Daily Travel Behavior and Emotional Well-Being: A comprehensive assessment of travel-related emotions and the associated trip and personal factors

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Abstract: Emotional well-being has become an important societal goal given the rising evidence from psychology research that positive emotions have long-lasting benefits for human development. Although daily travel behavior has been found to influence emotional well-being, existing research in the field has focused on limited travel behavior dimensions such as travel mode and/or travel duration. Other dimensions such as travel purpose and travel companionship have received limited attention. Using data from the 2012-2013 American Time Use Survey, this paper offers a comprehensive assessment of how various trip- and personal-level factors relates to various positive and negative emotions. Results show that both positive and negative emotions are shaped in various ways by the mode, duration, purpose, and companionship characteristics of a trip. Of the modes examined, biking is the happiest mode; public transit is the least happy, least meaningful, and most tiresome mode; and utilitarian walking for transportation is strongly associated with negative motions. Long travel ($\geqslant$45 Mins) is the least happy and most tiresome and stressful. While short travel (<15 mins) is the least tiresome and stressful, it is also the least meaningful. Travel purpose shows strong associations with both positive and negative emotions. Travel for discretionary purposes such as leisure, exercise, and community activities is associated with higher levels of positive emotions and lower levels of negative emotions than travel for work or household maintenance. Travel companionship shows significant associations with positive emotions but limited associations with negative emotions. Travel with family members (except parents) and/or friends is the happiest. Besides trip-level factors, personal demographics, health conditions, and residential locations play significant roles in predicting travel-related emotions. During trips, immigrants and low-income people tend to experience more intensive emotions regardless of positive or negative. Implications of these findings for transportation policy and future research directions are discussed.

Keywords: travel mode, travel duration, travel purpose, travel companionship, emotions, happy, stress

INTRODUCTION

Individuals who have high levels of emotional well-being (i.e., who experience more frequent positive emotions and less frequent negative emotions) are often successful across multiple life domains including marriage, friendship, income, work, and health (Achat, 2000; Lyubomirsky et al., 2005). The broaden-and-build theory of positive emotions suggests that emotional well-being helps people build lasting resources and forms the link between happiness and desirable outcomes (Cohn et al., 2009). Positive emotions initiate upward spirals toward enhanced emotional well-being (Fredrickson & Joiner, 2002). Positive emotions promote original thinking;

foster skills and behaviors such as sociability and activity; and encourages altruism, liking of self and others, and effective conflict resolution skills, all of which are behaviors and skills paralleling success (Lyubomirsky et al., 2005). Evidence has also shown that general emotional well-being helps to prevent negative physiological reactions to life events, such as depression (Sabatini, 2014; Achat et al., 2000), and is strongly associated with health and longevity (Danner et al., 2001; Diener & Chan, 2011; Lawrence et al., 2015).

Given the known benefits of emotional well-being, it is important for transportation planners and policy makers to understand the connections between personal demographics, travel behavior, and emotional well-being. Transportation plays an important role in our daily lives and Americans spend significant amount of time per day on daily trips. The 2012-2013 American Time Use Survey shows that Americans on average spend 73.4 minutes per day on daily trips—almost twice the time we spent on socializing and more than four times the time we spent on exercising (Hofferth et al., 2013). It is important to know whether some population groups are more likely to experience positive and/or negative emotions during trips than other groups. And It is important to know whether some trip types are more likely to induce positive emotions than other trip types after controlling for personal factors. Answer to these questions will help planners and policy makers develop transportation systems that maximize emotional well-being for all population groups.

The literature on travel behavior and emotional well-being has been fragmented. Under the conventional view that travel is a derived demand, people rarely conduct trips for its own pleasure and trips themselves generate disutility (Ettema et al., 2010). It is only recently that transportation researchers began to investigate how specific trip characteristics may be associated with positive and/or negative emotions (De Vos et al., 2013; Ettema et al., 2015; Morris & Guerra, 2015a; Gärling et al., 2013). Studies have shown that people tend to experience negative emotions during long trips, peak-hour work commutes, and bus trips (Morris & Hirsch, 2016; Morris & Guerra, 2015b). A separate body of literature focuses on how emotional well-being may have traffic safety implications and highlights the intensive negative emotions associated with driving behavior (Zhang & Chan, 2014; McLinton & Dollard, 2010). Studies have shown that road rage (an elevated level of aggressive feelings during driving) is significantly associated with hazardous driving behaviors (Wells-Parker et. al., 2002) and have negative traffic safety consequences (Jeon et al., 2014). However, fewer studies have systemically examined the travel behavior and emotional well-being connections in the context of personal demographics and health conditions. Little is known about how emotional well-being during trips vary across population groups. Further, although the emotional impacts of some trip characteristics (e.g., mode and duration) have been widely studied, studies on other dimensions of travel behavior (e.g., purpose and companionship) have been limited.

Using data from the 2012-2013 American Time Use Survey, this study responds to the literature gaps and offers a comprehensive assessment of travel-related emotions and the associated trip and personal factors. We examine a wide range of personal factors, including race and ethnicity, gender, income, immigrant status, and health and disability status. Trip factors include factors examined in the existing literature, as well as factors such as purpose and companionship that have received limited attention in the literature on travel behavior and emotions.

PRIOR RESEARCH

The literature review below focuses on studies linking travel behavior to emotional/affective aspects of well-being. A separate body of literature exists focusing on linking travel behavior to cognitive aspects of well-being. Emotional/affective well-being refers to how we "feel" about our lives and cognitive well-being refers to how we "think" about our lives (Diener, 1984). Emotional well-being can be measured by frequency and/or intensity of specific positive and negative emotion experiences such as joy, love, stress, sadness, and anger (Kahneman & Deaton, 2010). In contrast, cognitive aspects of well-being can include overall hedonic (e.g., satisfaction and happiness) and eudaimonic (e.g., meaningfulness) evaluations of one's life as a whole and/or specific life domains, e.g., work, housing, health, leisure, environment, and travel. The literature review below does not include studies on travel behavior and cognitive well-being.

For the purpose of this review, we traced published articles using Google Scholar between May and June, 2016. The term "travel" was combined with each of the following emotional well-being keywords including "well-being", "emotion", "mood", and "happiness", yielding four unique combinations. Of the hundreds of the studies that came up in the searches, we read all abstracts to remove studies are not related to daily travel behavior. For example, a substantial body of research exists on the connections between tourism-oriented leisure travel behavior and emotional well-being (Sirgy, 2009; Wang et al., 2011; Dolnicar et al., 2012). These leisure travel studies were excluded from this review. In the review process, we also discovered studies in the field of traffic psychology that examine negative aspects of travel experiences (such as stress and anger) of road and transit users and yet often do not overlap with the well-being literature. These traffic psychology studies were included in this review. Note studies on the relationship between air travel and negative emotions (i.e. fatigue, stress) (Flower et al., 2003; Samuels, 2012; Reilly et al., 2005) are excluded from our studies. By removing the unrelated studies and including additional related studies, we identified 30 studies that provide empirical evidence on the connections between daily travel behavior and emotional well-being. These empirical studies were summarized in Table 1. Note that review articles and conceptual papers such as De Vos et al. (2013) that do not provide original empirical evidence are not included in Table 1.

The summary in Table 1 shows several interesting patterns. First, U.S. and European studies dominate the literature on daily travel behavior and emotional well-being. Of the 30 studies, only five studies are outside the U.S. and Europe, including two from Japan, one from Australia, one from Canada, and one from Hong Kong, China. Second, although many studies use established emotional well-being or traffic psychology measures such as Swedish Core Affect Scale, Affect Balance Scale, and Driver Anger Scale, a significant number of studies use self-designed measures such as travel happiness ratings, stress and emotion ratings, metal distress scores, etc. Interestingly six studies used a modified Satisfaction with Travel Scale (STS). STS is often considered a measure of cognitive evaluation and these six studies modified the traditional STS scale and added affective dimensions that describe emotional experiences during travel. Finally, the majority of the studies use self-design surveys with relatively small sample sizes to provide empirical evidence, including mail, web, face-to-face, in-class paper surveys, and household drop off surveys. Only five studies used pre-existing, large nationwide surveys including the American Time Use Survey, the British Household Panel Survey, and the Gallup-Healthways Survey.

Table 1 Prior research summary

Author, year	Study Sample	Data source	Study Nation	Emotion measures and scale
Abou-Zeid et al., 2012	30 persons	Experiment & email survey	Switzerland	Travel happiness ratings
Abou-Zeid & Ben-Akiva, 2011	594 persons	Web & face-to-face survey	US	Stress and emotion ratings
Bergstad et al., 2011	1,330 persons	Mail & web survey	Sweden	Swedish Core Affect Scale
Chng et al., 2016	3630 workers	UK Household Longitudinal Survey	UK	Mental distress scores
Choi et al., 2013	338,172 persons	Gallup–Healthways Survey	US	WBI; Happiness rating yesterday
Cœugnet et al., 2013	445 drivers	Roadside face to face survey	France	Emotion self-assessments
De Vos et al., 2015a	1720 persons	Web survey	Belgium	Satisfaction with Travel Scale*
De Vos et al., 2015b	1411 persons	Web survey	Belgium	Satisfaction with Travel Scale*
Deffenbacher, 2001	453 students	In-class paper survey	US	Driving Anger Scale; Trait Anger Scale
Dukes et al., 2001	144 students	Face to face survey	US	Driving Anger Scale
Eriksson et al., 2013	123 students	In-class paper survey	Sweden	Swedish Core Affect Scale
Ettema et al., 2012	520 workers	Mail survey	Sweden	Satisfaction with Travel Scale*
Ettema et al., 2011	155 students	In-class paper survey	Sweden	Satisfaction with Travel Scale*
Ettema et al., 2013	256 drivers	Mail survey	Netherlands	Satisfaction with Travel Scale*
Hennessy, 2008	114 students	In-vehicle paper survey	US	Aggression
McLinton & Dollard, 2010	215 workers	Household drop off paper survey	Japan	Driving Anger Scale; Trait Anger Expression
Morris & Guerra, 2015a	37,841 persons	American Time Use Survey	US	Total affect/mood score combining 1 positive & 4 negative emotions
Morris & Guerra, 2015b	23,441 persons	American Time Use Survey	US	Five individual emotion ratings and a combined total affect score
Morris & Hirsch, 2016	14,336 persons	American Time Use Survey	US	Total affect/mood score combining 1 positive & 4 negative emotions
Nass et al., 2005	40 persons	Experiment	US	Emotion ratings
Novaco et al., 1979	100 workers	Mail survey	US	Frustration tolerance; Mood ratings
Olsson et al., 2013	713 workers	Mail survey	Sweden	Satisfaction with Travel Scale*; Emotion ratings
Páez & Whalen, 2010	1251 students	Web survey	Canada	Travel enjoyment/nervous ratings
Raggatt & Morrissey, 1997	10 bus drivers	Face to face survey	Australia	Anxiety and stress ratings
Song et al., 2007	1503 persons	Chinese American Psychiatric Epidemiologic Study	US	Depression scale; Traffic stress
Summala & Mikkola, 1994	2606 drivers	Accident reports	Finland	Fatigue ratings
Wener & Evans, 2011	286 workers	Mail survey	US	Stress ratings; Mood ratings
Wener et al., 2003	53 workers	Face-to-face & mail survey	US	Perceived Stress Scale; Spousal rating scales
Xiong & Zhang, 2014	900 persons	Web survey	Japan	Happiness and mode ratings
Zhang & Chan, 2014	50 drivers	In-class paper survey	Hong Kong, China	Valance–Arousal Space

Notes: *Traditionally, Satisfaction with Travel Scale (STS) is a measure of cognitive evaluation. The STS used in these studies has been modified to include affective dimensions that describe emotional experiences.

The majority of the 30 studies above examined the emotional effects of travel mode and travel duration. Specifically, the effects of travel mode on emotional well-being are complex. Although Bergstad et al. (2011) found that car use (measured by percent weekly car use) has a small effect on emotional well-being, car use in general is associated with higher levels of positive emotions when compared to transit use (Abou-Zeid & Ben-Akiva, 2011; Eriksson et al., 2013; Ettema et al., 2011; Páez & Whalen, 2010; Olsson et al., 2013). And car passenger is associated with higher happiness than car driver, but lower happiness than bicyclists (Morris & Guerra, 2015a). Moreover, evidence has also shown that car use under specific conditions may be associated with various negative emotional experiences such as anger, mental stress, fatigue and frustration. For example, long-distance driving, high-frequency driving, driving under time pressure, and driving on congested roads are associated with higher levels of negative emotions (Cœugnet et al., 2013; Novaco et al., 1979; Deffenbacher, 2001; Raggatt & Morrissey, 1997). Among transit use, bus is associated with the lowest levels of emotional well-being (De Vos et al., 2015a; De Vos et al., 2015b; Ettema et al., 2011; Morris & Guerra, 2015a) and train commuters tend to have more positive and less negative emotions (Wener & Evans, 2011). Non-motorized transportation modes such as walking and biking are associated with higher levels of emotional well-being when compared to car and transit modes (Abou-Zeid & Ben-Akiva, 2011; Olsson et al., 2013; De Vos et al., 2015a; Morris & Guerra, 2015a).

Several studies also find interactive effects between travel mode and other factors such as the built environment and vehicle types on emotional well-being. Song et al. (2007) found that driving stress and anger can be moderated or reduced by built environment attributes such as neighborhood greenness. Ettema et al. (2011) found that emotional well-being during bus trips is positively associated with access to bus stops. Consistently, Chng et al. (2016) found that mental distress of transit commuters is negatively associated with public transport connectivity. Novaco et al. (1979) found that commuters who drive larger cars demonstrated greater tolerance for frustration. Car drivers experience heightened fear when their safety was threatened (Zhang &Chan, 2014), and experience more road rage when they encounter reckless driving of other drivers (Dukes et al., 2001). In addition, activities such as talking to others and work or entertainment activities during transit trips can moderate the negative emotional experiences of transit commuters (Millonig et al., 2012; Ettema et al., 2012; Olsson et al., 2013).

The effects of travel duration and distance on emotional well-being are straightforward. There is general consensus that longer trip duration/distance is associated with lower emotional well-being regardless of the mode (Choi et al., 2013; Ettema et al., 2011; Ettema et al., 2012; De Vos et al., 2015a; Olsson et al., 2013). De Vos et al. (2015a) provided evidence that, while given a trip of a certain distance, completing it in a shorter duration is considered desirable. Abou-Zeid & Ben-Akiva (2011) found that having a commute duration shorter than that of others is related to more social comparative happiness. Long-distance driving is associated with high levels of fatigue and stress (Raggatt & Morrissey, 1997). Auto passenger is found to be an exception for the negative relationship between travel duration and emotional well-being (Morris & Guerra, 2015b). Long bicycle and walking trips are more painful than shorter ones, and long-duration transit commuting that involves multiple transfers is deleterious for mood (Morris & Guerra, 2015b). Eliminating transit transfers is associated with reduced stress (Wener et al., 2003). In

addition, travel circumstances causing the enjoyment of scenery or the thrill of speed contribute to a more or less positive emotion with travel duration (Morris & Guerra, 2015a).

Only a few studies looked into emotional effects of travel purpose (Ettema et al. 2012; Ettema et al. 2013; De Vos et al. 2015a; Morris & Guerra, 2015a). Ettema et al. (2013) found that travelers having a recreational trip purpose have higher emotional well-being than travelers having other trip purposes. With the purpose of commuting to work, activities of talking to others during the trip promote people's emotional well-being. With the purpose of commuting from work, there is no negative effect of trip duration on emotional well-being (Ettema et al., 2012). With the purpose of conducting leisure activities, long-distance travel is perceived more positively than shorter-distance ones (De Vos et al., 2015a). Work-related travel has a negative effect on mood (Morris & Guerra, 2015a). Studies on how activities during travel such as talking to others affect emotions provide some insights into the effects of travel companionship (Ettema et al., 2012; Olsson et al., 2013). However, to the authors' knowledge, no studies to date have directly examined the effects of travel companionship on emotional well-being.

Our literature review reveals that the current understanding of the travel behavior and emotional well-being is fragmented and incomprehensive. The field is in need of studies that use large, national datasets; and studies that examine the travel behavior and emotional well-being connection from the perspective of travel mode, duration, purpose, and companionship and in the context of personal demographics and health conditions. This paper is a direct response to literature gaps.

METHOD

Data and Variables

The American Time Use Survey (ATUS) provides nationally representative data on how, where, and with whom Americans spend their time in each of more than 400 detailed activities (Bureau of Labor Statistics, 2006). In 2010, 2012, and 2013, ATUS included a set of well-being questions as a special supplement to the ATUS that collects information on how people felt during selected activities. With this supplement, ATUS becomes the only national survey that provides emotional well-being data at the activity episode level. And because ATUS classifies trips as a specific category of activities, ATUS is also the only national survey that provides emotional well-being data at the trip level.

ATUS uses the computer-assisted telephone interview technique that survey respondents are interviewed on the next day of a pre-selected day about how they spent their time from 4 AM on the pre-selected day to 4 AM of the interview day (Basner et al. 2007). Days are selected to ensure proportional distribution across the days of the week and even distribution across the weeks of the year. Each activity described by the respondent is coded using a three-tiered scheme, going from a top-level category of activities, to subcategories, and then to the most detailed third-tier categories that describe very specific actions. To provide a specific example, the top-level ‘‘traveling’’ category includes a second-tier category of ‘‘traveling related to caring for and helping household members’’ under which ‘‘travel related to caring for and helping household children’’ is a third-tier activity.

This research uses publicly available data from the 2012-2013 ATUS. Data was downloaded from the ATUS Data Extract Builder (ATUS-X) website. ATUS-X assigns uniform codes across all of the data collection years and brings relevant documentation into a coherent form, which makes it easy for researchers to use multi-year ATUS data (Hofferth et al., 2013). The original 2012-2013 ATUS data includes a total of 1,074,193 activities reported by 23,828 respondents. Because each respondent was only asked to report well-being information on up to three randomly selected activities, only 64,902 (6%) activities in the 2012-2013 ATUS dataset come with well-being data. Of the 64,902 activities with well-being data, 77% are non-trip activities and are excluded from our study. We further excluded trips made by children under age 18, and trips that were missing information on the mode of transportation. Trips that involved taxi, limousine service, boat, and plane were also excluded due to the limited number of observations. The final dataset used in this research includes a total of 13,532 trips. Each trip record comes with various trip-level information and various person-level information on the individual who conducted the trip.

Table 2 describes the variables used in this research. The dependent variables include six emotional well-being variables (Happy, Pain, Sad, Tired, Stressed, and Meaningful) at the trip-level which are scaled 0-6. As shown in Table 2, people felt happy and meaningful during most of the trips—indicated by the high mean values of the Happy and Meaningful variables (4.451 and 4.096 respectively). In relatively rare occasions, people felt sad or pain during trips, as indicated by the very low mean values of the Sad and Pain variables (0.546 and 0.782 respectively). People are more likely to feel tired and stressed during trips (mean values are 2.053 and 1.268 respectively) than feel said and pain. As shown in Table 2, the explanatory variables in this research include various trip-level variables (mode, duration, purpose, companionship, time and day) and various personal attributes (socio-demographics, residential location, and health conditions).

Table 2 Variable Description (N=13,532)

Variables	Description	Mean	Std Dev
Emotional well-being during the trip			
Happy	Ordinal variable scaled 0-6: 0=not at all happy, 6=very happy	4.451	1.553
Meaningful	Ordinal variable scaled 0-6: 0=not at all meaningful, 6=very meaningful	4.096	2.035
Sad	Ordinal variable scaled 0-6: 0=not at all sad, 6=very sad	0.546	1.273
Pain	Ordinal variable scaled 0-6: 0=not at all pain, 6=very pain	0.782	1.498
Tired	Ordinal variable scaled 0-6: 0=not at all tired, 6=very tired	2.053	1.932
Stressed	Ordinal variable scaled 0-6: 0=not at all stressed, 6=very stressed	1.268	1.703
Travel mode			
Car Driver	Dummy variable: 1 if traveled as an automobile driver	0.773	0.419
Car Passenger	Dummy variable: 1 if traveled as an automobile passenger	0.158	0.364
Walk	Dummy variable: 1 if traveled by walking	0.045	0.207
Bike	Dummy variable: 1 if traveled by bicycle	0.004	0.065
Transit	Dummy variable: 1 if traveled by bus, subway or train	0.020	0.142
Travel duration			
<15 Mins	Dummy variable: 1 if trip duration <15 mins	0.591	0.492
15-45 Mins	Dummy variable: 1 if trip duration is between 15 and 45 mins	0.336	0.472
⩾45 Mins	Dummy variable: 1 if trip duration ⩾45 mins	0.108	0.310

Variables	Description	Mean	Std Dev
Travel purpose			
Work or Edu	Dummy variable: 1 if trip was work or education related	0.203	0.402
Maintenance	Dummy variable: 1 if trip was related to household maintenance	0.384	0.486
Eat or Drink	Dummy variable: 1 if trip was related to eating and/or drinking	0.108	0.311
Leisure	Dummy variable: 1 if trip was related to socializing and leisure	0.143	0.350
Exercise	Dummy variable: 1 if trip was related to exercise and recreation	0.041	0.197
Community	Dummy variable: 1 if trip was related to spiritual/volunteering activities	0.106	0.308
Travel companionship			
Alone	Dummy variable: 1 if trip was made alone with nobody else	0.527	0.499
Spouse/Partner	Dummy variable: 1 if trip was made with spouse or unmarried partner	0.191	0.393
Parent	Dummy variable: 1 if trip was made with parent(s)	0.025	0.155
Child	Dummy variable: 1 if trip was made with child(ren)	0.194	0.395
Other Family	Dummy variable: 1 if trip was made with other family members	0.080	0.272
Co-worker	Dummy variable: 1 if trip was made with people from work	0.012	0.111
Friends	Dummy variable: 1 if trip was made with friends or acquaintances	0.099	0.299
Trip time and day			
Workday	Dummy variable: 1 if trip was during weekdays excluding holidays	0.495	0.500
Rush Hour	Dummy variable: 1 if trip started during 7-9am or 4:30-6:30pm	0.259	0.438
Personal attributes: socio-demographic, residential location, and health conditions			
Young	Dummy variable: 1 if age < 35	0.265	0.441
Old	Dummy variable: 1 if age > 60	0.236	0.424
Male	Dummy variable: 1 if respondent is male	0.471	0.499
Black	Dummy variable: 1 if respondent is black, =0 if not	0.149	0.357
Hispanic	Dummy variable: 1 if respondent is Hispanic, =0 if not	0.142	0.349
Immigrant	Dummy variable: 1 if respondent is immigrant, =0 if not	0.151	0.358
Low-income	Dummy variable: 1 if respondent's household income < $25,000	0.220	0.414
High-income	Dummy variable: 1 if respondent's household income > $75,000	0.331	0.471
Spouse Present	Dummy variable: 1 if respondent lived with spouse/unmarried partner	0.535	0.499
Child Present	Dummy variable: 1 if respondent lived with child(ren) under 18	0.437	0.496
Central City	Dummy variable: 1 if respondent lived in central city	0.275	0.447
Rural	Dummy variable: 1 if respondent lived in non-metropolitan rural areas	0.165	0.371
Disability	Dummy variable: 1 if respondent had physical or cognitive difficulty	0.082	0.274
HBP	Dummy variable: 1 if respondent had high blood pressure in last 5 years	0.303	0.459
Pain Medicine	Dummy variable: 1 if respondent was on pain medication yesterday	0.280	0.449

Ordered Logistic Regression

Given the ordinal scale of the six dependent variables, this paper applies the ordered logistic regression technique to estimate the effects of various trip and personal attributes on emotional well-being during the trip. A total of six regression models are estimated. Detailed model specifications for the Happy regression model are below. The five other regression models (Meaningful, Sad, Pain, Tired, and Stressed) follow the same model specifications as the Happy model below.

$$\ln\left(\frac{\pi(Happy)_{ij}^{*}}{1-\pi(Happy)_{ij}^{*}}\right) = \alpha + \beta_T Trip_i + \beta_P Person_i + \varepsilon$$

Where

- $\pi(Happy)_{ij}^{*}$ is the cumulative probabilities of feeling happy for trip i ; $j = 0, \dots, 6$, which indicates the response category of the Happy question from not at all happy ($j = 0$) to very happy ($j = 6$); $\pi(Happy)_{ij}^{*} = \pi(Happy)_{i0} + \cdots + \pi(Happy)_{ij}$.
- $Trip_i$ is a set of trip-level dummy variables shown in Table 2 describing mode, duration, purpose, companionship, and time and day information of trip i ; β_T represents the regression coefficient associated with each of the trip-level dummy variables.
- $Person_i$ is a set of person-level dummy variables shown in Table 2 describing socio-demographics, residential location, and health conditions of the person who conducted trip i; β_P represents the regression coefficient associated with each of the person-level dummy variables.
- ε is the regression error term.

RESULTS

The six estimated models are all statistically significant. In all models, regression coefficients were adjusted for auto-correlation between trips made by the same person. Table 3 reports results associated with positive emotions and Table 4 reports results associated with negative motions. Because coefficients of ordered logistic regression are in the format of log odds which is not intuitive, we calculated the exponential function of each regression coefficient—the odds ratio. For example, if the variable Male has an odds ratio of β in the Happy Model, this means that compared to female, the odds of male being very happy (Happy = 6) versus the combined lower categories (Happy= 0-5) during a trip are β times greater. The following texts provide detailed interpretations of regression results.

Positive emotions during the trip: Happy & Meaningful

As shown in Table 3, the happiness levels of being a car passenger and walking are similar with the happiness levels of being a car driver (the reference category), as indicated by the insignificance of the Car Passenger and Walk variables in the Happy Model. Compared to other modes, biking is associated with higher levels of happiness and public transit is associated with lower levels of happiness during the trip. Specifically, the odds of a bike trip being very happy versus the combined lower happiness categories is 1.667 times greater than that of a driving trip, while all other variables in the model are held constant. The odds of a transit trip being very happy versus the combined lower happiness categories is 0.741 times smaller than that of a driving trip. In the Meaningful Model, biking is not statistically significant, meaning that a bike trip is not reported as more meaningful than a car driving trip. A transit trip is reported as less meaningful than trips made with other modes.

Table 3 Ordered logistic regression results on positive emotions (N=13,532)

	Happy			Meaningful		
Variable	**Coef.**	**Sig.**	**Odds ratio**	**Coef.**	**Sig.**	**Odds ratio**
Travel mode (Car driver is the reference category)						
Car Passenger	0.015		1.015	-0.012		0.988
Walk	-0.070		0.932	0.065		1.067
Bike	0.511	**	1.667	0.316		1.372
Transit	-0.300	**	0.741	-0.258	*	0.773
Travel duration (15-45 mins is the reference category)						
<15 Mins	-0.041		0.960	-0.073	**	0.929
⩾45 Mins	-0.155	***	0.856	-0.030		0.971
Travel purpose (Maintenance is the reference category)						
Work or Edu	-0.086	*	0.917	-0.047		0.954
Eat or Drink	0.373	***	1.452	0.158	***	1.171
Leisure	0.255	***	1.290	0.139	***	1.149
Exercise	0.346	***	1.414	0.214	**	1.239
Community	0.269	***	1.309	0.405	***	1.499
Travel companionship (Alone is the reference category)						
Spouse/Partner	0.188	***	1.207	0.220	***	1.246
Parent	0.004		1.004	0.199	*	1.221
Child	0.288	***	1.334	0.460	***	1.584
Other Family	0.334	***	1.397	0.510	***	1.665
Co-worker	0.266		1.305	0.269		1.309
Friends	0.325	***	1.384	0.251	***	1.285
Trip day and time						
Workday	-0.143	***	0.866	0.071	*	1.074
Rush Hour	0.039		1.040	0.078	**	1.081
Personal attributes						
Young	-0.159	***	0.853	-0.496	***	0.609
Old	0.452	***	1.572	0.261	***	1.298
Male	-0.241	***	0.786	-0.152	***	0.859
Black	0.534	***	1.705	0.757	***	2.132
Hispanic	0.403	***	1.496	0.513	***	1.670
Immigrant	0.238	***	1.269	0.394	***	1.482
Low-income	0.022		1.022	0.177	***	1.194
High-income	-0.218	***	0.804	-0.309	***	0.734
Spouse Present	0.262	***	1.300	0.081	*	1.084
Child Present	-0.072		0.931	0.049		1.051
Central City	-0.070	*	0.933	-0.069	*	0.933
Rural	0.185	***	1.203	0.124	**	1.132
Disability	-0.219	***	0.803	0.059		1.061
HBP	-0.071	*	0.931	0.068		1.071
Pain Medicine	-0.300	***	0.741	-0.101	**	0.904
Thresholds						
y=0	-3.202	***	0.041	-1.903	***	0.149
y=1	-2.799	***	0.061	-1.497	***	0.224
y=2	-2.097	***	0.123	-1.008	***	0.365
y=3	-0.979	***	0.376	-0.301	***	0.740
y=4	-0.101		0.904	0.256	***	1.292
y=5	0.972	***	2.643	0.893	***	2.442
Pseudo R2	0.0243			0.0295		

Legend: * p<.1; ** p<.05; *** p<.01

Table 3 also shows that trips with longer durations (⩾ 45 minutes) tend to be less happy and trips with shorter durations (<15 minutes) tend to be less meaningful. Trips with discretionary purposes are generally happier and more meaningful than trips associated with work, education, and household maintenance activities. Among trips with discretionary purposes, trips associated with eating and drinking are happiest and trips associated with spiritual and volunteering activities are most meaningful. Although trips made during non-holiday weekdays are less happy than weekend and holiday trips, non-holiday weekday trips are considered more meaningful. Rush hour trips are more meaningful but are not happier than non-rush hour trips.

Interestingly, travel companionship significantly predicts positive emotions during the trip. Trips made with spouse or unmarried partner, children, other family members, and/or friends are in general happier and more meaningful than trips made alone, trips made with parents, or trips made with people from work. After controlling for travel companionship, trips made by people who live with children are not happier or more meaningful than trips made by people who do not live with children. However, after controlling for travel companionship, trips made by people who live with spouse or unmarried partner remain happier and more meaningful than trips made by those who do not live with spouse or unmarried partner.

When it comes to personal attributes, socio-economically advantaged people (young, male, white, high-income, and U.S. citizen) in generally reported daily trips to be less happy and less meaningful than disadvantaged people (old, female, Black, Hispanic, low-income, and immigrant). This is not surprising because daily trips for transportation are often considered as wasteful activities and socio-economically advantaged people may attach higher values to their travel time and perceive greater loss for their trips. In contrast, people with health disadvantages (i.e., people with disabilities, high blood pressure, and using pain medication) in general report lower happiness and meaningfulness during their trips than people with health advantages. This may be due to the extra efforts that people with health disadvantages have to make when carrying out daily trips. Living in central cities and metropolitan areas is associated with less happy and less meaningful trips.

Negative emotions during the trip: Pain, Sad, Fatigue, and Stress

As shown in Table 4, being a car passenger is associated with higher levels of pain, sad, and fatigue (tiredness), but not higher levels of stress, when compared to being a car driver (the reference category). Walking is associated with higher levels of all four negative emotions when compared to driving a car. It is important to note that walking trips in our study are utilitarian walking (i.e., walking for the sake of transportation), not walking for the sake of leisure or recreation. Taking transit is associated with a higher level of tiredness when compared to driving a car, but not higher levels of pain, sad or stress. Specifically, the odds of feeling very tired during a transit trip is 1.271 times greater than that of a car driving trip. Biking show no significant differences from driving a car when it comes to negative emotions.

Table 4 Ordered logistic regression results on negative emotions (N=13,532)

Variable	Pain Coef.	Sig.	Odds ratio	Sad Coef.	Sig.	Odds ratio	Tired Coef.	Sig.	Odds ratio	Stress Coef.	Sig.	Odds ratio
Travel mode (Car driver is the reference category)												
Car Passenger	0.249	***	1.283	0.136	*	1.145	0.158	***	1.171	-0.075		0.928
Walk	0.321	***	1.378	0.280	**	1.323	0.201	**	1.223	0.221	**	1.247
Bike	0.434		1.544	0.237		1.268	-0.161		0.851	-0.316		0.729
Transit	-0.044		0.957	0.215		1.240	0.239	*	1.271	-0.085		0.918
Travel duration (15-45 mins is the reference category)												
<15 Mins	0.063		1.065	-0.046		0.955	-0.088	**	0.916	-0.072	*	0.930
⩾45 Mins	-0.006		0.994	0.091		1.096	0.117	**	1.124	0.197	***	1.218
Travel purpose (Maintenance is the reference category)												
Work or Edu	-0.007		0.993	0.115	*	1.122	0.206	***	1.229	0.179	***	1.196
Eat or Drink	-0.286	***	0.751	-0.215	***	0.806	-0.081		0.922	-0.342	***	0.710
Leisure	-0.295	***	0.744	-0.018		0.982	-0.114	**	0.892	-0.238	***	0.788
Exercise	-0.015		0.985	-0.390	***	0.677	-0.090		0.914	-0.539	***	0.584
Community	-0.187	**	0.830	-0.041		0.959	-0.111	*	0.895	-0.218	***	0.804
Travel companionship (Alone is the reference category)												
Spouse/Partner	-0.021		0.979	-0.171	**	0.843	-0.101	*	0.904	-0.179	***	0.836
Parent	-0.256		0.774	-0.175		0.840	0.052		1.053	-0.374	***	0.688
Child	-0.238	***	0.788	-0.290	***	0.748	-0.065		0.937	-0.046		0.955
Other Family	0.098		1.103	-0.002		0.998	0.064		1.066	0.160	**	1.174
Co-worker	-0.103		0.902	-0.186		0.831	0.046		1.047	0.011		1.011
Friends	-0.057		0.945	-0.250	***	0.779	0.002		1.002	-0.142	**	0.868
Trip day and time												
Workday	0.016		1.016	0.087	*	1.091	0.208	***	1.231	0.269	***	1.308
Rush Hour	-0.098	**	0.906	-0.133	***	0.876	-0.051		0.950	-0.036		0.964
Personal attributes												
Young	-0.355	***	0.701	-0.186	***	0.830	0.328	***	1.388	0.145	***	1.156
Old	-0.363	***	0.695	-0.342	***	0.711	-0.637	***	0.529	-0.602	***	0.548
Male	0.078		1.081	0.064		1.066	-0.238	***	0.788	-0.115	***	0.891
Black	-0.075		0.927	-0.169	**	0.845	-0.204	***	0.816	-0.393	***	0.675
Hispanic	0.015		1.015	-0.081		0.922	-0.005		0.995	-0.214	***	0.808
Immigrant	0.243	***	1.275	0.454	***	1.575	-0.009		0.991	0.104	*	1.110
Low-income	0.261	***	1.298	0.190	***	1.209	0.005		1.006	0.080		1.084
High-income	-0.244	***	0.783	-0.091		0.913	0.014		1.014	0.142	***	1.153
Spouse Present	-0.100	*	0.905	-0.244	***	0.783	-0.027		0.973	-0.068		0.934
Child Present	0.125	**	1.133	0.024		1.024	0.212	***	1.236	0.192	***	1.212
Central City	-0.035		0.966	-0.020		0.981	0.006		1.006	0.067		1.069
Rural	0.020		1.020	-0.106		0.899	-0.023		0.977	-0.173	***	0.841
Disability	0.828	***	2.289	0.387	***	1.473	0.222	***	1.249	0.319	***	1.375
HBP	0.325	***	1.384	0.215	***	1.239	0.202	***	1.224	0.245	***	1.278
Pain Medicine	1.582	***	4.865	0.492	***	1.635	0.579	***	1.784	0.502	***	1.653
Thresholds												
y=0	1.481	***	4.396	1.312	***	3.713	-0.472	***	0.624	0.241	***	1.273
y=1	1.915	***	6.789	1.759	***	5.806	-0.008		0.992	0.747	***	2.111
y=2	2.427	***	11.330	2.245	***	9.441	0.556	***	1.744	1.381	***	3.977
y=3	3.084	***	21.852	2.906	***	18.289	1.302	***	3.676	2.057	***	7.822
y=4	3.872	***	48.022	3.511	***	33.483	2.147	***	8.559	2.814	***	16.678
y=5	4.762	***	117.011	4.261	***	70.876	3.131	***	22.904	3.693	***	40.167
Pseudo R2	0.0796			0.0209			0.0207			0.0247		

Legend: * p<.1; ** p<.05; *** p<.01

Longer trips are associated with stronger feelings of tiredness and stress. The odds of feeling very tired and very stressful during a long trip (≥ 45 mins) are respectively 1.125 and 1.218 times greater than feeling that way during a medium-length trip ($15 \text{ mins} \leq \text{trip length} \leq 45 \text{ mins}$). Longer trips are not significantly associated with stronger feelings of pain or sadness. These results on negative emotions, along with the results on positive emotions above, illustrate the importance of examining various negative and positive emotion components separately. By examining these emotion components separately, we find that, although longer trips are less happy, they are not more meaningful. And, although longer trips are more tired and stressful, they are not more painful or sad.

Travel for discretionary purposes (e.g., eat or drink, leisure, exercise, and community) are generally associated with less negative emotions than travel for household maintenance activities. Travel for work or education purposes are generally sadder and more tired and stressful than travel for household maintenance activities. Travel with people are generally associated with less negative emotions than travel alone. An exception is that travel with other family members (excluding parents, spouse/partner, and children) is more stressful than travel alone. Workday travel is associated with higher levels of sadness, tiredness, and stress, but not pain. Unexpectedly, after controlling for trip purpose, rush-hour travel is associated with lower levels of pain and sadness and has no association with tiredness and stress.

When it comes to personal attributes, age shows interesting associations with negative emotions during trips. During trips, young adults are less likely to feel pain or sad but are more likely to feel tired and stress than middle-aged adults. Older adults are less likely to feel any negative emotions during trips than middle-aged adults. In other words, older adults in general enjoy trips more than middle-aged adults. Race and ethnic minorities (Black and/or Hispanic) in general report lower levels of negative emotions than White. Interestingly, immigrants and low-income people report both higher levels of negative and positive emotions than non-immigrants and middle-income people. These results further illustrate the importance of examining negative and positive emotions separately. In other words, having more intensive position emotions does not mean having less intensive negative emotions. During trips, immigrants and low-income people tend to experience more intensive emotions regardless of positive or negative ones. People who live with spouse tend to report lower levels of negative emotions and people who live with children tend to report higher levels negative emotions. People with health disadvantages in general report higher levels of pain, sadness, fatigue, and stress than people with health advantages. Central city residence shows no association with negative emotions during trips.

PREDICTED PROBABILITIES

The odds ratio estimates are relatively difficult to explain. To ease interpretation and explain the positive emotions and negative emotions clearly, we predict the probabilities of being in the highest level of positive emotions (happy, meaningful) and negative emotions (pain, sad, tired and stress) by travel mode, purpose and companionship using the estimated models. All the predictions are made by holding control variables at their typical values (i.e., modal values). The typical trip in our dataset is a household maintenance trip shorter than 15 mins made by a typical person. The trip is a drive alone trip during non-rush hours in a workday. The typical person is a healthy white male who lives with spouse or unmarried partner and without children; he has a

family income from $25,000 to $75,000 and lives in the suburbs of a metropolitan area. Figure 1a-c shows the prediction results on positive emotions.

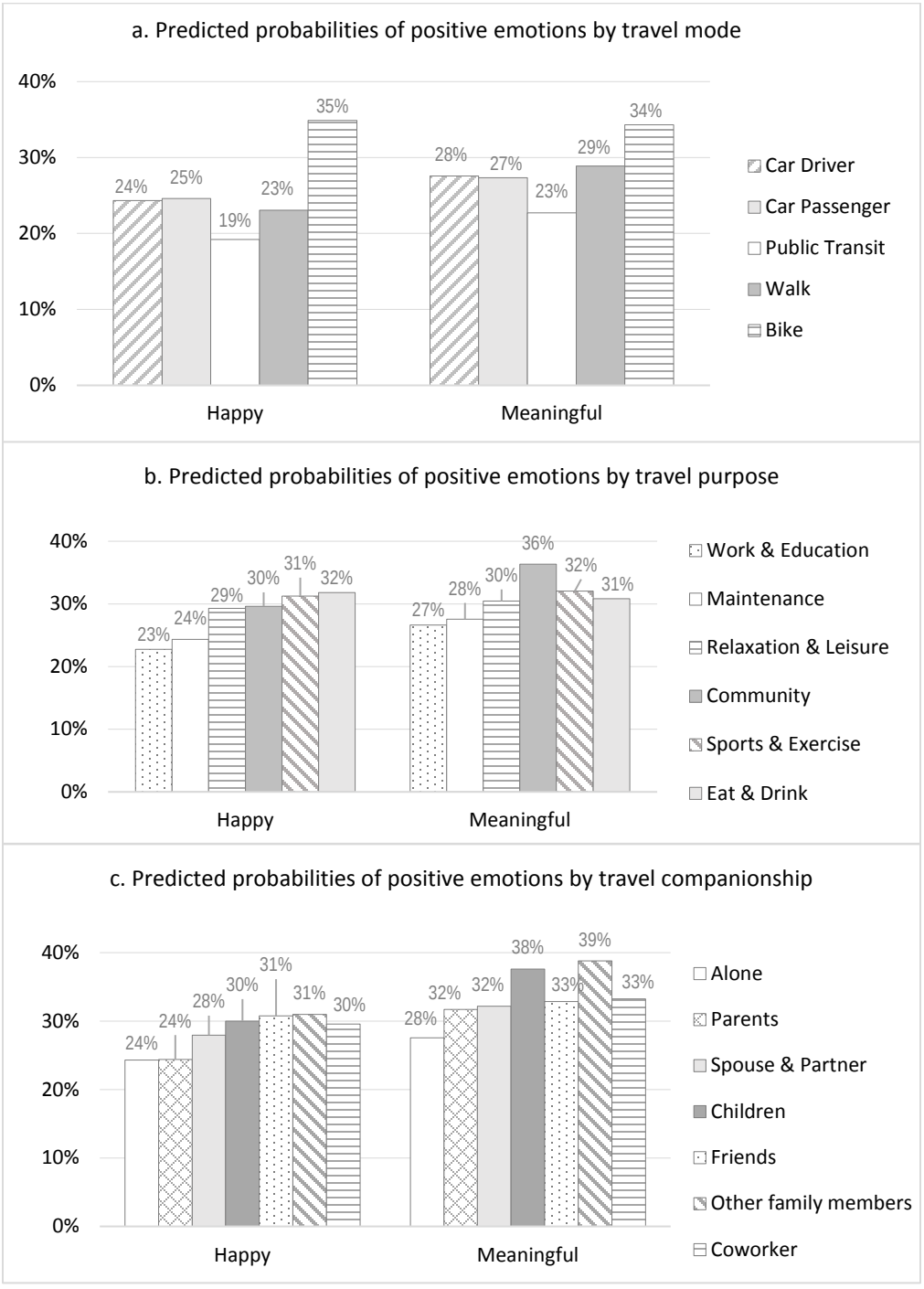

Figure 1a-c Predicted probabilities of feeling the highest levels of positive emotions (outcome value=6) by travel mode, travel purpose and travel companionship

Figure 1a shows the predicted probability of being very happy and very meaningful during travel across trip modes when hold all other variables (except the trip mode variables) at their modal values. For a typical person, his likelihood of being very happy during a biking trip is about 35%. This likelihood drops to 24% when he drives a car for the same trip (i.e., same trip characteristics except mode), and 19% when he takes transit. The typical person's likelihood of being very meaningful during car driving trip is 28%, but this likelihood drops to 23% when he takes transit. Figure 1a also shows a difference in meaningfulness between biking (34%) and car driving (28%), but this difference is not shown as statistically significant in the model results in Table 3. To avoid inconsistency, we avoid discussing statistically insignificant differences in the following text.

Figure 1b shows that the typical person (middle-income, healthy white male) has a likelihood of 29-32% feeling very happy during a trip of discretionary purposes. The likelihood of feeling very happy drops to 23-24% during a trip of work/education or household maintenance purposes. The likelihood of feeling very meaningful is highest during a trip for the purpose of spiritual/volunteering activities, which is 36%. This likelihood drops to 30-32% for trips of other discretionary purposes. The likelihood of feeling very meaningful is 27-28% for the trips of work/education and household maintenance purposes.

Figure 1c shows that the typical person has a likelihood of 28-31% feeling very happy when traveling with family members (except parents) and friends/coworkers. This likelihood drops to 24% when traveling alone or traveling with parents. The typical person has a likelihood of 38-39% feeling very meaningful when travelling with children and other family members (i.e., family members other than parents, spouse/partner, and children). This likelihood drops to 32-33% when traveling with parents, spouse/partner, friends, and coworkers, and the likelihood is lowest at 28% when traveling alone.

Figure 2a-c shows the predicted probabilities of feeling very pain, sad, tired and stressful during travel across mode, purpose, and companionship categories. Indicated by higher likelihood values in Figure 2a-c, fatigue and stress are more relevant negative emotions than pain and sadness. When compared across modes, public transit is associated with the highest likelihood of tiredness at 4.58%; walking for transportation is associated with the highest likelihood of sadness (1.6%), stress (3.05%), and pain (1.23%). Note that although bike is shown as the most painful in Figure 2a, the difference between bike and car driving is insignificant in Table 4.

When comparing across trip purposes, work/education trips have the highest likelihood of all four negative emotions, followed by household maintenance trips. Trips for sports/exercise activities have the lowest likelihood of sadness (0.82%) and stress (1.45%), and trips for leisure/relaxation activities have the lowest likelihood of pain (0.67%) and tiredness (3.26%).

Fewer differences in negative emotions across companionship categories are statistically significant. Of the statistically significant results, traveling with children is associated with the least pain (0.71%) and sadness (0.91%). Traveling with parents is associated with the least stress (1.71%) and traveling with spouse/partner (3.30%) is associated with the least fatigue.

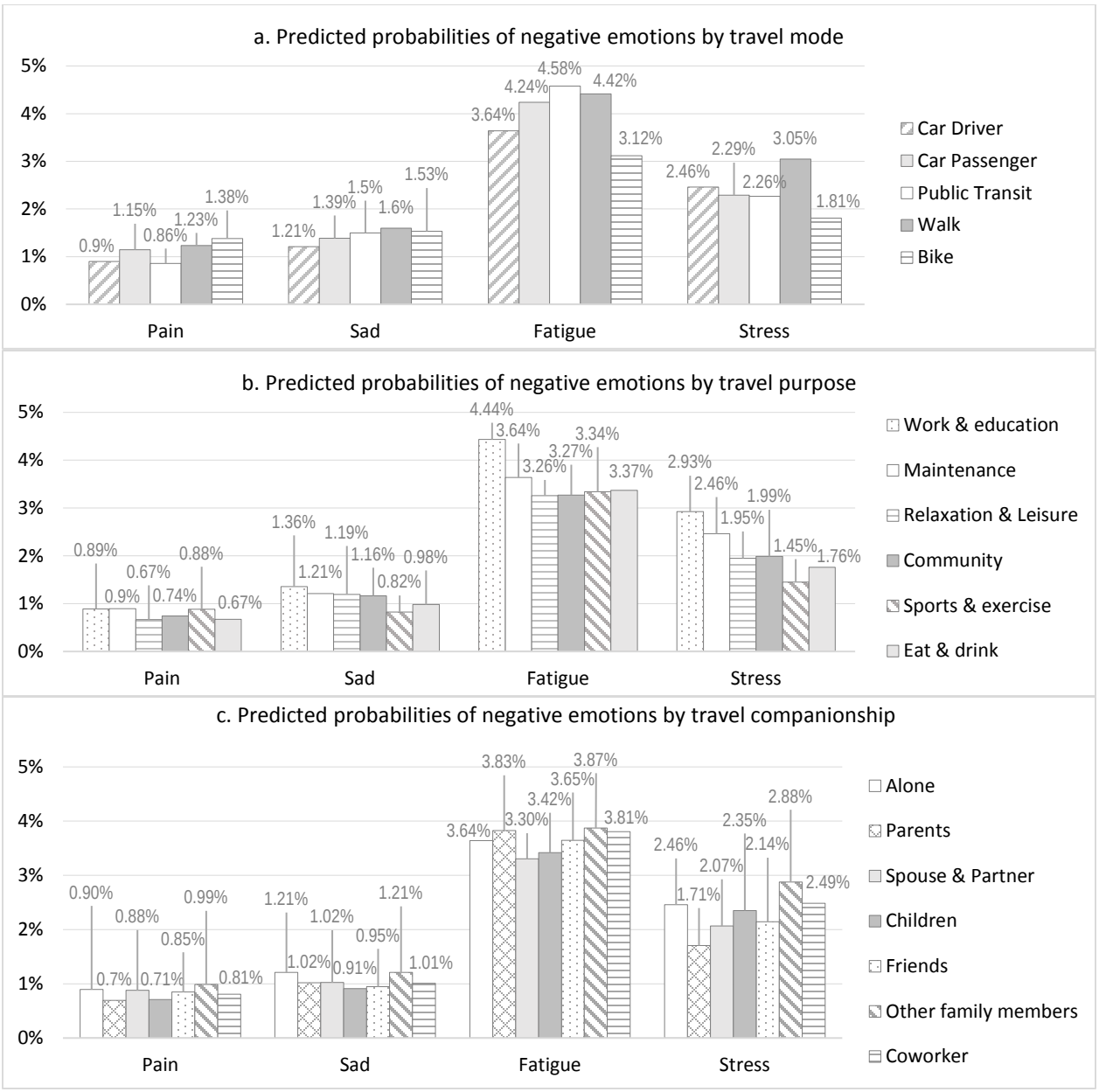

Figure 2a-c Predicted probabilities of feeling highest levels of negative emotions (outcome values=6) by travel mode, purpose and companionship

CONCLUSIONS AND DISCUSSION

Many existing studies have examined how travel mode and duration connect to various emotional well-being measures (Abou-Zeid & Ben-Akiva, 2011; Bergstad et al., 2011; Choi et al., 2013; Cœugnet et al., 2013; De Vos et al., 2015a; De Vos et al., 2015b; Deffenbacher, 2001; Eriksson et al., 2013; Ettema et al., 2011; Ettema et al., 2012; Morris & Guerra, 2015a; Morris & Guerra, 2015b; Novaco et al., 1979; Olsson et al., 2013; Páez & Whalen, 2010; Raggatt & Morrissey, 1997). However, none of the existing studies investigated these connections in the contexts of both travel purpose and companionship. Further, most studies used composite indices

of emotional well-being and only one study (Morris & Guerra, 2015a) examined specific positive and negative emotion components separately, including happy, pain, sad, fatigue, and stress. Using 2012-2013 ATUS data, this study offers a comprehensive assessment of how various travel behavior characteristics (mode, duration, purpose, and companionship) relates to two specific positive emotions and four specific negative emotions after controlling for personal socio-demographic and health conditions.

Our analyses yield interesting results. Compared to car driving, being a car passenger is not associated with any positive emotions after controlling for travel companionship but is associated with negative emotions of pain, sadness, and tired. This finding is partly consistent with Morris & Guerra (2015a) which finds that being a car passenger is not associated with greater emotional well-being (measured by a total affect score) than car driving after controlling for human interaction during the trip. The result indicates that travel companionship has a stronger relationship with emotions during a car trip than whether the person is a driver or passenger during the trip. More importantly, our results on travel companionship and emotions provide additional insights that travel-related emotions are not only sensitive to whether or not you travel with someone but also sensitive to whom you travel with. Happiness has the strongest relationship with traveling with other family members (other than parents, children, and spouse/partner) and/or friends; meaningfulness has the strongest relationship with traveling with children and/or other family members. For negative emotions, traveling with parents is the least stressful, traveling with children is the least sad and painful, and traveling with spouse/partner is the least tired.

The result that public transit is the least happy mode is consistent with prior research (De Vos et al. 2015a; De Vos et al. 2015b; Ettema et al. 2011; Morris & Guerra 2015a). We also find that public transit trips are reported as the least meaningful and most tired trips. There is no significant association between public transit and stress, which is inconsistent with prior studies on waiting time perceptions associated with public transit trips (Fan et al. 2016). Biking is shown to the happiest of all the modes examined in the study and is not significantly associated with any of the four negative emotions. This result is consistent with prior evidence that biking is generally associated with greater happiness and emotional well-being (Olsson et al. 2013; De Vos et al. 2015a; Abou-Zeid & Ben-Akiva 2011; Morris & Guerra 2015a).

The results have important policy implications. Public transit is an important mode of transportation for people who cannot afford cars in the United States, which addresses poverty, unemployment, and equal opportunity goals (Fan et al., 2012). It is also widely accepted that public transit has the potential of reducing traffic congestion and confronting environmental challenges (Chester et al., 2013). Given the equity and environmental benefits of public transit, it is a cause for concern that public transit in the U.S. is generally associated with low happiness, low meaningfulness, and high fatigue. Future research should examine how public transit infrastructure and services can be improved to make transit trips happier, more meaningful, and less tiresome. Without making transit travel experiences more emotionally pleasant, it would be difficult to encourage people to use public transit just for the sake of equity and environmental benefits.

Biking is found to be the happiest mode in this study. Yet, the U.S. has had one of the lowest biking mode share among developed counties (Buehler & Pucher, 2012). Pucher et al. (2011) found evidence of bicycling renaissance in the U.S.: the bike share of total trips in the U.S. had increased from 0.6% to 1% between 1977 and 2009. Specifically, cycling rates have increased much faster in large cities than in the country as a whole. Among the 50 largest cities in the U.S. and according to the 2010-2014 5-year American Community Survey data, Portland has the highest bike share in work commute (6.28%), followed by Minneapolis (3.90%), Washington D.C. (3.88%), and San Francisco (3.70%). Existing evidence suggests that even car-dependent American cities can greatly increase biking by implementing infrastructure and programs to promote biking (Pucher et al., 2011). Biking has the potential of becoming a very important transportation mode in the U.S. that positively contributes to people's happiness and well-being. Infrastructure and program efforts for promoting biking may include expanded and improved bike lanes and paths, traffic calming, parking, bike-transit integration, bike sharing, training programs, and promotional events (Pucher et al., 2011).

The findings that emotional experiences during travel significantly relate to travel duration, travel purpose, and travel companionship suggest that travel-related emotional well-being can be shaped by land use policy and urban design strategies. Compact land development patterns and mixed land uses have been found to shorten trip length (Fan & Khattak, 2008; Ewing & Cervero, 2001), encourage trips for leisure and recreation activities (Frank & Engelke, 2001; Krizek & Waddell, 2002), and promote out-of-home joint activity engagement with family and friends (Fan & Khattak, 2009; Fan, 2010). By establishing the connections between travel duration, purpose, and companionship with emotional experiences, findings from this research suggest that compact land development patterns and mixed land uses may indirectly evoke positive emotions and reduce negative emotions by creating a built environment conducive to shorter trips, more discretionary trips, and more joint trips with family and friends.

Finally, specific positive and negative emotions are found to have differing relationships with travel behavior characteristics and personal attributes, which highlights the importance of examining specific emotions separately as opposed to a total composite well-being score. For example, of the four negative emotions, transit is only significantly associated with fatigue and has no associations with pain, sadness, and stress. Travel duration is associated with fatigue and stress, but not pain or sadness. Biking is associated with happiness but not meaningfulness. Shorter travel (<15 mins) is associated with lower meaningfulness but shows no association with happiness. The differences across positive and negative emotions point to future research needs. Future research is recommended to examine the underlying mechanisms though which travel behavior attributes affect each specific emotion. It is likely that different travel behavior and personal attributes contribute to emotional well-being via distinct processes and mechanisms. There is a need for more contextualized, grounded qualitative research to explore specific mechanisms associated with specific emotions and how these mechanisms are sensitive to travel behavior and personal contexts.

REFERENCES

Abou-Zeid, M., & Ben-Akiva, M. (2011). The effect of social comparisons on commute well-being. Transportation Research Part A: Policy and Practice, 45(4), 345-361.

Abou-Zeid, M., Witter, R., Bierlaire, M., Kaufmann, V., & Ben-Akiva, M. (2012). Happiness and travel mode switching: findings from a Swiss public transportation experiment. Transport Policy, 19(1), 93-104.

Achat, H., Kawachi, I., Spiro, A., Demolles, D. A., & Sparrow, D. (2000). Optimism and depression as predictors of physical and mental health functioning: The normative aging study. Annals of Behavioral Medicine, 22(2), 127-130.

Bergstad, C. J., Gamble, A., Gärling, T., Hagman, O., Polk, M., Ettema, D., Olsson, L. E. (2011). Subjective well-being related to satisfaction with daily travel. Transportation, 38(1), 1-15.

Buehler, R., & Pucher, J. (2012). International Overview: Cycling Trends in Western Europe, North America, and Australia. City cycling, 9-29.

Chester, M., Pincetl, S., Elizabeth, Z., Eisenstein, W., & Matute, J. (2013). Infrastructure and automobile shifts: positioning transit to reduce life-cycle environmental impacts for urban sustainability goals. Environmental Research Letters, 8(1), 015041.

Chng, S., White, M., Abraham, C., & Skippon, S. (2016). Commuting and wellbeing in London: The roles of commute mode and local public transport connectivity. Preventive medicine, 88, 182-188.

Choi, J., Coughlin, J., & D'ambrosio, L. (2013). Travel Time and Subjective Well-Being. Transportation Research Record: Journal of the Transportation Research Board, 2357, 100-108.

Cœugnet, S., Naveteur, J., Antoine, P., & Anceaux, F. (2013). Time pressure and driving: Work, emotions and risks. Transportation Research Part F: Traffic Psychology and Behaviour, 20, 39-51.

Cohn, M. A., Fredrickson, B. L., Brown, S. L., Mikels, J. A., & Conway, A. M. (2009). Happiness unpacked: Positive emotions increase life satisfaction by building resilience. Emotion, 9(3), 361-368.

Danner, D. D., Snowdon, D. A., & Friesen, W. V. (2001). Positive emotions in early life and longevity: Findings from the nun study. Journal of Personality and Social Psychology, 80(5), 804-813.

De Vos, J., Mokhtarian, P. L., Schwanen, T., Acker, V. V., & Witlox, F. (2015a). Travel mode choice and travel satisfaction: Bridging the gap between decision utility and experienced utility. Transportation. 1-26

De Vos, J., Schwanen, T., Acker, V. V., & Witlox, F. (2013). Travel and Subjective Well-Being: A Focus on Findings, Methods and Future Research Needs. Transport Reviews, 33(4), 421-442.

De Vos, J., Schwanen, T., Acker, V. V., & Witlox, F. (2015b). How satisfying is the Scale for Travel Satisfaction? Transportation Research Part F: Traffic Psychology and Behaviour, 29, 121-130.

Deffenbacher, J. L., Lynch, R. S., Oetting, E. R., & Yingling, D. A. (2001). Driving anger: Correlates and a test of state-trait theory. Personality and Individual Differences, 31(8), 1321-1331. doi:10.1016/s0191-8869(00)00226-9

Diener, E., & Chan, M. Y. (2011). Happy People Live Longer: Subjective Well-Being Contributes to Health and Longevity. Applied Psychology: Health and Well-Being, 3(1), 1-43.

Diener, Ed (1984). "Subjective well-being". Psychological Bulletin 95 (3): 542–575.

Dolnicar, S. Lazarevski, K. Yanamandram, V.(2012) Quality-of-Life and Travel Motivations: Integrating the Two Concepts in the Grevillea Model. In B. B. Uysal, M. Perdue, R. R, Sirgy, M. J.(Ed.) Hand Book of Tourism and Quality of Life Research (pp. 293-308). retrieved from http://link.springer.com/chapter/10.1007/978-94-007-2288-0_17

Dukes, R. L., Clayton, S. L., Jenkins, L. T., Miller, T. L., & Rodgers, S. E. (2001). Effects of aggressive driving and driver characteristics on road rage. The Social Science Journal, 38(2), 323-331.

Eriksson, L., Friman, M., & Gärling, T. (2013). Perceived attributes of bus and car mediating satisfaction with the work commute. Transportation Research Part A: Policy and Practice, 47, 87-96.

Ettema, D. Friman, M. Gärling T. & Olsson, E. L. (2015) Travel Mode Use, Travel Mode Shift and Subjective Well-Being: Overview of Theories, Empirical Findings and Policy Implications. In B.B. Wang, D., & He, S. (Eds.). Mobility, sociability and well-being of urban living (pp.129-150). Retrieved from http://link.springer.com/chapter/10.1007/978-3-662-48184-4_7?no-access=true

Ettema, D., Friman, M., Gärling, T., Olsson, L. E., & Fujii, S. (2012). How in-vehicle activities affect work commuters' satisfaction with public transport. Journal of Transport Geography, 24, 215-222.

Ettema, D., Gärling, T., Eriksson, L., Friman, M., Olsson, L. E., & Fujii, S. (2011). Satisfaction with travel and subjective well-being: Development and test of a measurement tool. Transportation Research Part F: Traffic Psychology and Behaviour, 14(3), 167-175.

Ettema, D., Gärling, T., Olsson, L. E., & Friman, M. (2010). Out-of-home activities, daily travel, and subjective well-being. Transportation Research Part A: Policy and Practice, 44(9), 723-732.

Ettema, D., Gärling, T., Olsson, L. E., Friman, M., & Moerdijk, S. (2013). The road to happiness: Measuring Dutch car drivers' satisfaction with travel. Transport Policy, 27, 171-178.

Ewing, R., & Cervero, R. (2001). Travel and the built environment: a synthesis. Transportation Research Record: Journal of the Transportation Research Board, (1780), 87-114.

Fan, Y. (2010). Urban form and family-engaged active leisure: impact assessment using census data and night-time satellite images. Geocarto International, 25(6), 453-470.

Fan, Y., & Khattak, A. (2008). Urban form, individual spatial footprints, and travel: Examination of space-use behavior. Transportation Research Record: Journal of the Transportation Research Board, (2082), 98-106.

Fan, Y., & Khattak, A. J. (2009). Does urban form matter in solo and joint activity engagement?. Landscape and urban planning, 92(3), 199-209.

Fan, Y., Guthrie, A. E., & Levinson, D. M. (2012). Impact of light rail implementation on labor market accessibility: A transportation equity perspective. Journal of Transport and Land Use, 5(3).

Fan, Y., Guthrie, A., & Levinson, D. (2016). Waiting time perceptions at transit stops and stations: Effects of basic amenities, gender, and security. Transportation Research Part A: Policy and Practice, 88, 251-264.

Flower, D. J., Irvine, D., & Folkard, S. (2003). Perception and predictability of travel fatigue after long-haul flights: a retrospective study. Aviation, space, and environmental medicine, 74(2), 173-179.

Frank, L. D., & Engelke, P. O. (2001). The built environment and human activity patterns: exploring the impacts of urban form on public health. Journal of Planning Literature, 16(2), 202-218.

Fredrickson, B. L., & Joiner, T. (2002). Positive Emotions Trigger Upward Spirals Toward Emotional Well-Being. Psychological Science, 13(2), 172-175.

Gärling, T., Ettema, D., Friman, M., & Olsson, L. (2013). How Daily Travel Influences Emotional Well-Being. In paper presented at the 2nd national conference on transport research, Göteborg, Sweden, 22-23 October.

Hennessy, D. A. (2008). The Impact of Commuter Stress on Workplace Aggression. Journal of Applied Social Psychology, 38(9), 2315-2335.

Jeon, M., Walker, B. N., & Yim, J. (2014). Effects of specific emotions on subjective judgment, driving performance, and perceived workload. Transportation Research Part F: Traffic Psychology and Behaviour, 24, 197-209.

Kahneman, D., & Deaton, A. (2010). High income improves evaluation of life but not emotional well-being. Proceedings of the National Academy of Sciences, 107(38), 16489-16493.

Krizek, K., & Waddell, P. (2002). Analysis of lifestyle choices: Neighborhood type, travel patterns, and activity participation. Transportation Research Record: Journal of the Transportation Research Board, (1807), 119-128.

Lawrence, E. M., Rogers, R. G., & Wadsworth, T. (2015). Happiness and longevity in the United States. Social Science & Medicine, 145, 115-119.

Lyubomirsky, S., King, L., & Diener, E. (2005). The Benefits of Frequent Positive Affect: Does Happiness Lead to Success? Psychological Bulletin, 131(6), 803-855.

Mclinton, S. S., & Dollard, M. F. (2010). Work stress and driving anger in Japan. Accident Analysis & Prevention, 42(1), 174-181.

Millonig, A., Sleszynski, M., & Ulm, M. (2012, September). Sitting, waiting, wishing: Waiting time perception in public transport. In 2012 15th International IEEE Conference on Intelligent Transportation Systems (pp. 1852-1857). IEEE.

Minnesota Population Center. National Historical Geographic Information System: Version 2.0. Minneapolis, MN: University of Minnesota 2011.

Morris, E. A., & Guerra, E. (2015a). Mood and mode: Does how we travel affect how we feel? Transportation, 42(1), 25-43.

Morris, E. A., & Guerra, E. (2015b). Are we there yet? Trip duration and mood during travel. Transportation Research Part F: Traffic Psychology and Behaviour, 33, 38-47.

Morris, E. A., & Hirsch, J. A. (2016). Does rush hour see a rush of emotions? Driver mood in conditions likely to exhibit congestion. Travel behaviour and society, 5, 5-13.

Nass, C., Jonsson, I. M., Harris, H., Reaves, B., Endo, J., Brave, S., & Takayama, L. (2005, April). Improving automotive safety by pairing driver emotion and car voice emotion. In CHI'05 Extended Abstracts on Human Factors in Computing Systems (pp. 1973-1976). ACM.

Novaco, R. W., Stokols, D., Campbell, J., & Stokols, J. (1979). Transportation, stress, and community psychology. American Journal of Community Psychology, 7(4), 361-380.

Olsson, L. E., Gärling, T., Ettema, D., Friman, M., & Fujii, S. (2013). Happiness and Satisfaction with Work Commute. Social Indicators Research, 111(1), 255-263.

Páez, A., & Whalen, K. (2010). Enjoyment of commute: a comparison of different transportation modes. Transportation Research Part A: Policy and Practice, 44(7), 537-549.

Pucher, J., Buehler, R., & Seinen, M. (2011). Bicycling renaissance in North America? An update and re-appraisal of cycling trends and policies. Transportation research part A: policy and practice, 45(6), 451-475.

Pucher, J., Buehler, R., & Seinen, M. (2011). Bicycling renaissance in North America? An update and re-appraisal of cycling trends and policies. Transportation research part A: policy and practice, 45(6), 451-475.

Raggatt, P. T., & Morrissey, S. A. (1997). A field study of stress and fatigue in long-distance bus drivers. Behavioral medicine, 23(3), 122-129.

Reilly, T., Waterhouse, J., & Edwards, B. (2005). Jet lag and air travel: implications for performance. Clinics in sports medicine, 24(2), 367-380.

Sabatini, F. (2014). The relationship between happiness and health: Evidence from Italy. Social Science & Medicine, 114, 178-187.

Samuels, C. H. (2012). Jet lag and travel fatigue: a comprehensive management plan for sport medicine physicians and high-performance support teams. Clinical Journal of Sport Medicine, 22(3), 268-273.

Sirgy, M. J. (2009). Toward a Quality-of-Life Theory of Leisure Travel Satisfaction. Journal of Travel Research, 49(2), 246-260.

Song, Y., Gee, G. C., Fan, Y., & Takeuchi, D. T. (2007). Do physical neighborhood characteristics matter in predicting traffic stress and health outcomes? Transportation Research Part F: Traffic Psychology and Behaviour, 10(2), 164-176.

Summala, H., & Mikkola, T. (1994). Fatal accidents among car and truck drivers: effects of fatigue, age, and alcohol consumption. Human Factors: The Journal of the Human Factors and Ergonomics Society, 36(2), 315-326.

Wang, Y., Mcguire, F. A., & Zhou, B. (2011). The influence of travel experience on mature travelers' quality of life. International Journal of Information Systems in The Service Sector, 3(1), 52-64.

Wells-Parker, E., Ceminsky, J., Hallberg, V., Snow, R. W., Dunaway, G., Guiling, S., Anderson, B. (2002). An exploratory study of the relationship between road rage and crash experience in a representative sample of US drivers. Accident Analysis & Prevention, 34(3), 271-278.

Wener, R. E., & Evans, G. W. (2011). Comparing stress of car and train commuters. Transportation Research Part F: Traffic Psychology and Behaviour, 14(2), 111-116.

Wener, R. E., Evans, G. W., Phillips, D., & Nadler, N. (2003). Running for the 7: 45: The effects of public transit improvements on commuter stress. Transportation, 30(2), 203-220.

Xiong, Y., & Zhang, J. (2014). Applying a Life-oriented Approach to Evaluate the Relationship between Residential and Travel Behavior and Quality of Life based on an Exhaustive CHAID Approach. Procedia - Social and Behavioral Sciences, 138, 649-659.

Zhang, T., & Chan, A. H. (2014). How appraisals shape driver emotions: A study from discrete and dimensional emotion perspectives. Transportation Research Part F: Traffic Psychology and Behaviour, 27, 112-123.