., M. Hickman, and S. Washington. 2007. "Household Type and Structure, Time-Use Pattern, and Trip-Chaining Behavior." *Transportation Research Part A: Policy and Practice* 41 (10): 1004–1020. <https://doi.org/10.1016/j.tra.2007.06.007>.
- Leyden, K.M. 2003. "Social Capital and the Built Environment: The Importance of Walkable Neighborhoods." *American Journal of Public Health* 93 (9): 1546–1551. <https://doi.org/10.2105/AJPH.93.9.1546>.
- McDonald-Lopez, K., A.K. Murphy, A. Gould-Werth, J. Griffin, M.D.M. Bader, and N. Kovski. 2023. "A Driver in Health Outcomes: Developing Discrete Categories of Transportation Insecurity." *American Journal of Epidemiology* 192 (11): 1854–1863. <https://doi.org/10.1093/aje/kwad145>.

- Morrish, N., and A. Medina-Lara. 2021. "Does Unemployment Lead to Greater Levels of Loneliness? A Systematic Review." *Social Science & Medicine* 287: 114339. <https://doi.org/10.1016/j.socscimed.2021.114339>.
- Morrison, P.S., and B. Beer. 2017. "Consumption and Environmental Awareness: Demographics of the European Experience." In *Socioeconomic Environmental Policies and Evaluations in Regional Science*, edited by H. Shibusawa, K. Sakurai, T. Mizunoya, and S. Uchida, 79–95. *New Frontiers in Regional Science: Asian Perspectives*, vol. 24. Singapore: Springer. https://doi.org/10.1007/978-981-10-0099-7_5.
- Murphy, A.K., K. McDonald-Lopez, N. Pilkauskas, and A. Gould-Werth. 2022. "Transportation Insecurity in the United States: A Descriptive Portrait." *Socius: Sociological Research for a Dynamic World* 8. <https://doi.org/10.1177/23780231221121060>.
- Ozbilen, B., G. Akar, K. White, H. Dabelko-Schoeny, and Q. Cao. 2024. "Analysing the Travel Behaviour of Older Adults: What Are the Determinants of Sustainable Mobility?" *Ageing & Society* 44 (9): 1964–1992. <https://doi.org/10.1017/S0144686X22001180>.
- Pavot, W., and E. Diener. 2008. "The Satisfaction with Life Scale and the Emerging Construct of Life Satisfaction." *The Journal of Positive Psychology* 3 (2): 137–152. <https://doi.org/10.1080/17439760701756946>.
- Razon, N., and L. Gottlieb. 2022. "Content Analysis of Transportation Screening Questions in Social Risk Assessment Tools: Are We Capturing Transportation Insecurity?" *Journal of the American Board of Family Medicine* 35 (2): 400–405. <https://doi.org/10.3122/jabfm.2022.02.210256>.
- Robbennolt, D., H. Hwang, A. Jaiswal, S. Verma, S. Chakrabarti, and C.R. Bhat. 2026. "Who Is Willing to Pay for Travel Time Savings and How Much? An Iterative Bidding Contingent Valuation Study in Mumbai." *Transportation Research Part A: Policy and Practice* 210: 105042. <https://doi.org/10.1016/j.tra.2026.105042>.
- Zarabi, Z., P. Gerber, and S. Lord. 2019. "Travel Satisfaction vs. Life Satisfaction: A Weighted Decision-Making Approach." *Sustainability* 11 (19): 5309. <https://doi.org/10.3390/su11195309>.
- Zhaoyang, R., M.J. Sliwinski, L.M. Martire, and J.M. Smyth. 2018. "Age Differences in Adults' Daily Social Interactions: An Ecological Momentary Assessment Study." *Psychology and Aging* 33 (4): 607–618. <https://doi.org/10.1037/pag0000242>.