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What makes travel pleasant and/or tiring? An investigation based on the French National Travel Survey

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Abstract The 2007–2008 French National Travel Survey (FNTS) included questions about the trip experience for a random subsample of the respondents' daily travel, offering a rare opportunity to examine a national profile of attitudes toward travel. This study analyzes the self-reported (mental and/or physical) fatigue associated with the selected trip, and its (un)pleasantness. Only 8 % of trips were tiring, and fewer than 4 % were unpleasant, indicating that travel is by no means universally distasteful. We present a bivariate probit model of the mental and physical fatigue associated with the trip, and binary logit models of whether the trip was pleasant (yes/no) or unpleasant (yes/no). For the most part, socioeconomic variables and indicators of trip length, distance, purpose, and mode have logical relationships to fatigue and pleasantness. However, 11 variables out of 31 common to both sets of models have impacts on fatigue that are opposite to those on un/pleasantness, pointing to conditions under which a trip can be fatiguing but pleasant, or

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conversely. Accordingly, a key contribution of the research is to demonstrate the value of jointly considering both constructs in order to more comprehensively capture the overall attitudes toward the travelling activity. It is also of interest that activities conducted during the trip appear in both sets of models. In particular, the results *suggest* that although listening to the radio/music decreases the tendency to rate the trip as mentally fatiguing, it tends to be seen as ameliorating the disutility of a tedious trip more than increasing the pleasantness of the trip. Among the policy-relevant findings, we note the especially negative attitudes towards multimodal trips and trips mainly involving driving cars.

Keywords Positive utility of travel · Travel multitasking · Stress · Bivariate probit model · Binary logit model

Introduction

It is by now a cliché that "travel is a derived demand", signifying the prevailing view among transportation economists and engineers that travel is a disutility, to be endured only for the necessity of getting from one place to another, but to be minimized with respect to time, cost, or some combination of the two. In recent years, however, a number of scholars have begun to view daily travel in a different light, focusing on the experiential nature of the journey itself, beyond the purely utilitarian outcome of conveyance from A to B.[1] As reviewed in the next section, this focus has taken a number of different forms, but they have in common an interest in the trip as an activity in its own right, not merely as ancillary to conducting other activities.

Most of the growing number of empirical studies addressing this theme have used special-purpose surveys administered to small and localized (and sometimes "convenience") samples. Although such studies are undeniably valuable, they may be subject both to non-response biases (those with more extreme attitudes toward travel may be more inclined to take the survey) and to response biases (those who do take the survey may be drawn, consciously or subconsciously, to give the answers that they deduce the researchers are hoping to see). By contrast, the data analyzed in the present paper are obtained from a general-purpose travel survey administered to a large and, most importantly, nationally-representative (after weighting) sample—namely, the 2007–2008 French National Travel Survey (FNTS) (in French, the *Enquête Nationale Transports et Déplacements*, ENTD). As such, they offer a rare opportunity to examine a national profile of attitudes toward travel.

Using the same dataset, a companion paper (Papon 2012) develops and analyzes a $3 \times 2 \times 2 = 12$-category typology of trips based on three dimensions: (1) the degree to which the destination is primary (with options (a) trip purpose is "promenade without precise destination", (b) destination primary—"the only important thing in this trip was to go from one place to another", for trips that are not promenades, and (c) intermediate between the two extremes); (2) whether any activities were performed during the trip (yes or no); and (3) whether or not the trip involved "sensation" from any of several sources (feelings during the trip, incidents occurring, (un)pleasantness, or fatigue). As can be seen, multiple questions in the survey are used to define the various categories. The present

[1] Of course, in some contexts, notably those of holiday travel or journeys of self-discovery, such a perspective is not at all new. The novelty of the development described here lies in the application of some of those same principles to the ordinary travel of everyday life.

paper focuses on two of those questions to obtain the dependent variables of interest in this study: MUFATIGUE (whether or not the trip was physically tiring, mentally tiring, or both) and MUSENSATION (whether the trip was pleasant, unpleasant, or neither).

The general purpose of this paper, then, is to better understand: what kinds of trips are found pleasant, by what kinds of people, and similarly for finding travel tiring? The answers may, for example, point to ways of making travel more enjoyable and/or less stressful, or they may suggest distributional inequities that could be addressed. In any event, they will add to our appreciation for how individuals perceive the journey itself. And since individuals' positive or negative affect for the journey can influence their later travel choices (regarding frequency, mode, length, and other variables), this knowledge will ultimately improve our understanding of travel-related choices.

The remainder of this paper is organized as follows. In the next section we briefly review some previous studies of the stress of traveling, together with the burgeoning literature on positive attitudes toward travel, to inform the hypotheses to be tested by the present research. The third section describes the empirical context of the present study, including an overview of the data collection and some descriptive statistics for key variables. The fourth section presents two sets of models for the dependent variables of interest: a bivariate probit model of the physical and mental fatigue associated with the trip, and binary logit models of whether the trip was reported to be pleasant or not, and unpleasant or not. The fifth section offers some concluding remarks.

Review of selected relevant literature and subsequent study hypotheses

The idea that travel can be physically and/or mentally tiring is obviously not a new one—to the contrary, much has been written on the hardships of travel, from the pedestrian movements of earliest times to air travel in the post-September-11 era of today. In addition to the very-much-ahead-of-its-time study conducted by Horowitz (1981), one set of literature that is pertinent to our present focus on daily travel is the research on the stress of commuting. Investigations in this area date back at least to the 1970s (Stokols et al. 1978). Collectively, studies have found that greater commuting stress is associated with longer, more congested, and/or more unpredictable commutes, with driving more than with riding transit, with less control over the in-vehicle environment, and with being female (Evans et al. 2002; Gatersleben and Uzzell 2007; Gottholmseder et al. 2009; Novaco and Collier 1994; Roberts et al. 2011; Sandow and Westin 2010; Wener and Evans 2011), although at least one study found no influence of gender (Lucas and Heady 2002). Research has also shown that commuting stress has negative spillover effects into the home (Novaco et al. 1991) and work (Wener et al. 2005) realms of life.

This first group of relevant papers can assist us in formulating some hypotheses that we plan to test with our data. Even if the endogenous variables of most of these studies are labeled as "stress", their operational definitions vary. Sometimes a direct rating question is asked, such as "how do you feel…", with possible answers "very stressed" to "very relaxed" (Gottholmseder et al. 2009). In others, stress is a latent variable, associated with a number of items such as satisfaction, aversiveness (to traffic), need to relax, negative effects on home life (Novaco and Collier 1994) and even a measure of salivary cortisol levels (Wener and Evans 2011). Either of our two endogenous variables, travel (un)pleasantness and tiredness, could be related to stress by one or another of these definitions. Therefore, we test the hypotheses that both our endogenous variables are positively related with the following individual characteristics: being of working age, having attended higher education, belonging to more active social categories (as proxies for work effects, with the opposite direction of causation compared to Wener et al. 2005) and being female. Previous research suggests also that such variables might be positively correlated with the following trip-related characteristics: work-related and compulsory trips, travel, walk and wait time, traveling during peak hours, use of public transit means. These offer additional hypotheses that we plan to test.

On the other hand, over the past 15 years (Salomon and Mokhtarian 1998) there has been a growing appreciation that travel is not *automatically* stressful—that in fact it can be downright enjoyable. Mokhtarian and Salomon (2001) point out that a positive utility for travel can arise both from activities conducted while traveling and from the enjoyment of the trip itself (and that these two sources are easily confounded), apart from the instrumental value of reaching a desired destination. Recent studies have used a variety of measures to assess how the trip (or the travel) itself is evaluated by the traveler, including travel liking (Ory and Mokhtarian 2005); whether the individual wants to increase or decrease travel of that kind (Choo et al. 2005; Páez and Whalen 2010); the subjective value of the time spent traveling, from wasted or lost to very worthwhile or well-spent (Lyons et al. 2007; Gottholmseder et al. 2009; Gripsrud and Hjorthol 2012; Susilo et al. 2012; Lin 2012); latent variables representing "specific trip (dis)utility", based on subjective indicators of physical or mental conditions (Diana 2005); a "primary utility of travel" construct (Diana 2008); a stressed—relaxed ordinal scale (Gottholmseder et al. 2009) or separate measures of stress and ease or enjoyment (Abou-Zeid et al. 2012; LaJeunesse and Rodriguez 2012); a newly-developed "satisfaction with travel scale" (Ettema et al. 2011; Friman et al. 2013) as well as a single-item measure of satisfaction with the commute (Abou-Zeid et al. 2012); and whether riding transit is "a better use of time and/or money than driving" (Frei and Mahmassani 2011).

Additional recent studies point to the role of travel in improving (or degrading) one's subjective well-being, quality of life, and/or happiness (Stutzer and Frey 2008; Olsson et al. 2013; Archer et al. 2013). Although this relationship can occur because of the *instrumental* role of travel in providing access to life-improving opportunities (health care, social and cultural activities, and so on), several scholars also point to the value of travel *itself* in contributing to subjective well-being (e.g. Ettema et al. 2010; Bergstad et al. 2011; Russell 2012). On the other hand, Morris and Guerra (2014) found that one's mood when traveling seems no worse than on average, and in general that travel has relatively little impact on mood per se.

This second stream of studies suggested to us an additional set of hypotheses to be tested. As with stress, both our endogenous variables (travel unpleasantness and tiredness) can be seen as (negatively) associated with the travel liking construct. On the basis of the travel liking models developed so far, we additionally postulate that trip unpleasantness or tiredness are positively correlated with finding travel time longer than expected and the presence of physical constraints or health problems. The potential impact on our endogenous variables of activities conducted while traveling is ambiguous: although some activities may generally be expected to increase the pleasantness or diminish the unpleasantness of the trip, or to reduce the perceived fatigue of the trip, it is also easy to imagine circumstances under which they may have the opposite effect.

In sum, the present study is comfortably situated within a broad range of research on how travel is experienced, both as a target (dependent) variable of interest, and as an explanatory variable for other outcomes of interest. Our immediate focus is on the experience of travel (specifically, whether tiring and/or pleasant) as dependent variable. While the studies reviewed above usually focus on particular trip categories (for example commute trips, trips by public transport and especially by train, or trips performed by particular groups of individuals such as university students and workers), the empirical context of this study (described in the next section) is much more general. This is due not only to the consideration of a sample of individuals that is representative of a whole nation, as mentioned in the introduction, but also to the fact of studying all kinds of trips (by mode, purpose, etc.).

We further test a large set of exogenous variables in our models, allowing for a more complete picture and for new insights to advance the state of the art in this research area. Beyond the above mentioned hypotheses that are derived from the state of the art, the FNTS dataset allowed us to consider also other factors that have seldom or never been related to travel pleasantness and/or tiredness in previous research. We therefore test whether living with others, and in particular being a single parent, makes the trip more unpleasant and tiring, since stricter scheduling constraints are expected. On the other hand, traveling with others, therefore with opportunities for social interactions, is assumed to act in the opposite direction. Crowding is a presumably negative element that we are also going to assess. Other "background effects" that we will consider include liking the travel means used for the trip (postulated to decrease the trip unpleasantness and tiredness) and the fact of living in suburban or rural environments, where congestion is likely to be a less serious problem and therefore making trips less tiring and unpleasant. Finally, we would like to take a look at the whole trip chain and hypothesize that trip-related tiredness would increase when the number of trips previously made during the day is larger.

The range of hypotheses that we would like to test with our models is quite broad, yet additional factors that are not available in our dataset might also have an influence on our dependent variables. For example, the abovementioned research dealing with the satisfaction with travel scale shows the influence of contextual factors such as mood and satisfaction with life. Attitudes, preferences, opinions, expectations, past satisfaction, and adaptation towards various trip attributes versus the actual characteristics of the trip would probably also play a role. Mobility habits have a deep effect on travel choices as shown by a consistent body of research, and would probably influence our dependent variables as well. Finally, trip-related variables that are introduced in the next section are only partly covering aspects such as comfort or the overall quality of the journey.

Empirical context

The survey and sample

The French National Travel Survey (FNTS) is conducted about once a decade. The 2007–2008 administration was conducted in six waves spanning 12 months, to control for seasonal variations in travel (for more detail than can be provided here, see Papon et al. 2008). It involved six different survey instruments, and produced files based on households, individuals, vehicles, and trips. The geographically-stratified random sample comprised 20,178 households from the initial sample frame that completed the face-to-face survey during the surveyor's first visit. Within each of these households, a random individual older than 5 years (selected with a probability weighted toward more frequent tripmakers), called the "Kish" person, was asked to report (in a second face-to-face interview) all trips made on a prior weekday and weekend day; 18,632 persons/households completed the interview during this second visit. Since some of these individuals did not travel at all during the seven days before the second visit, trip-related information was collected for 17,998 persons and 132,880 trips.

To avoid placing an excessive burden on the respondent, the questions of interest to the present study (i.e., the "primary utility inset") were asked for only a single trip among those reported by the Kish individual. First, this trip was randomly selected for 17,940 persons, and then the primary utility inset was asked only if the selected trip lasted 10 min or more. Due to a programming error, trips lasting between one hour and one hour and nine minutes (1:00–1:09), those lasting 2:00–2:09, etc., were also excluded from the selection, however, this is not expected to materially affect the results, as there is no reason to expect trips of those particular lengths to differ substantially from those that are slightly shorter or longer.

Beyond these filters based on trip duration, some individuals did not answer one or both questions related to the two dependent variables of interest to the present study. Thus, for the MUFATIGUE model, the data available consist of information concerning the 13,063 trips (before weighting) for which that question was answered, and the individual making each trip. For the MUSENSATION models, the unweighted sample size is 13,061. The two samples are nearly identical, with 13,052 individuals answering both questions and 13,072 answering at least one of the two.

The full sample of households (N = 20,178) was originally weighted to represent the entire French population older than 5, and then the sample of "Kish" persons (N = 18,632) was again weighted to represent the entire French population older than 5 after the drop-off between the two visits, using the variable PONDKI in the dataset. However, the further-reduced subset, consisting of those who answered the primary utility inset, was no longer fully representative of the population. In addition, the selected subsample of trips was not necessarily representative of all trips. To help remedy some resulting distortions, a new set of weights was created by the second author (represented by the variable PUPDN in the dataset), which allow the study subsample to represent the day type distribution (weekday, Saturday, or Sunday) of all trips. This correction was made in view of the importance of the trip, as well as the tripmaker, to the present analysis. If the primary utility subsample had a disproportionate number of Sunday trips, for example, then descriptive statistics on the distribution of MUFATIGUE and MUSENSATION would be biased.

Although the resulting weighted sample is therefore representative in some respects, there are ways in which it is representative neither of all people (since those who did not travel or made trips only shorter than 10 min on the two diary days are excluded) nor of all trips (since short trips are excluded). However, it does include a majority of the full sample, and should provide a reasonably accurate picture of the distributions and relationships of interest to this study. Tables 1 and 2 summarize some key descriptive statistics for the sample.

We can see from the tables that the candidate exogenous variables for our models mainly comprise factual individual and trip characteristics for which measurement errors are not a major problem (e.g. age, residence, travel means). On the other hand, we also consider some variables for which precision or even biases could be an issue. In particular, individuals had to report information about their health conditions, which could be affected by their actual perceptions and subjective thresholds (e.g. being hindered from traveling or not), or even social desirability biases, possibly amplified by the adopted face-to-face survey protocol (e.g. regularly taking exercise). Furthermore, even "objective" measures such as travel times could be affected by biases, since, for example, it has been shown that car drivers tend to underestimate their travel times (van Exel and Rietveld 2010). In the FNTS, travel time is the difference between reported arrival time and reported departure

Table 1 Key descriptive statistics for the sample (variables relating to the individual performing the trip)

	Unweighted sample frequency (number of trips)	Weighted sample percentage	Notes on variable measurement
TOTAL	13,072	100	
Age group			Birth date of each household member asked in a table of persons living in dwelling unit (THL) shared by all surveys by INSEE (the French Statistics Agency)
0–5*	53	0.80	
6–10	412	5.92	
11–14	363	5.28	
15–17	251	4.47	
18–20	288	3.92	
21–24	544	6.01	
25–34	1,673	14.52	
35–49	2,995	24.41	
50–64	3,671	21.58	
65–74	1,530	7.57	
75 and more	1,292	5.52	
Female	7,330	49.86	Gender from THL
Household type			Household typology built by INSEE after description of couple, marital status, mother, father, other relative relationship in THL
Single	3,482	15.18	
Single parent family	941	8.31	
Couple without children	4,021	24.60	
Couple with children	4,309	48.13	
Other	319	3.77	
Social category**			INSEE typology of social categories in 24 groups from THL, then grouped into four classes by us
Not active	2,206	23.66	Groups 81–82
Independent	1,086	6.97	Groups 10–23 or 71–72
Lower	5,261	41.84	Groups 51–69 or 76
Higher	4,519	27.53	Groups 31–48 or 73
Degree			From THL, grouped by us
High school education or more	4,702	32.96	Groups 10–42
Did not finish high school	8,370	67.04	Groups 43–71
Attends education, age above 15	676	7.90	From THL
Disabled	1,286	6.90	Built from THL: disabled persons or persons with simply some hindrances or difficulties in daily life

Table 1 continued

	Unweighted sample frequency (number of trips)	Weighted sample percentage	Notes on variable measurement
Hindered in traveling	1,141	6.05	Specific FNTS question: physical hindrance or limitation in travel outside home (any travel mode)
Very good health	4,453	39.85	FNTS question on general health condition
Health problems	2,046	12.66	FNTS question "have you been limited for at least 6 months because of a health problem in activities that people usually do?"
Obese	1,188	8.32	BMI (body mass index) ≥30; computed by us using FNTS questions on height and weight
Regularly exercises (at least once a week)—excluding sport lessons at school	5,320	42.83	FNTS question
Walks more than 30 min per day on average—including for work	7,883	61.52	FNTS question
Residence zone			Built from INSEE typology of communes (ZHU) from THL information, then grouped by us into four categories
Suburban	4,124	27.97	ZHU 5 or 8
Exurban	2,087	13.26	ZHU 4 or 7
Rural	4,480	37.77	ZHU 0–3
Downtown	2,381	21.00	ZHU 6 or 9

* Although in theory the sample should not include tripmakers younger than six years old, post hoc data cleaning activities generated a small number of such cases

** These designations apply to the reference person in the household, which is not necessarily the person making the trip in question. They are based on a classification system ("Profession Catégorie Socioprofessionnelle", or "PCS") that is standard in France. "Lower social class" refers to "blue and pink collar" occupations such as manual laborers and clerical staff, and the same categories when retired. "Higher social class" refers to managers, self-employed professionals such as doctors, executives, "white collar" salaried professionals, technicians, foremen, and the same categories when retired. "Independent social class" refers to farmers, retailers, craftsmen, electricians and the like, if self-employed, and the same categories when retired. "Not active social class" refers to those who are unemployed, homemakers, or students

time, which is less subject to under- or overestimation, but the reported departure and arrival times themselves are prone to being rounded to the nearest 5 min.

Care has been taken to limit as much as possible those shortcomings. For example, "Obese" is a derived variable based on the body mass index, which was computed on the basis of information on the respondent's weight and height. Health problems were assessed through a five-point bipolar scale, from which the related binary variables have been derived as shown in the table. Trip-related temporal information has been scrutinized in the data cleaning process to ensure the internal consistency of the dataset. The attitudinal variable capturing the liking for the mode used during the sampled trip is only a single-

Table 2 Key descriptive statistics for the sample (variables relating to the trip)

	Unweighted sample frequency (number of trips)	Weighted sample percentage	Notes on variable measurement
TOTAL	13,072	100	
Surveyed day			FNTS surveyed day or "travel day", we used it for weighting sample
Saturday	3,701	13.37	
Sunday	2,569	9.03	
Monday to Friday	6,802	77.60	
Trip purpose			From FNTS question: highest origin or destination purpose (in following order), grouped by us
Work	2,411	27.43	Answers 91–96
Education	617	10.66	Answers 11–12
Shopping	3,587	21.82	Answers 20–21
Visit	2,127	11.64	Answers 51–52
Sport or travel without precise destination	1,426	8.42	Answers 76–78
Other	2,904	20.03	Including medical care (31), administrative errands (41), escort (61–64), other leisure trips (71–75), vacations (80–82) and other personal business (89)
Trip departure time			FNTS question, grouped by us
Night (0–7 am)	350	4.99	
Morning peak (7–9 am)	1,272	24.41	
Business hours (9 am–5 pm)	7,643	50.72	
Evening peak (5–7 pm)	2,302	12.71	
Evening post peak (7–12 pm)	1,505	7.17	
Travel time			Difference between departure and arrival time (FNTS questions)
00–09 min*	41	0.30	
10–19 min	6,440	53.09	
20–39 min	4,502	33.03	
40–79 min	1,431	9.71	
80 min and more	658	3.86	
Walking time			FNTS question on total time spent walking during the trip, grouped by us
0	7,096	54.23	
1–5 min	2,605	21.39	
6–15 min	2,233	17.16	
16 min and more	1,059	6.76	
Waiting time for public transit			FNTS question on total time spent waiting for a public transit vehicle during the trip, grouped by us
0–5 min	12,708	96.66	
6–15 min	294	2.93	
16 min and more	70	0.41	

Table 2 continued

	Unweighted sample frequency (number of trips)	Weighted sample percentage	Notes on variable measurement
Travel time assessment			FNTS question
Non–response	6,191	50.98	
Shorter than expected	252	1.79	
As long as expected	6,070	43.18	
Longer than expected	559	4.05	
Trip distance			Not an FNTS question, estimated after the survey by assignment model and regression; grouped by us
0.1–0.9 km	1,218	10.00	
1.0–3.1 km	2,076	17.57	
3.2–9.9 km	4,521	33.91	
10 km and more	5,231	38.37	
Main travel mode			FNTS question, grouped by us
Walk	2,314	17.14	Answers 10–13
Bicycle	329	2.90	Answer 20
Moped (less than 50 cc)	70	0.98	Answers 22–23
Motorcycle (50 cc or more)	85	0.67	Answers 24–29
Car driver	6,657	50.60	Answers 30–31 or 33–39
Car passenger	2,299	15.78	Answer 32
Public transportation	1,318	11.92	Answers 40–90
Multimodal	359	2.85	When two or more travel modes were used
Likes mode used during this trip	8,796	67.83	Constructed by us according to FNTS questions on liking of bicycle, moped, motorcycle, car driving, public transport pass, and mode used
No seat available in public transit	249	3.11	FNTS question “Did you have a seat”
Travel with another person	3,763	32.68	FNTS question
Number of activities during travel			FNTS question on selected trip
0	7,870	61.09	
1	3,080	26.75	
2	1,657	8.47	
3 or more	465	3.69	
Talked with other people	3,813	27.75	From proposed activity list in FNTS question on selected trip
Made phone call or sent text	513	4.58	From proposed activity list in FNTS question on selected trip
Listened to music or radio	1,563	11.82	From proposed activity list in FNTS question on selected trip
Looked at the landscape	634	4.18	From proposed activity list in FNTS question on selected trip

Table 2 continued

	Unweighted sample frequency (number of trips)	Weighted sample percentage	Notes on variable measurement
Cumulative travel during the day			From FNTS trip description
1st to 3rd trip of the day	10,774	86.97	
4th trip of the day	1,317	7.07	
5th trip of the day	449	2.74	
6th trip of the day or more	532	3.22	

* Although in theory the sample should not include trips less than 10 min long, post hoc data cleaning activities generated a small number of such cases

item assessment of what may be considered a latent construct, but we suggest that it is relatively straightforward for a respondent to decide whether s/he "likes" a mode or not.

The FNTS was a complex project that also involved other data gathering efforts (including long-distance trips, retrospective biographical grids, vehicle diaries, and GPS tracking) that are not described here since they are not relevant to the present study.

The dependent variables

As indicated in the Introduction, the dependent variables of interest to the present study are obtained from two survey questions. One question asked about the extent to which the trip was tiring, and produced the FNTS variable MUFATIGUE, taking on the values "yes, especially mentally" ("nerveusement" in French), "yes, especially physically", "yes, both mentally and physically", and "no, not tiring". The second asked about the pleasantness of the trip, and produced the FNTS variable MUSENSATION, taking on the values "pleasant or rather pleasant", "unpleasant or rather unpleasant", and "neither pleasant nor unpleasant". If taken as single-item assessments of latent constructs, we acknowledge that these two variables are subject to measurement errors. If taken prima facie as indicators of fatigue and unpleasantness, however, we expect measurement error to be minimal, especially given that only binary versions of the variables are used in the models (e.g., it is relatively unlikely that a trip would be misreported as "pleasant" when it was not).

Although developed in a somewhat ad hoc manner, these two variables are directly related to the two dimensions widely viewed as underlying measures of affect: valence and activation[2] (see, e.g., Russell 2013 for a general exposition, and Ettema et al. 2011 for an application to the construction of the "satisfaction with travel" scale). "Valence" refers simply to pleasure versus displeasure, or a hedonic dimension, and clearly matches our MUSENSATION. Positive or negative travel experience was also one of the dimensions of the "affect plane" identified by Meissonnier (2012). "Activation" refers to level of arousal or energy, and our MUFATIGUE focuses on the deactivation end of this dimension (addressing the activation end only through the reported absence of deactivation), additionally distinguishing whether the tiredness (or depletion of energy) is physical, mental, or both (or neither).

[2] We are indebted to a reviewer for this observation.

Table 3 Crosstabulation of MUFATIGUE and MUSENSATION

Unweighted frequency (number of trips) Weighted sample row percentage	MUFATIGUE				
	Tiring, especially mentally	Tiring, especially physically	Tiring, both mentally and physically	Not tiring	Unweighted total (weighted share)
MUSENSATION					
Unpleasant	99 25.3 %	67 14.2 %	55 11.0 %	206 49.5 %	427 (3.6 %) 100.00 %
Neither	120 2.0 %	257 3.2 %	116 1.6 %	5,571 93.2 %	6,064 (50.7 %) 100.00 %
Pleasant	63 1.3 %	307 3.6 %	74 1.4 %	6,117 93.7 %	6,561 (45.5 %) 100.00 %
Total	282 2.5 %	631 3.8 %	245 1.9 %	11,894 91.8 %	13,052 (100.0 %) 100.00 %

Table 3 shows the crosstabulation of MUFATIGUE and MUSENSATION. Turning first to the margins of the table, we see that the vast majority (92 %) of the selected trips were not tiring. Among the remaining 8 %, 6 % were physically tiring and 4 % were mentally tiring. About half of the selected trips were neither pleasant nor unpleasant. A large minority (46 %) were pleasant, while fewer than 4 % were unpleasant. Although neither “not tiring” nor “pleasant” is equivalent to “desired for its own sake”, these results illustrate that travel is by no means universally distasteful. Individuals may not be strongly motivated to eliminate a trip that is pleasant, or even one that is neutral.

We examine the crosstabulation of these two variables to see how they are related to each other. We could imagine tiring trips to be considered more unpleasant (or conversely, unpleasant trips to be considered mentally tiresome), but on the other hand, some kinds of trips (e.g. those in which the trip itself is a desired physical activity such as walking or bicycling, or those undertaken for leisure purposes at the destination) may be tiring but with pleasant associations.

The table shows that unpleasant trips are considerably more likely to be viewed as tiring, and that for those trips, in contrast to the marginal distribution for fatigue, the source of the fatigue is far more likely to be mental than physical. Nevertheless, neutral and even pleasant trips were also tiring in 6–7 % of the cases.

It is also of interest to see how MUFATIGUE and MUSENSATION relate to other available variables. Space does not permit an exhaustive descriptive analysis, but the variable of perhaps greatest interest is trip purpose. Table 4 crosstabulates trip purpose against the two dependent variables. It can be seen that compared to non-tiring trips, mentally tiring trips are far more likely to be for work and less likely to be for shopping, while physically tiring trips are more likely to be for shopping. Compared to the overall distribution of trip purposes, unpleasant and neutral trips are disproportionately more often for work, whereas pleasant trips are more often for sport. However, even for work, some 28 % of trips are reported as pleasant (compared to 46 % of all trips), and only 5 % (4 %) as unpleasant. Interestingly, shopping and visit trips show a bit of bipolarity, being somewhat more prevalent among both unpleasant and pleasant trips than among trips viewed neutrally.

Table 4 MUFATIGUE and MUSENSATION by trip purpose

Unweighted frequency (number of trips) Weighted sample row and column percentages	Trip purpose						
	Work	School	Shopping	Visit	Sport	Other	Unweighted total (weighted share)
MUFATIGUE							
Tiring, especially mentally	87	15	51	37	20	72	282 (2.5 %)
	49.6 %	8.4 %	11.9 %	6.7 %	5.9 %	17.5 %	100 %
	4.5 %	2.0 %	1.4 %	1.5 %	1.8 %	2.2 %	2.5 %
Tiring, especially physically	108	23	217	86	74	124	632 (3.8 %)
	23.7 %	7.7 %	27.2 %	11.8 %	9.9 %	19.8 %	100 %
	3.3 %	2.8 %	4.7 %	3.9 %	4.5 %	3.8 %	3.8 %
Tiring, both mentally and physically	81	10	49	43	7	55	245 (1.9 %)
	38.8 %	9.8 %	19.1 %	11.6 %	4.7 %	16.1 %	100 %
	2.7 %	1.7 %	1.6 %	1.9 %	1.0 %	1.5 %	1.9 %
Not tiring	2,134	568	3,269	1,959	1,324	2,650	11,904 (91.8 %)
	26.8 %	10.9 %	21.9 %	11.8 %	8.5 %	20.2 %	100 %
	89.5 %	93.6 %	92.3 %	92.8 %	92.7 %	92.5 %	91.8 %
Totals for MUFATIGUE	2,410	616	3,586	2,125	1,425	2,901	13,063 (100 %)
	27.4 %	10.7 %	21.8 %	11.6 %	8.4 %	20.0 %	100 %
	100 %	100 %	100 %	100 %	100 %	100 %	100 %
MUSENSATION							
Unpleasant	121	20	90	69	20	108	428 (3.7 %)
	39.3 %	8.1 %	17.5 %	12.6 %	4.4 %	18.1 %	100 %
	5.3 %	2.8 %	3.0 %	4.0 %	1.9 %	3.3 %	3.7 %
Neither	1,578	331	1,704	837	327	1,292	6,069 (50.8 %)
	36.1 %	10.8 %	20.0 %	9.0 %	4.0 %	20.1 %	100 %
	66.8 %	51.4 %	46.4 %	39.4 %	24.2 %	50.9 %	50.8 %
Pleasant	709	266	1,791	1,220	1,076	1,502	6,564 (45.6 %)
	16.8 %	10.7 %	24.2 %	14.5 %	13.7 %	20.1 %	100 %
	27.9 %	45.9 %	50.6 %	56.6 %	73.9 %	45.8 %	45.6 %
Totals for MUSENSATION	2,408	617	3,585	2,126	1,423	2,902	13,061 (100 %)
	27.4 %	10.7 %	21.8 %	11.6 %	8.4 %	20.0 %	100 %
	100 %	100 %	100 %	100 %	100 %	100 %	100 %

Models of fatigue and pleasantness

Functional forms

For both dependent variables of interest, several functional forms are plausible. With respect to MUFATIGUE, we experimented with multinomial logit models, but found it difficult to interpret variables that were (for example) significant to the "physically tiring" alternative but not the "both physically and mentally tiring" alternative, or conversely. The functional form we found most satisfying conceptually is a bivariate probit model of the two outcome choices "mentally tiring" versus "not" and "physically tiring" versus "not". Whereas a single-equation model treats the four possible answers listed in the section titled "The dependent variables" as respective *single alternatives*, the bivariate (two-equation) model treats them as *pairs of outcomes* (one outcome for each type of fatigue). This structure explicitly recognizes the ability of a trip to be separately mentally and/or physically tiring (or neither), distinguishes the explanatory variables relevant to each type of fatigue, and allows the unobserved characteristics influencing the perception of one type of fatigue to be correlated with those influencing the perception of the other type. Using our knowledge about whether one type of fatigue is present to inform our predicted probabilities for the presence of the other type (and conversely) increases the precision of our estimates (i.e. increases the efficiency of the coefficient estimators).

The general specification (with the person subscript suppressed for simplicity) for a bivariate probit model with two dependent variables (as we have) is

$$Y_i^* = \boldsymbol{\beta}_i' X_i + \varepsilon_i,\ i = 1(\text{mentally}), 2(\text{physically}),$$

where Y_i^* is an unobserved variable representing the latent utility or propensity of being in the "higher" status for fatigue type i (where "higher" in our context is "tiring" [vs. "not tiring"]), $\boldsymbol{X_i}$ is a vector of observed characteristics believed to be relevant to the fatigue status for type i, $\boldsymbol{\beta}_i$ is a vector of unknown coefficients to be estimated, ε_i represents the impact of unobserved variables on the status propensity for type i and is normally distributed with mean 0 and variance 1, and the variance–covariance matrix of the error terms is

$$\Sigma = \begin{bmatrix} 1 & \rho_{12} \\ \rho_{12} & 1 \end{bmatrix}.$$

The observed binary choice or status variable is $Y_i = 1$ if $Y_i^* > 0$, and 0 otherwise. Thus, the joint probability of a pair $\{Y_i = y_i,\ i = 1,\ 2\}$, conditioned on parameters $\boldsymbol{\beta}$, $\sum$, and a set of explanatory variables X, can be written as

$$\Pr[Y_i = y_i,\ i = 1, 2|\beta, \Sigma] = \int_{A_1} \int_{A_2} \varphi(z_1, z_2, \rho_{12})\, dz_2 dz_1,$$

where φ is the density function of a bivariate normal distribution with mean vector 0 and the variance–covariance matrix (correlation matrix) $\sum$, and A_i is the interval $(-\infty, \boldsymbol{\beta}_i' X_i)$ if $y_i = 1$ and $[\boldsymbol{\beta}_i' X_i, \infty)$ if $y_i = 0$ (Chib and Greenberg, 1998). The parameters $\boldsymbol{\beta}_i$ and the correlation of the error terms can be estimated via the maximum likelihood method; the SAS software package was used to perform this estimation.

With respect to MUSENSATION, even more model options are possible. The three possible answers to the question are clearly ordered with respect to the degree of pleasantness of the trip, and thus an ordinal response model would be logical. However, multinomial logit models have sometimes been found to be superior even for ordered discrete variables (e.g. Bhat and Pulugurta 1998; Potoglou and Susilo 2008), and all three nested logit structures could also be reasonable. Ultimately, after testing all of these options, the best results (considering interpretability as well as well as statistical tests, such as the proportional odds assumption test which decisively rejected the ordered response model) were obtained by simply separately modeling the two binary outcomes of "pleasant" (yes or no) and "unpleasant" (yes or no), using binary logit models. Since these latter are of common usage in travel behavior research we do not formally present them here, pointing the interested reader to Ben-Akiva and Lerman (1985) for an exhaustive coverage of the topic.

The subsections below discuss each set of models in turn.

Table 5 Bivariate probit model of whether the trip was mentally and/or physically tiring (unweighted N = 12,063)

	Mentally tiring (yes = 1, no = 0)		Physically tiring (yes = 1, no = 0)	
	Coefficient	*p*-value	Coefficient	*p*-value
Constant	−2.288	<.0001	−1.762	<.0001
Individual characteristics				
Socioeconomic				
Age group: 0–5 (ref.: 25–34 years)	1.489	<.0001	1.283	<.0001
Age group: 21–24 (ref.: 25–34 years)	0.345	<.0001	0.249	0.001
Age group: 50–64 (ref.: 25–34 years)			−0.181	0.0004
Female			0.169	<.0001
Household type: Single parent family (ref.: single)	0.300	<.0001	0.156	0.019
Social category: Lower (ref.: independent)			−0.192	0.0007
Social category: Higher (ref.: independent)			−0.283	<.0001
Health/fitness				
Disabled	0.194	0.033		
Hindered in traveling	0.245	0.018	0.601	<.0001
Health problems	0.241	0.0008	0.375	<.0001
Obese	0.416	<.0001		
Very good health			−0.258	<.0001
Regularly exercises (at least once a week)	−0.185	0.0001	−0.156	0.0006
Walks more than 30 min per day on average	0.111	0.014		
Residence zone (ref.: lives in a downtown)				
Lives in a suburb	0.109	0.024	0.156	0.0005
Attitudinal				
Likes the mode used during this trip	−0.207	<.0001		
Trip characteristics				
Purpose (ref.: work)				
Education	−0.179	0.028		
Shopping	−0.356	<.0001		
Visit	−0.451	<.0001	−0.230	0.0009
Sport	−0.357	0.0004	−0.270	0.001
Other	−0.253	<.0001	−0.119	0.028
Departure/arrival time (ref.: business hours, 9 am–5 pm)				
Evening peak hour (5–7 pm) departure time	0.182	0.004	0.301	<.0001
Evening post peak (7 pm–midnight) departure time			0.246	0.001
Night (midnight–7 am) departure time	0.383	<.0001	0.510	<.0001
Travel time				
Travel time 40–79 min (ref.: 10–19 min)	0.446	<.0001	0.487	<.0001
Travel time 80 + mins (ref.: 10–19 min)	0.537	<.0001	0.698	<.0001
Walking time >15 min (ref.: no walking)	0.486	<.0001	0.741	<.0001

Table 5 continued

	Mentally tiring (yes = 1, no = 0)		Physically tiring (yes = 1, no = 0)	
	Coefficient	*p*-value	Coefficient	*p*-value
Travel time assessment (ref.: longer than expected)				
Travel time shorter than expected			0.292	0.018
Travel time as long as expected	0.440	<.0001	0.285	0.0005
Mode (ref.: walk)				
Bicycle	0.432	0.011	0.669	<.0001
Motorcycle	0.564	0.038		
Car passenger	0.278	0.006		
Car driver	0.596	<.0001		
Public transportation	0.515	<.0001		
Multimodal*	0.257	0.017	0.340	0.0006
No seat available on public transit			0.241	0.013
Activities during the trip				
Listened to music or radio	−0.142	0.037		
Looked at the landscape			−0.524	<.0001
Number of activities conducted during the trip (0, 1, 2 +)			−0.125	0.001
Rho	0.688	<.0001		
Unweighted number (weighted share)	Yes: 482 (4.4 %)	No: 11581 (95.6 %)	Yes: 760 (5.7 %)	No: 11303 (94.3 %)
LL(equally likely)	−25,242			
LL(MS)**	−6,735			
LL(final)	−3,787			
McFadden's R^2 [1−(LL(final)/LL(MS))]	0.44			

* This indicator is not disjoint with the individual mode variables, which only indicate the main mode used on the trip. Multimodal trips will most often involve public transportation as one or more of the modes, and as such the total impact of a multimodal trip on mental fatigue will generally be represented by adding this coefficient to the one for public transit

** The weighted-sample shares of the four joint-outcome alternatives are as follows, where the first letter of each alternative label indicates whether the trip was mentally tiring (M) or not (N), and the second letter indicates whether the trip was physically tiring (P) or not (N): MN 2.50 %, MP 1.87 %, NP 3.81 %, and NN 91.81 % (these alternatives respectively correspond to the (Y_1, Y_2) pairs {10}, {11}, {01}, and {11} using the notation defined in the subsection titled "Functional forms"). The total weighted sample size is 18,208.596. The log-likelihood of the market-share model is computed as $\Sigma_j (n_j \ln n_j) - (n \ln n)$, where n_j is the number of cases belonging to alternative j (j = MN, MP, NP, NN), and $n = \Sigma_j n_j = 18{,}208.596$

When is travel tiring?

Table 5 presents the final bivariate probit model of the mental and physical fatigue of the trip. All variables in Tables 1 and 2 were tested for inclusion; only significant variables are retained in the model and reported in the table. Although there is no universally-reported measure of goodness of fit for such a system of equations, McFadden's R^2 can be used for the goodness of fit of a multivariate probit model (e.g. Lansink et al. 2003). In this study, McFadden's R^2 is calculated by 1−ln[L(final)]/ln[L(MS)], where ln[L(final)] and ln[L(MS)] are the values of the log-likelihood function evaluated at the estimated parameters of the final model and for the model with constant predicted probabilities equal to the market shares, respectively. It varies between 0 and 1, with higher values being better. The McFadden's R^2 of our model is 0.44, which is considered good for a disaggregate discrete choice model involving four alternatives (see, e.g., Hensher et al. 2005).

Turning to the parameters in the model, we first note that a large number and several kinds of personal and trip characteristics are significant to the perception of the trip as being tiring: in addition to the constant term, 29 variables are significant in the mental fatigue equation, and 28 for physical fatigue. Almost two-thirds (18) of these variables are common to both equations, and always with the same sign. Thus, the two forms of fatigue do share a number of sources—not only from the observed variables appearing in both models, but the sizable magnitude (0.7) and significance of the correlation term (rho) shows that unobserved variables are common influences on both perceptions as well. The latter result confirms the value of modeling both perceptions together.

Space does not permit a full discussion of every variable in the model, but we present results for each group of variables, highlighting the most interesting findings. With respect to personal characteristics, we note that age has a decidedly nonlinear relationship to fatigue. Very young children are substantially more likely than the reference group of 25-to-34-year-olds to find the trip tiring in both respects, whereas people ages 6 to 20 are no more or less likely to do so than the reference group. Those who are 21–24 years old are also more likely than the reference group to find the trip tiring, perhaps because they may be more physically active, and also because if they do have children accompanying them, those children are likely to be younger, on average, than for the older adults in the reference group. People ages 35–49 are again no more or less likely to find the trip tiring than the just-younger reference group, but those who are 50–64 are less likely to find it physically tiring. The latter result may be a consequence of self-selection (people this age are less likely to undertake trips that they expect to be strenuous), habituation (have grown more tolerant of trip fatigue), or demography (less likely to have young children along). Older people are again no more or less likely to find the trip fatiguing than the reference group: perhaps the factors leading to the negative coefficient for the middle-aged group are being roughly counteracted by the increasing frailty of age, which would pull the coefficient in the positive direction.

Our hypothesis that those who are less healthy are more likely to find travel tiring is generally supported (as shown by several variables in the model), but some nuances are of interest. For example, those who are classified as disabled or obese are more likely to rate the trip as mentally tiring, but no more likely than others to rate it as physically tiring (after controlling for other related variables). On the other hand, the same is true of those who are accustomed to walking more than 30 min a day.

Noteworthy to urban planners is the finding that those who live in suburban areas tend to be more likely to find the trip tiring (in both ways) than those living in a downtown—perhaps reflecting a greater difficulty of traveling in areas with few practical alternatives to the automobile. And consistent with other studies finding that a mode-related travel liking seems to reduce the disutility of traveling (Choo et al. 2005; Mokhtarian et al. 2001), those who like the mode used during the trip are less likely to find the trip mentally fatiguing.

With respect to trip variables, work is (as hypothesized) the most fatiguing trip purpose, as shown by the negative coefficients of all other purposes relative to the work reference category. Departure times at evening or night also increased the chance of fatigue of both kinds, which is logical in view of the accumulated stresses of a day, and heightened concerns about personal safety and vehicle reliability at night. Arriving either on time or early was associated with a greater probability of fatigue, relative to arriving late. Although we might not have predicted this result, in retrospect it stands to reason that pushing oneself to arrive early or on time can create more stress than does the "relief valve" of allowing oneself to be late—at least when the penalty for being late is not severe, which is often the case.

The model supports our hypothesis that longer trips are more likely to be tiring, both mentally and physically. Trips involving more walking are also more likely to be tiring—not only physically, as would be expected, but also mentally. The latter result may reflect not just longer trips in general (since total travel time is largely controlled for), but also the complexity of a multimodal trip. The latter inference is further supported by the positive coefficient (for both types of fatigue) of the indicator of a multimodal trip, relative to a unimodal trip. Aside from multimodal trips, only the bicycle mode (naturally enough) increases the likelihood that the trip is physically tiring relative to walk trips, and (also naturally) walking is shown (by the positive coefficients for all the *other* modes) to be the most mentally comfortable mode. In ascending order of mental fatigue, the remaining modes are ranked as follows: car passenger, bicycle, public transportation, motorcycle, and car driver. These results are consistent with the stereotypes of stressful urban driving, in contrast to being driven or to bicycling or walking. However, since most multimodal trips involve public transportation, when the coefficient for the multimodal indicator is added to that for the transit indicator it is evident that multimodal trips involving transit are the most mentally fatiguing of all. This is as expected, in view of the additional effort associated with navigation and making transfer connections on time for such trips.

Significantly to the context of this research, the number and types of activities conducted during the trip affect how tiring it is perceived to be. As could be expected, listening to music or radio lowers the chance that it is seen as mentally fatiguing, again pointing to a way of at least reducing the disutility of a trip for those who *must* travel, and perhaps actively increasing its utility for those who *want to* travel (Cao and Mokhtarian 2005). Looking at the landscape lowers the chance of the trip being seen as physically tiring, perhaps an association of this activity with being a passenger. Finally (for this model), the number of activities conducted during the trip tends to lower the chance that the trip is seen as physically tiring, probably because the ability to conduct a higher number of activities will also tend to be associated with being a passenger, which is less physically strenuous than operating a vehicle or walking.

When is travel pleasant?

Table 6 presents the separate binary logit models of the outcomes "pleasant" or "not", and "unpleasant" or "not" (grouping the "neither pleasant nor unpleasant" outcome with "not" in both cases). McFadden's R^2 (with the constant-only, or market-share, models as base) is 0.12 for both models, which is a typical goodness of fit for disaggregate travel behavior-related models, but possibly indicates that the mostly demographic and trip context variables available to us can only explain a limited amount of the information in the dependent variables of interest.

These two models share many significant variables with the bivariate probit model of fatigue discussed in the preceding subsection, as well as with each other. Specifically, in addition to the constant term, 42 variables are significant to the model for pleasantness, and 35 for the model of unpleasantness. Nineteen of these are shared between the two models, in most (11) cases with opposite signs as would normally be expected. Again, we discuss

Table 6 Binary logit models of whether the trip was pleasant or unpleasant (unweighted N = 12,061)

	Pleasant (yes = 1, no = 0)		Unpleasant (yes = 1, no = 0)	
	Coefficient	*p*-value	Coefficient	*p*-value
Constant	−0.931	<.0001	−3.891	<.0001
Surveyed day (ref.: Monday to Friday)				
Saturday	0.132	0.0077		
Sunday	0.583	<.0001	−0.675	0.0004
Individual characteristics				
Socioeconomic				
Age group: 0–5 (ref.: 25–34 years)	0.625	0.0006		
Age group: 6–10 (ref.: 25–34 years)	0.960	<.0001	−1.263	<.0001
Age group: 11–14 (ref.: 25–34 years)			−0.623	0.011
Age group: 15–17 (ref.: 25–34 years)	−0.809	<.0001	−1.014	0.0004
Age group: 18–20 (ref.: 25–34 years)	−0.737	<.0001		
Age group: 21–24 (ref.: 25–34 years)	−0.244	0.003	0.801	<.0001
Age group: 35–49 (ref.: 25–34 years)	0.247	<.0001		
Age group: 50–64 (ref.: 25–34 years)	0.195	0.006	−0.431	0.0004
Age group: 65–74 (ref.: 25–34 years)	0.767	<.0001	−0.872	<.0001
Age group: 75 or more (ref.: 25–34 years)	0.674	<.0001	−1.048	<.0001
Attends education, age above 15	1.112	<.0001		
Household type: Couple without children (ref.: single)	−0.119	0.013	−0.467	0.0001
Household type: Couple with children (ref.: single)	−0.121	0.004	−0.326	0.001
Household type: Other household type (ref.: single)			−1.594	<.0001
Social category: Lower (ref.: independent social class)	−0.197	<.0001	0.548	0.0007
Social category: Higher (ref.: independent)			0.819	<.0001
High school educ. or more (ref.: did not finish high school)	−0.153	0.0001		
Health/fitness				
Disabled			−0.428	0.034
Hindered in traveling			0.460	0.022
Health problems	−0.180	0.0005	0.912	<.0001
Obese			0.326	0.024
Very good health	0.086	0.020	0.326	0.0003
Regularly exercises (at least once a week)			0.289	0.0007
Residence zone (ref.: lives in a downtown)				
Lives in a rural area	0.230	<.0001		
Attitudinal				
Likes the mode used during this trip	0.218	<.0001	−0.754	<.0001
Trip characteristics				
Purpose (ref.: work)				
Education	0.290	<.0001		

Table 6 continued

	Pleasant (yes = 1, no = 0)		Unpleasant (yes = 1, no = 0)	
	Coefficient	*p*-value	Coefficient	*p*-value
Shopping	0.605	<.0001		
Visit	0.667	<.0001		
Sport	1.182	<.0001	−0.946	<.0001
Other	0.294	<.0001		
Departure/arrival time (ref.: midday, 9 am–5 pm)				
Morning peak (7–9 am) departure time			0.290	0.003
Night (midnight–7 am) departure time	0.198	0.012		
Travel time				
Travel time 20–39 min (ref.: 10–19 min)			0.247	0.032
Travel time 40–79 min (ref.: 10–19 min)			1.256	<.0001
Travel time 80 + mins (ref.: 10–19 min)			1.388	<.0001
Walking time 5–15 min (ref.: no walking)			0.423	0.0003
Walking time >15 min (ref.: no walking)			0.592	0.0002
Wait time 5–15 min (ref.: <5 min)	−0.868	<.0001		
Travel time assessment (ref.: longer than expected)				
Travel time shorter than expected	0.838	<.0001		
Travel time as long as expected			0.663	<.0001
Trip distance (ref.: < 1 km)*				
Total distance 1.0–3.1 km	0.437	<.0001	0.501	0.0002
Total distance 3.2–9.9 km	0.333	0.0004	0.327	0.003
Total distance 10 km or more	0.617	<.0001		
Mode (ref.: walk)				
Bicycle	0.507	<.0001		
Scooter	−0.455	0.011	0.709	0.030
Motorcycle	0.983	<.0001		
Car passenger	−0.787	<.0001	−0.840	<.0001
Car driver	−0.977	<.0001		
Public transportation	−0.498	<.0001	−1.274	<.0001
Multimodal			0.618	0.008
No seat available on public transit	−0.549	<.0001	0.721	0.003
Traveling with another person	0.168	<.0001		
Activities during the trip				
Talked with other people	0.663	<.0001		
Made phone call or sent text	0.202	0.011		
Listened to music or radio	−0.160	0.003		
Cumulative travel of the day (ref.: 1st trip)				
Current trip is 4th one of the day			0.550	<.0001
Current trip is 5th one of the day	0.209	0.034		
Current trip is 6th or higher one of the day	0.292	0.002		

Table 6 continued

	Pleasant (yes = 1, no = 0)		Unpleasant (yes = 1, no = 0)	
	Coefficient	*p*-value	Coefficient	*p*-value
Unweighted number (weighted share)	Yes: 6070 (45.5 %)	No: 5993 (54.5 %)	Yes: 393 (3.7 %)	No: 11670 (96.3 %)
LL(equally likely)	−12631.88		−12631.88	
LL(MS)	−12558.91		−2866.57	
LL(final)	−11083.98		−2530.54	
McFadden's R^2 [1—(LL(final)/LL(MS))]	0.12		0.12	

* Distance was not self-reported, but rather estimated afterwards using the trip origin, destination, duration and mode

variables in groups, personal characteristics followed by trip characteristics, highlighting effects that are especially interesting.

Similarly to the fatigue model, the relationship of age to the perception of the trip as pleasant or unpleasant is quite nonlinear, but here it must be interpreted together with the variable indicating student status (at any level of education) of the respondent. Given the sizable positive value of the latter coefficient (in the pleasantness model), we see that most age groups (with the exception of 21-to-24-year-olds who are not students) are more likely than the reference group of 25-34-year-olds to perceive the trip as pleasant (and less likely to perceive it as unpleasant), with the very old and (especially) the very young being most (least) likely to do so. Perhaps the reference group is more burdened with balancing work and family obligations, and therefore less inclined to focus on the benefits of travel, than those who are in earlier or later stages of the life cycle. We see echoes of this interpretation for other socioeconomic variables in both models.

Only two health/fitness variables are significant in the pleasantness model, with the expected signs (negative for having health problems, positive for being very healthy). By contrast, the unpleasantness model has six such variables. As hypothesized, those who are hindered in traveling, have health problems, or are obese are more likely to find the trip unpleasant. What is interesting is that so, too, are those who are very healthy and those who practice a sport. Perhaps such individuals are having to travel using a passive mode such as driving or even public transit, and are restless at the enforced inactivity of the trip. On the other hand, it may also be surprising that disabled individuals are *less* likely to view the trip as *un*pleasant—perhaps because the opportunity for a change of pace or scenery is more strongly welcomed by those with lower mobility in general.

With respect to geographic indicators, we note that those living in rural locations are more likely to find the trip pleasant, compared to those who live in a downtown. This provides an interesting counterpoint to the models of the preceding subsection, for which we saw that those living in suburbs were more likely to find the trip fatiguing (in both respects). As expected, those who liked the mode they used for the trip were more likely to rate the trip as pleasant, and less likely to rate it as unpleasant.

With respect to trip characteristics, it is consistent with our hypothesis that trips for the reference purpose of work are less likely to be viewed as pleasant than those made for any other purpose. On the other hand, trips made for school, shopping, visit and sport are increasingly more pleasant than work trips, all else equal. Interestingly, those arriving early are more likely than those arriving late to perceive the trip as pleasant, even though in the preceding subsection we noted that the former group is also more likely than the latter to find the trip physically tiring. On the other hand, those arriving on time are more likely (than those arriving late) to see the trip as being *un*pleasant, as well as being mentally or physically tiring.

The associations with travel time are logical. Trips with total travel times of 20 min or longer are more likely to be seen as unpleasant than shorter trips, with the impact of trips 40 min or longer being more than five times that of trips 20–39 min long. Similarly, trips involving walk times of 5 min or more are more likely to be rated unpleasant than those involving no walking, with the effect escalating for walk times of more than 15 min. Having to wait 5–15 min renders the trip *less* likely to be considered pleasant, relative to shorter or longer wait times (in the latter instance, perhaps because the traveler can better prepare for and use longer wait times).

Trip distance exhibits some interesting associations: longer trips tend to be more often viewed as pleasant than shorter trips—perhaps they are more often trips for leisure purposes (even though trip purpose is also controlled for, its impact could interact with distance), or perhaps they sometimes represent an escape from a daily routine, even if the trip purpose is work or personal business rather than leisure. However, trips between 1 and 10 km also tend to be more often viewed as *un*pleasant than shorter or longer trips. There are some intriguing impacts of the cumulative day's travel, as well. Relative to the first trip of the day, the fourth trip of the day is more likely to be seen as unpleasant, perhaps because that may often be the homebound commute trip. On the other hand, the fifth and sixth (or higher) trips of the day are more likely to be seen as pleasant, perhaps representing social/recreational/entertainment excursions in the evening.

With respect to mode of the current trip, only trips by bicycle and motorcycle tend to be more often seen as pleasant than those by the reference mode of walking. On the other hand, trips as a car or public transit passenger are not only less often seen as pleasant than walk trips are, they are also less often seen as *un*pleasant, suggesting that such trips are more often accepted matter of factly as being neither pleasant nor unpleasant. However, for multimodal trips involving transit, or for trips involving not having a seat on public transit, the latter impact is diminished (and eliminated entirely when both factors apply).

Finally, the role of activities conducted during the current trip is somewhat complex. Similarly to the results of Ettema et al. (2012) for travel satisfaction, when a trip involves talking with other people, it is more likely to be considered pleasant. Interestingly, this effect still holds for communicating *remotely* with others (by making a phone call or sending a text), though not as strongly. Contrary to expectations, however, when a trip involves listening to music or radio, it is *less* likely to be rated as pleasant (despite being also less likely to be considered mentally fatiguing, as discussed in the preceding subsection). Perhaps this represents a causal influence in the opposite direction, with the traveler engaging in such activities to ameliorate an otherwise even less pleasant journey, an interpretation consistent with a similar finding by Ettema et al. (2012) (however, it could also be a comment on the low appeal of the radio).

Discussion and conclusions

The inclusion of several distinctive questions in the 2007–08 French National Travel Survey offered a unique opportunity to investigate respondents' attitudes toward their travel using a large, nationally-distributed sample. With respect to a single randomly selected trip, each respondent was asked (among other things) whether the trip was tiring (mentally, physically, both, or neither) and pleasant (or unpleasant, or neither). The vast majority (92 %) of trips were not tiring; a sizable share (46 %) were considered pleasant, with just over half (51 %) viewed neutrally and less than 4 % considered unpleasant. Pleasant trips were more likely to be shopping, visiting or sport-recreation related, but even for work trips, 28 % are reported as pleasant (compared to 46 % of all trips), and only 5 % (4 %) as unpleasant. These results support the contention that travel is not an unmitigated disutility.

With the purpose of better understanding the influences on how a trip is perceived, we built bivariate probit models of whether the trip was mentally tiring or not and physically tiring or not, and separate binary logit models of whether the trip was viewed as pleasant or not and unpleasant or not. Building on the specific significant relationships discussed in the preceding section, it is interesting here to comment on the numerous instances in which the same variable played a positive role in one set of models and a negative role in the other: of the 31 variables common to the fatigue model and one or both of the un/pleasantness models, 11 of them played opposite roles. For example, being disabled was associated with higher probabilities that the trip was (mentally) tiring, but also with lower probabilities that it was rated as unpleasant, while for being very healthy and practicing a sport, the converse was true. These findings remind us that unpleasantness and fatigue *are* separate dimensions, and highlight the value of analyzing multiple indicators of attitude toward a given trip.

For the most part, indicators of trip length, distance, purpose, and mode have the hypothesized relationships to fatigue and pleasantness. Interestingly, however, while trips of longer *duration* are more likely to be rated as fatiguing and unpleasant, trips of longer *distance* are more likely to be rated as pleasant—suggesting (as would be expected) that travel speed and congestion levels interact with the physical distance of the trip to influence its perception.

Activities conducted during the trip appear in both sets of models. Most intriguingly, listening to the radio/music decreases the chance that the trip is seen as mentally fatiguing, but also decreases the chance it is seen as pleasant. We suggest that the latter result may point to the opposite direction of causality, in which engaging in the activity may be a *result* of how (un)pleasant the trip is seen to be (positive activities may be more important when the trip itself is viewed negatively), rather than a *cause* of it.

This observation points to an important pathway for future research. Single-equation models are unable to disentangle multiple directions of causality, so it will be important to address the role of activities conducted while traveling using structural equations modeling. In addition to the variables analyzed in the present study, it will also be important to incorporate into the structural equations model the variable called MURAISON, a variable in the FNTD dataset that assesses the reason(s) for traveling (with responses "The only important thing in this trip was to go from one place to another", "The activities during the trip were important for me", and "The feelings during the trip were important for me").

There are many interesting policy implications of the above findings. A general observation is that making trips more pleasant is a way of improving social welfare. Humans *must* travel a certain amount, and obviously it is preferable for that obligatory time to be spent pleasantly rather than unpleasantly. On the other hand, there may be a public interest in being selective about *which kinds of trips* society tries to make more pleasant, as trips that are considered pleasant may be less susceptible to efforts by policymakers to reduce vehicle travel. Thus, it makes sense to develop policies to shift car trips onto more sustainable modes, by increasing the pleasantness of alternative modes. Our results indicate that improvements to social welfare would especially result from designing transportation systems to cater more effectively to active travel and to recreational travel, and from designing cities so that trips over 40 min are not necessary to perform daily activities.

Focusing further on the implications related to the relationship between mode and trip pleasantness or tiredness, it appears that multimodal trips are the most critical ones, since they are more often perceived as unpleasant, and as mentally or physically tiring, than unimodal trips are. This outcome needs to be carefully considered and addressed, since more recent transport policies, after having acknowledged the difficulty of merely substituting many car trips with more environmentally benign means, are pushing toward a joint use of different travel modes for the same trip. Failing to acknowledge the related additional "burden" might lead to smaller than expected benefits of schemes such as intermodal interchanges. On the other hand, the careful design of such interchanges (including information provision and system operation adjustments, as well as supportive infrastructure) to simplify the navigation task and to minimize the risk of missing a transfer connection can help *reduce* the stress of such trips.

Conversely, driving a car is more often seen as mentally tiring than are other single modes, and also the least often seen as pleasant. This points to the different characteristics and subjective determinants of the demand for travel by different modes, an issue that is perhaps not completely well captured in current modeling practices where different alternatives are often analyzed in a "symmetric" or generic way. Policy actions specifically aimed at changing the level of use of different means through modal diversion should therefore be attentively assessed by considering such differentiated attitudinal effects. Our results overall indicate that the constructs here studied could have an important role in shaping mobility behaviors, and could therefore profitably be assessed in future research endeavors.

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