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ISSN: 2365-9793

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ABSTRACT

Feelings in Travel Episodes and Extreme Temperatures

In recent decades, global warming and its relationship to individual well-being has concerned researchers and policy makers, with research focusing on the consequences of global warming on well-being. In this paper, we analyse the relationship between weather conditions and the feelings reported by individuals during daily travel episodes. We use data from the Well-Being module of the American Time Use Survey for the years 2010, 2012, 2013, and 2021, together with county-level weather information. Our findings indicate an association between extreme temperatures and certain measures of affective well-being while commuting, and notable differences are found, depending on the main travel purpose. In the current context of global warming, when daily temperatures are expected to rise in the future and heat waves will become more frequent, our findings indicate that certain travel activities could be more sensitive to rising temperatures, from an affective perspective, which may help to complement the well-being consequences of global warming.

JEL Classification: R40, I10, J22

Keywords: well-being, travel episode, purpose, extreme temperatures, time use, ATUS

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1. Introduction

Global warming has attracted the attention of researchers and policy makers because of its many negative consequences for society and for individuals. In this sense, global warming has been linked to negative consequences for mental health (Li et al., 2020; Mullins and White, 2019; Hua et al., 2023), well-being (Connolly, 2013; Noelke et al., 2016), economic equality (Diffenbaugh and Burke, 2019), work absenteeism (Heyes and Saberian, 2022), violence (Blakeslee and Fishman, 2018; Otrachshenko et al., 2021) and mortality (Deschênes and Greenstone, 2011; Barreca et al., 2016; Yu et al., 2019; Liao et al., 2023). In a context of rising daily temperatures, with less rain, and heat waves becoming more frequent, an analysis of the negative consequences of worsening weather conditions is of vital importance to be able to propose possible solutions.

One crucial individual factor that may be affected by worsening weather conditions and global warming is well-being. Individual well-being refers to judgments or evaluations made by individuals about their life-satisfaction and their ratings of happiness, sadness, stress, and other emotions (Kahneman et al., 1999). Improving the subjective well-being, quality of life, and life satisfaction of citizens has become an important policy objective in many countries and there is an expanding field of empirical research that looks at the determinants of happiness. Weather conditions have been reported to influence individual well-being, as in Kämpfer and Mutz (2013), who find that respondents surveyed on days with exceptionally sunny weather (days with sunshine duration of more than four hours and, simultaneously, days with no precipitation) reported a greater life satisfaction than respondents interviewed on days with 'ordinary' weather (i.e., mixed or bad weather).

It is well established that individuals obtain utility – instant utility or instant happiness – from their daily activities (Kahneman et al., 2004; Kahneman and Krueger, 2006; Sevilla et al., 2012), measured through feelings of enjoyment during the activities. For instance, while Kahneman et al. (2004) rank socializing and eating activities among the most enjoyable activities, commuting ranks as the worst activity. This is consistent with prior studies finding a negative relationship between commuting – travel related to work – on the well-being of workers (Stutzer and Frey, 2008; Morris, 2015; Morris and Guerra, 2015a; Morris and Hirsch, 2016; Friman et al., 2017; Gimenez-Nadal and Molina, 2019). The instant utility obtained by individuals during commuting may be affected by weather conditions, as shown by Connolly (2013), who analyzes the Princeton Affect and Time

Survey (PATS), combined with county-level weather data in the Summer of 2006, to show that lower temperatures increase happiness and reduce fatigue and stress during daily activities, while higher temperatures negatively impact life satisfaction.

Against this background, we examine the relationship between weather and commuting well-being, using representative time use data linked to the weather, collected from thousands of meteorological stations located across the US. We extend the analysis to other non-commuting episodes, given that travel episodes are necessary for meeting basic needs, such as getting to work, doing social activities, going to the grocery store, all with a significant impact on overall well-being, with spill-over effects across other life domains (due to the opportunity costs of time). In recent years, an increasing amount of research has studied the relationship between travel episodes and subjective well-being, focusing on factors such as choice of travel mode, travel duration, congestion conditions, and interactions with others.

Using data from the four waves (2010, 2012, 2013, 2021) of the Well-being Module (WBM) of the American Time Use Study (ATUS), we test the relationship between weather conditions and well-being during travel. We find that extreme temperatures are related to the individual well-being reported during travel episodes, although the relationships differ according to the main travel purpose. In particular, we find that higher maximum temperatures are related to increases in happiness and meaningfulness during unpaid work travel episodes. For personal care travel, we find reductions of happiness and increases in feelings of sadness, stress, and pain on hotter days. For leisure travel, we find that higher maximum temperatures are positively related to fatigue, whereas we find no impact during childcare trips. For commuting episodes, we find a negative relationship between daily maximum temperatures and feelings of pain, along with evidence of a non-linear effect of maximum temperatures on instant feelings during commuting and travel for unpaid work, personal care, and leisure. We note that the effects of extreme temperatures on instant feelings are small compared with other key socio-demographic determinants.

We contribute to the literature by investigating how weather conditions are related to individual well-being while travelling for a range of purposes, paying special attention to extreme temperatures. Little is known about the effects of daily weather conditions on commuter well-being, and a number of researchers have called for research examining this relationship (Böcker et al., 2016; Ettema et al., 2017; Friman et al., 2017; Abenoza

et al., 2019). We contribute to the individual well-being literature by analysing the effects of extreme temperatures as an environmental predictor. To the best of our knowledge, this is the first study to explore this relationship. In this context, it is important to distinguish whether travel episodes differentially affect individual well-being, depending on the travel purpose, travel mode, or social relationship.

The remainder of the paper is organized as follows. Section 2 summarizes prior studies. Data and variables are presented in Section 3, and Section 4 describes our econometric strategy. Results are shown in Section 5, and Section 6 sets out our conclusions.

2. Literature review

Individual well-being can be measured objectively (e.g., income, inequality, health status) and subjectively (e.g., happiness, sadness, stress, fatigue).[1] In recent years, increasing interest, both from academia, governments, and institutions, is turning away from the objective dimensions of well-being, to measure economic prosperity, analyze its determinants, and study its role in different outcomes. One important motivation behind the move toward subjective measures is that objective measures do not reflect all aspects of the quality of life of a person (Dolan et al., 2008; Stiglitz et al., 2009; Clark, 2018; De Vos, 2019).

Daily travel has been identified as affecting subjective well-being, and a body of literature has addressed the question of travel-time and well-being (Ettema et al., 2010; Chen et al., 2019). Most studies conclude that life satisfaction is lower for those with longer commutes (Stutzer and Frey, 2008; Choi et al., 2013; Stone and Schneider, 2016; Friman et al., 2017; Nie and Sousa-Poza, 2018; De Vos, 2019; Simón et al., 2020; Zijlstra and Verhetsel, 2021). For instance, Nie and Sousa-Poza (2018) use data for China, collected in 2010 from the China Family Panel Studies, finding evidence that a longer commute time is associated with lower levels of both life satisfaction and happiness, especially in commutes longer than an hour (i.e., extreme commute time). Ingelfed et al. (2019) show a non-linear association, since only those individuals who commute more than 80 km display a negative association with life satisfaction. Recently, Zijlstra and

[1] See Sandberg et al. (2023) for a description of well-being as a multidimensional concept, together with the different dimensions of individual well-being

Verhetsel (2021) use the European Working Conditions Survey (EWCS) for the year 2015, obtaining results in line with most prior findings in a cross-country setting; more time spent on commuting is negatively associated with well-being, although in some cases – such as Germany, Romania, and Hungary - the effect is close to zero.

Certain studies have paid attention to the means of travel and have shown that satisfaction varies significantly between transport modes. For instance, Morris and Guerra (2015a) use the 2010 ATUS well-being module, finding that, in comparison to car drivers and passengers, cyclists and pedestrians (public transit users) exhibit a more (less) positive mode, whereas Adam et al. (2018), using the UK Time Use Survey (UKTUS), find that commutes using passive modes of transport (e.g., car, train) are the least enjoyable activities carried out during the day, and enjoyment of active commuting (e.g., cycling, walking) is significantly higher than that of passive commuting. This finding, that travel satisfaction is highest for active transport modes, has long been common in the transport literature (Páez and Whalen, 2010; De Vos et al., 2013; St-Louis et al., 2014; Legrain et al., 2015; De Vos et al., 2016; Friman et al., 2017; Lancée et al., 2017; Smith, 2017; Westman et al., 2017; Ye and Titheridge, 2017; De Vos, 2018; Zhu and Fan, 2018; Handy and Thigpen, 2019; Mouratidis et al., 2019; Singleton, 2019; Lades et al., 2020; De Vos et al., 2022; Echeverría et al., 2022).

Other studies have shown effects of commuting on satisfaction while engaged in other activities (Adam et al., 2018; Lorenz, 2018; Gimenez-Nadal and Molina, 2019; Chatterjee et al., 2020; Clark et al., 2020). The idea is that, as time is a finite resource and we are constrained to 24 daily hours, lengthy commutes could have spill-over effects and may impact feelings reported while performing other activities, such as leisure, child care, relaxing with family and friends… Adam et al. (2018) report that commuting has little impact on an individual's enjoyment of other daily activities, with the exception of personal care and sleep, and Gimenez-Nadal and Molina (2019) show that commuting leads to negative feelings (e.g., sadness and fatigue) during activities of child care in the US. On the other hand, Clark et al. (2020) show a negative relationship between commuting time and leisure time satisfaction for England.

Nevertheless, there is some controversy in specific regional contexts and certain studies find no evidence of a negative effect of commuting on well-being (Olsson et al., 2013; Dickerson et al., 2014; Lorenz, 2018). Lorenz (2018), using panel data from the German Socio-Economic Panel (SOEP) and fixed-effects models, finds no evidence that

commuting is associated with lower satisfaction. Other works show heterogeneity in the commuter well-being response, and, for instance, Roberts et al. (2011) and Feng and Boyle (2014) show that commuting duration has negative effects on the psychological health only of women, particularly those with children, whereas Lancée et al. (2017) find that commuting is associated with lower levels of well-being for those with long work-weeks.

Recent research has analysed to what extent weather conditions are related to individual well-being. In a study of weather conditions and emotional well-being, Connolly (2013) reports that women are more responsive than men to temperature and precipitation, showing a negative relationship between rain and high temperature, on the one hand, and life satisfaction, on the other. Similarly, Noelke et al. (2016) examine the impact of ambient temperature on emotional well-being in the US, using large-sample survey responses during 2008-2013, finding that higher temperatures significantly reduce well-being. Compared to average temperatures in the 50-60 ºF range, temperatures above 70 ºF reduce positive feelings (e.g., joy, happiness), and increase negative feelings (e.g., stress, anger, fatigue). These authors report heterogeneity results by age and education level, since the effects are particularly strong among less educated and older Americans, possibly due to their greater exposure to high temperatures. Frijters et al. (2020) find that the effects of weather on individual well-being are very small in the US.

To the best of our knowledge, only a study by Ettema et al. (2017) and another from Abenoza et al. (2019) specifically explore travel satisfaction during adverse weather conditions. Ettema et al. (2017) focus on three Swedish cities (Stockholm, Göteborg, and Karlstad) in Summer, and on a specific travel activity, the commute to work. They find that temperature leads to a more positive mood, wind leads to higher activation for public transit, and sunshine leads to a more negative mood for cyclists and pedestrians. By contrast, Abenoza et al. (2019) examine how weather characteristics impact overall commuter satisfaction in Sweden. They study Stockholm County and use data from four meteorological stations, showing that temperature, precipitation, and snow cover have an impact on the travel experience. Against these works, our study includes a variety of travel activities, classified according to the main purpose into five categories, six different affective dimensions of subjective well-being, and daily maximum temperatures collected from thousands of meteorological stations located around the US, during four entire

survey years. The greater sample size of our nationally representative dataset, covering all of the US, allows us to estimate robust relationships.

3. Data and variables

Our data are drawn from the American Time Use Survey (ATUS) and the National Oceanic and Atmospheric Administration (NOAA) of the National Climatic Data Center (NCDC). The ATUS, a joint project of the Bureau of Labor Statistics and the US Census Bureau, conducted every year since January 2003, is a time-diary study that provides nationally representative data on how, where (including all of the noteworthy transport modes for travel activities), and with whom Americans who are at least 15 years of age spend their time during a 24-hour period on a preassigned day of the week (the "diary day"), from 4 AM on the pre-selected day to 4 AM of the interview day. Data are collected through Computer-assisted telephone interviews (CATI) for every day of the week, with weekend days oversampled, due to the fact that approximately one half of the diaries come from Saturdays and Sundays, whereas one half of the sample is allocated to weekdays. Respondents in the ATUS are collected from a subset of households who have recently completed the Current Population Survey (CPS). The survey is available in both English and Spanish, the two most common languages in the US.

The data set contains detailed diary recording of all activities performed by a person on one specific survey day. Each activity is assigned to one category, according to the primary nature of the activity, and there are roughly 101 travel purposes. In addition, further relevant information about these activities – such as duration, start and end time, place, mode of transportation, and purpose – is collected. The data set contains detailed socio-demographic and economic information about the respondents (such as demographics, labour market status, and income) as well as various household characteristics (such as spouse and child characteristics). Only one person of each household fills in the time use diary, so there is time use information for one individual per household.

In 2010, 2012, 2013 and 2021 the ATUS conducted a Well-Being Module (WBM) that collects quality of life data for three randomly selected episodes/activities reported for

each respondent.[2] Specifically, the WBM sampled three randomly selected daily activities and asked participants, in random order, about the extent to which they felt happiness, sadness, fatigue, pain, and stress during each episode, using a 7-point Likert scale of 0 to 6, in which zero indicates a low intensity ("did not experience the feeling at all") and 6 a high intensity ("feeling was extremely strong").[3] The module also asked one question about how meaningful the activity was, using a similar 7-point Likert scale too. This supplemental survey was added to the ATUS diary data to capture how individuals felt during selected activities and we use these responses as a proxy for individual well-being.[4]

Information about the county and day of the interview was used to add information on local weather conditions. Thus, respondents in a given county are assigned to the same weather on the same diary day (i.e., the day when they performed all the activities, the day prior to the interview day). However, the county of residence can only be identified for a part of the ATUS sample, since, due to confidentiality issues, only counties over 100,000 inhabitants are identified. Daily data at the county level for maximum temperature, in degrees Fahrenheit, were obtained from the NCDC of the NOAA, which provides historical weather data from thousands of weather stations across the United States.[5]

We restrict the sample to travel episodes with no missing well-being information, given that we want to analyze the relationship between weather conditions and well-being

[2] Note that the limitation of observing only three activities per respondent limits our sample size. The response rate in these years fluctuated between 39.4% in 2021 and 59.9% in 2010.

[3] The 2010-2012-2013 WB Modules were funded by the National Institute on Aging (NIA) and in 2021 the University of Maryland and the University of Minnesota, with grants from the National Institute for Child Health and Human Development and the National Science Foundation, sponsoring collection of the well-being module in the ATUS. The 2010-2012-2013 WB Modules were fielded for the three full years. In 2021, the WB Module was fielded between March 1, 2021 and December 31, 2021.

[4] This method of measuring feelings during activities is similar to a partial Day Reconstruction Method (DRM), since the module does not collect well-being ratings for all episodes of the day, due to time and resource limitations. Respondents are only interviewed once in the ATUS questionnaire. In the well-being module, respondents first 'reconstruct' the previous day and list all the activities in sequential order, with whom and where they did these activities. Next, they rate their feelings during three activities lasting at least 5 minutes, randomly chosen, excluding times respondents reported sleeping, grooming, and engaging in personal activities. Thus, DRM is a combination of time use and affective experience reported in activities. Consequently, it should be acknowledged that errors remembering feelings could introduce a potential memory bias (Xu and Schwarz, 2009; Schwarz and Xu, 2011; Lancée et al., 2017), although validation studies have indicated that the DRM is an acceptable approximation of experience sampling methods, recording feelings directly during activities (Grube et al., 2008; Ettema et al., 2012; Diener and Tray, 2014; Tweten et al., 2016; Stone and Schneider, 2016), since the time gap between the diary day and the reconstructed activity is shorter. We refer the reader to Kahneman et al. (2004) and Krueger et al. (2009) for more detail.

[5] The weather data were retrieved from https://www.ncdc.noaa.gov/cdo-web/datatools from thousands of weather stations spread across the US.

during travel episodes. We also drop observations with missing information on key socio-demographics, leaving us with a final sample of 14,752 travel episodes. We classify travel activities into five categories: commuting (travel to/from work), unpaid work travel (housework travel, household maintenance, travel to grocery shop, travel related to banking), personal care travel (travel related to eating and drinking), childcare travel (travel related to children) and leisure travel (travel related to volunteering or spiritual practices, travel related to socializing, travel related to arts and entertainment, travel related to exercise).[6]

Table 1 shows summary statistics of the travel categories. There are 14,752 episodes, which range from 1,148 for childcare travel to 5,256 unpaid work travel. The latter is the most frequent travel purpose, at around 35.63 per cent of all travel episodes, while childcare travel is the least frequent, around 7.78 per cent. For each travel episode, the average duration ranges from 24.69 minutes for childcare travel episodes to 83.59 minutes for leisure travel episodes. The average duration of commuting, unpaid work, and personal care trips episodes is 40.42, 49.18 and 60.19 minutes, respectively. Additionally, commuting by car is the most frequent method of travel, accounting for around 78.7 to 89.4 per cent, depending on the travel purpose. The proportion of travel that is done by public transit is around 0.1 to 6.8 per cent, while the proportion of travel made by active modes accounts for around 2.6 to 8.4 per cent. The proportion of travel taken in the presence of others is around 15.2 to 82.4 per cent. Specifically, for commuting travel episodes, 15.2 per cent of episodes is with others. In the case of unpaid work travel episodes, 65.5 per cent of episodes are with others. For personal care travel, 80.2 per cent are with others. For episodes of childcare travel, 82.4 per cent are with others, while around 73.1 per cent of leisure travel are with others.[7]

Table 1 also shows the average values of reported feelings during the various travel episodes. We observe that the highest levels of happiness and meaningfulness correspond to childcare travel episodes, while the highest levels of sadness, fatigue and stress correspond to commuting episodes. The highest levels of pain correspond to unpaid work travel episodes. Specifically, the average happiness and meaningfulness ratings during

[6] We refer the reader to Table A1 in the Appendix for a detailed description of the activity codes included in each travel category.

[7] For a detailed description of all variable definitions, see appendix Table A2. See Table A3 in the Appendix for summary statistics of the variables used in the manuscript, for each travel activity sub-sample (commuting travel, unpaid work travel, personal care travel, childcare travel, leisure travel).

childcare travel episodes are 4.680 and 4.767., Respondents during commuting travel episodes report average levels of sadness, fatigue, and stress of 0.673, 2.560 and 1.818, respectively, whil the average level of pain during unpaid work travel episodes is 0.832.

Several explanatory variables are defined in order to control for the personal heterogeneity of individuals, following prior studies analysing the determinants of affective well-being. The individual characteristics included are gender, age, education level, migration status, employment status, marital status, and household characteristics. Gender is categorized as a binary variable that takes value 1 for males and 0 otherwise (female and other). Age is defined as a continuous variable, measured in years. Education attainment is transformed into three binary variables, coded for less than high school, high school graduate, and some college of associate degree or higher. Native status is dichotomized through a dummy variable that takes value 1 for foreign citizens, 0 otherwise. Employment status is controlled through a dummy variable that takes value 1 for those employed. Marital status is measured through a dummy variable with no cohabiting and unmarried individuals as the reference group. The other household characteristics are household total (gross) income, household size, and total number of children under 18. We reclassify household income into three categories (low, middle, and high) from its original sixteen categories. Since the household income information in the ATUS is categorical, the thresholds to classify the low-, middle-, and high-income variables are set as below $25,000, between $25,001 and $75,000, and above $75,001, respectively.

4. Econometric strategy

To model the relationships between weather conditions and well-being while travelling, we use ordinary least squares (OLS) regression models with survey demographic weights at the activity level, and apply cluster standard errors by individual. Specifically, we estimate the following linear regression, separately for each travel category (commuting, unpaid work, personal care, childcare, leisure):

$$SWB_{ijt} = \alpha + \delta_1 Tmax_{ijt} + \delta_2 Tmax_{ijt}^2 + X'_{ijt}\beta_X + A'_{ijt}\beta_A + \gamma_s + \theta_m + \eta_t + \varepsilon_{ijt} \quad (1)$$

where subscript i denotes individuals, s denotes states, j denotes county of residence, and t denotes survey years. The dependent variable, SWB_{ijt}, is the outcome-feeling variable (happiness, meaning, sadness, fatigue, stress, or pain) reported by respondent i

in county j at time t. We standardize each subjective measure by using the z-score, subtracting the mean and dividing by the standard deviation, so that all estimated coefficients can be interpreted in terms of standard deviations of the instant feeling measure.[8] We perform this transformation on our dependent variables for each sub-sample (commuting travel, unpaid work travel, personal care travel, childcare travel, and leisure travel). $Tmax_{ijt}$ is the daily maximum temperature for individual i in county j at time t, and we include its quadratic form to test for any non-linearity of maximum temperature on subjective well-being. X_{ijt} is the vector of socioeconomic characteristics of individual i, and A_{ijt} is the vector of activity-related variables. Measurement errors are described by ε_{ijt}, the regression error term. Given our interest in weather conditions on individual's well-being during travel, our coefficients of interest are δ_1 and δ_2.

The individual control variables include gender (ref.: female); age and its square (divided by 100); highest education completed (ref.: primary education); being an immigrant (ref.: native individuals); employment status (ref.: non-employees); living with a married/unmarried partner; the number of children in the household; the household size; total household income (ref.: low household income, less than $25,000); and whether the interview was conducted on a weekend day. Since we restrict our analysis to travel episodes, we also include controls for the travel activity duration (because the travel episode durations are right skewed, they are logged), the mode of transport used (public transit, and active mode of transport; ref.: private vehicle), and the presence of others when the activity was done (e.g., spouse, parent, children, other family member, friends), with being alone as our category reference. All these activity-related variables are included in the vector A_{ijt}. Most have been shown to have an impact on life satisfaction and individual well-being (Dolan et al., 2008; Dickerson et al., 2014; Morris and Hirsch, 2016; Lorenz, 2018).

We also include state fixed effects, denoted by γ_s, to control for any unobserved heterogeneity at the regional level and account for permanent differences across states that may simultaneously influence travel, daily maximum temperature, and subjective well-being. Time-specific effects are captured by the year dummies η_t, which are included to account for unobserved factors pertaining to a specific year (2021 is the

[8] The z-score of instant feelings variables has been calculated using the formula; z-score = $\frac{X-\mu}{\sigma}$, where X is the raw instant-feeling score, μ is the mean and σ is the standard deviation of the variable X, in each sub-sample.

reference survey year), whereas the variable θ_m describes month dummies and controls for any seasonal pattern in $SWB_{ij,t}$ (with December as the reference month category).

5. Results

Tables 2 to 6 show the results of estimating Equation (1), differentiating by travel purpose and using OLS as the method of estimation.[9] We estimate the same six OLS regressions for each travel activity, including in each model six different instant-emotions as dependent variables. We are interested in the parameters of maximum temperature and the results show different relationships according to the main trip purpose. Specifically, daily maximum temperature is negatively related to instant feelings of pain during commuting episodes, whereas it is associated positively to positive emotions during unpaid work travel episodes. For personal care and leisure travel episodes, we document a positive relationship with negative emotions.

Regarding the relationship between daily maximum temperatures and well-being while commuting, we observe a U-shaped relationship between maximum temperature and feelings of pain, with the lowest value for maximum temperatures starting at 60ºF. Up to that point, an increase of 1ºF in daily maximum temperature is associated with a decrease of 2.4 percent of a standard deviation of pain during commuting episodes. For unpaid work travel, by contrast, we obtain an inverted U-shaped relationship to happiness and meaningfulness, with the maximum happiness level being reached for maximum temperatures above 54.76ºF, and the maximum level of meaning being achieved at 57.5ºF. For temperatures below 54.76, an increase of 1ºF in maximum temperature increases happiness by 2.3% of a standard deviation, and for maximum temperatures below 57.5 an increase of 1ºF is related to an increase of 2.3% of a standard deviation in meaningfulness. In the case of personal care travel, we document a non-linear relationship with happiness (U-shaped), sadness, stress, and pain (inverted U-shaped).

Furthermore, for daily maximum temperatures below 76.56ºF, an increase of one degree Fahrenheit in daily maximum temperature is related to an increase of 4.9 percent of a standard deviation in sadness during personal care travel, and for maximum

[9] See Tables A4-A8 for full set of estimates. Although the explanatory power in all models is not high (the R^2 in our full OLS models ranges from 0.080 to 0.291), suggesting the role of unobserved variables as potential determinants of emotional well-being, recent studies examining individual well-being during specific trips have obtained comparable explanatory power (Morris, 2015; Morris and Guerra, 2015a, 2015b; Morris and Hirsch, 2016; Gimenez-Nadal and Molina, 2019; Echeverría et al., 2022).

temperatures below 67.14ºF an increase of one degree Fahrenheit in daily maximum temperature is associated with an increase of 4.7 percent of a standard deviation in stress during personal care travel. For childcare travel we obtain no statistically significant effect of daily maximum temperatures, suggesting no relationship between extreme temperatures and well-being during those trips, while for leisure travel the estimates suggest an inverted U-shape with fatigue, with the maximum level of fatigue being reached during days with maximum temperatures over 57.89ºF.

Focusing on the relationship between travel duration and instant utility, we observe that the duration of the travel episode is positively related to negative feelings for all travel episodes, although the estimates differ according to the purpose of the travel episode, suggesting travel-specific effects on instant feelings. For commuting episodes, we obtain a negative statistically significant coefficient for happiness, while the estimates suggest a positive relationship to sadness, fatigue, and stress, in line with prior research using the ATUS database and the WB Module for the three first waves (Gimenez-Nadal and Molina, 2019). Specifically, a 1 percent increase in the time devoted to commuting during the episode is related to a reduction of happiness by 21.1 percent of a standard deviation, while it is related to increases of 8.8, 11.4, and 17.9 percent of a standard deviation in sadness, fatigue, and stress, respectively.

For unpaid work travel episodes (Table 3), we obtain a statistically significant positive relationship between episode duration and fatigue feelings, and a one percent increase in the unpaid work travel duration results in an increase of 7.9 percent of a standard deviation for fatigue. For personal care travel (Table 4), we also obtain a positive relationship between travel duration and all the negative feelings (i.e., sadness, fatigue, stress, pain), statistically significant at the 5% level, and these coefficients fluctuate between 10.5 and 21.2 percent of a standard deviation, depending on the instant-feeling considered. Similar estimates are reported for leisure travel episodes (Table 6), and the estimates range from 12.8 and 19.6 percent of a standard deviation. For childcare travel episodes (Table 5), the estimates suggest a positive relationship, statistically significant at the 1% level, with fatigue and stress. Specifically, an increase of one percent in the time devoted to childcare trips increases by 17.7 percent and 19.9 percent of one standard deviation the levels of fatigue and stress reported, respectively.

We also observe that mode of transport and travel companionship are related to the feelings reported during travel episodes. For means of transport, as previously noted in

Section 2, prior research has documented that active users are more satisfied than those using passive means of transport. Nevertheless, we do not find this relationship for any travel. These findings contrast with UK studies (Adam et al., 2018; Echeverría et al., 2022), suggesting a complex relationship between individual well-being and travel activities in general, and travel modes in particular. For public transit, we obtain different estimates according to travel purpose; for example, a negative, statistically significant relationship to sadness, fatigue, and pain during leisure travel episodes, while there is a negative relationship, statistically significant at the 1 per cent level, to meaningfulness during commuting episodes. These estimates also suggest that the relationship between different means of transport and individual well-being could be country-specific.

Regarding the presence of others during travel episodes, we find that travel companionship is positively related to happiness during commuting, unpaid work, personal, and leisure travel. Specifically, travelling with others is related to an increase of around 24.1 to 37.2 percent of a standard deviation in happiness. The estimates also suggest a negative relationship of commuting in company to stress during unpaid work travel (a statistically significant coefficient of -0.169) and sadness during leisure travel (a statistically significant coefficient of -0.294). These results are in line with prior research documenting that commuting alone, in contrast to commuting in company, has a negative impact on travel satisfaction (Mokhtarian et al., 2015; Morris and Guerra, 2015a, 2015b; Lancée et al., 2017; Zhu and Fan, 2018; De Vos, 2019).

Several socio-demographic characteristics are related to feelings reported during travel episodes, in line with prior studies of well-being (full results appear in Appendix Tables A4-A8). We obtain different estimates for socio-demographics according to travel purpose. For commuting episodes, those with higher education report lower levels of sadness, fatigue and pain, and weekend commuting episodes are positively related to sadness. By contrast, cohabiting couples declare less sadness and fatigue during unpaid work travel episodes, and employed individuals declare more fatigue. Weekend days also appear related to instant emotions during personal care and childcare travel, although the estimates differ. On the one hand, weekend personal care travel episodes are positively related to interest and negatively related to fatigue, while weekend childcare travel episodes are negatively related to stress emotions. Hence, weekend days are better valued in instant utility terms for personal and childcare travel episodes. Finally, we obtain for

leisure travel that men report lower levels of fatigue, stress and pain, married individuals are happier and less stressed, and weekend days are negatively related to fatigue emotions.

6. Conclusions

This paper provides evidence of the relationship between weather and instant feelings reported during daily travel episodes. Few researchers have investigated how weather is perceived during travel and this study is, to the best of our knowledge, the first to report relationships between temperature and different affective well-being measures while commuting. To do this, we link time use data containing well-being information from the ATUS, a nationally representative survey, with daily temperature information collected at the county level from the NCDC. Our empirical strategy offers a broad coverage of the country, which has significant spatial variation in weather conditions among states/counties and seasons, allowing for the identification of the relationship of temperature to well-being during travel. In the context of global warming, with higher temperatures, the analysis of how temperature is related to the feelings of travellers is an important issue.

We find that daily maximum temperature is negatively related to instant feelings of pain during commuting episodes, while it is associated positively with positive emotions during unpaid work travel episodes. For personal care and leisure travel episodes, we document a positive relationship with negative emotions. Thus, extreme temperatures and feelings during travel episodes are related, although the results are not common across travel time-use categories.

This study is not without limitations. First, our findings rely on the ATUS, so ounot be generalizable. The study deals with one country, the US. We cannot be sure that our results would hold in other geographical contexts and future studies must provide more evidence for other countries. Second, we use cross-sectional data, so we are unable to infer causation and results are subject to permanent individual heterogeneity in preferences. Future research should deal with the relationship between the purpose of daily trips, weather, and well-being, using a variety of datasets. Given that we only analyze one diary per respondent, future research must use panel data, preferably using travel diary data with a longitudinal structure, to have the same sample of respondents

during different seasons of the year. Nevertheless, to our knowledge, at present there are no such panels of time use surveys available.

The more obvious policy implication is that, despite that extreme temperatures are outside of the control of transit planners, policy makers should try to minimize and mitigate the negative impacts on travel well-being. Suggested policies include air-conditioning technologies in public transit and improving shelter in travel stations, such as bus stops. In the current global-warming context, we can anticipate that unpaid work, personal, and leisure travel episodes will be more affected, in comparison to other travel purposes, such as commuting or childcare. Adapting transport infrastructure to extreme temperatures for those travel episodes is another potential solution. However, this can be at the cost of increasing energy consumption, aggravating the problem of global warming. The use of sustainable, green modes of transport, as argued by Gimenez-Nadal et al. (2021), for morning commutes, for instance, could be proposed as an important awareness policy.

REFERENCES

Abenoza, R. F., Liu, C., Cats, O., & Susilo, Y. O. (2019). What is the role of weather, built-environment and accessibility geographical characteristics in influencing travelers' experience?. Transportation Research Part A: Policy and Practice, 122, 34-50. https://doi.org/10.1016/j.tra.2019.01.026

Adam, Z., Walasek, L., & Meyer, C. (2018). Workforce commuting and subjective well-being. Travel Behaviour and Society, 13, 183-196. https://doi.org/10.1016/j.tbs.2018.08.006

Barreca, A., Clay, K., Deschenes, O., Greenstone, M., & Shapiro, J. S. (2016). Adapting to climate change: The remarkable decline in the US temperature-mortality relationship over the twentieth century. Journal of Political Economy, 124(1), 105-159. https://doi.org/10.1086/684582

Blakeslee, D. S., & Fishman, R. (2018). Weather shocks, agriculture, and crime evidence from India. Journal of Human Resources, 53(3), 750-782. https://doi.org/10.3368/jhr.53.3.0715-7234R1

Böcker, L., Dijst, M., & Faber, J. (2016). Weather, transport mode choices and emotional travel experiences. Transportation Research Part A: Policy and Practice, 94, 360-373. https://doi.org/10.1016/j.tra.2016.09.021

Chatterjee, K., Chng, S., Clark, B., Davis, A., De Vos, J., Ettema, D., Handy, S., Martin, A., & Reardon, L. (2020). Commuting and wellbeing: a critical overview of the literature with implications for policy and future research. Transport Reviews, 40(1), 5-34. https://doi.org/10.1080/01441647.2019.1649317

Chen, S., Fan, Y., Cao, Y., & Khattak, A. (2019). Assessing the relative importance of factors influencing travel happiness. Travel Behaviour and Society, 16, 185-191. https://doi.org/10.1016/j.tbs.2019.01.002

Choi, J., Coughlin, J. F., & D'Ambrosio, L. (2013). Travel time and subjective well-being. Transportation Research Record, 2357(1), 100-108. https://doi.org/10.3141/2357-12

Clark, A. E. (2018). Four decades of the economics of happiness: Where next?. Review of Income and Wealth, 64(2), 245-269. https://doi.org/10.1111/roiw.12369

Clark, B., Chatterjee, K., Martin, A., & Davis, A. (2020). How commuting affects subjective wellbeing. Transportation, 47(6), 2777-2805. https://doi.org/10.1007/s11116-019-09983-9

Connolly, M. (2013). Some like it mild and not too wet: The influence of weather on subjective well-being. Journal of Happiness Studies, 14, 457-473. https://doi.org/10.1007/s10902-012-9338-2

De Vos, J. (2018). Do people travel with their preferred travel mode? Analysing the extent of travel mode dissonance and its effect on travel satisfaction. Transportation Research Part A: Policy and Practice, 117, 261-274. https://doi.org/10.1016/j.tra.2018.08.034

De Vos, J. (2019). Analysing the effect of travel satisfaction on satisfaction with the leisure activity at the destination of the trip, in relationship with life satisfaction. Transportation, 46(3), 623-645. https://doi.org/10.1007/s11116-017-9812-0

De Vos, J., Schwanen, T., Van Acker, V., & Witlox, F. (2013). Travel and subjective well-being: A focus on findings, methods and future research needs. Transport Reviews, 33(4), 421-442. https://doi.org/10.1080/01441647.2013.815665

De Vos, J., Mokhtarian, P. L., Schwanen, T., Van Acker, V., & Witlox, F. (2016). Travel mode choice and travel satisfaction: bridging the gap between decision utility and

experienced utility. Transportation, 43(5), 771-796. https://doi.org/10.1007/s11116-015-9619-9

De Vos, J., Le, H. T., & Kroesen, M. (2022). Does commute duration attenuate the effect of travel mode choice on commute satisfaction?. Travel Behaviour and Society, 28, 13-21. https://doi.org/10.1016/j.tbs.2022.02.004

Deschênes, O., & Greenstone, M. (2011). Climate change, mortality, and adaptation: Evidence from annual fluctuations in weather in the US. American Economic Journal: Applied Economics, 3(4), 152-185. https://doi.org/10.1257/app.3.4.152

Dickerson, A., Hole, A. R., & Munford, L. A. (2014). The relationship between well-being and commuting revisited: Does the choice of methodology matter?. Regional Science and Urban Economics, 49, 321-329. https://doi.org/10.1016/j.regsciurbeco.2014.09.004

Diener, E., & Tay, L. (2014). Review of the day reconstruction method (DRM). Social Indicators Research, 116(1), 255-267. https://doi.org/10.1007/s11205-013-0279-x

Diffenbaugh, N. S., & Burke, M. (2019). Global warming has increased global economic inequality. Proceedings of the National Academy of Sciences, 116(20), 9808-9813. https://doi.org/10.1073/pnas.1816020116

Dolan, P., Peasgood, T., & White, M. (2008). Do we really know what makes us happy? A review of the economic literature on the factors associated with subjective well-being. Journal of Economic Psychology, 29(1), 94-122. https://doi.org/10.1016/j.joep.2007.09.001

Echeverría, L., Gimenez-Nadal, J. I., & Molina, J. A. (2022). Green mobility and well-being. Ecological Economics, 195, 107368. https://doi.org/10.1016/j.ecolecon.2022.107368

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. https://doi.org/10.1016/j.tra.2010.07.005

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. https://doi.org/10.1016/j.jtrangeo.2012.02.007

Ettema, D., Friman, M., Olsson, L. E., & Gärling, T. (2017). Season and weather effects on travel-related mood and travel satisfaction. Frontiers in Psychology, 8, 140. https://doi.org/10.3389/fpsyg.2017.00140

Feng, Z., & Boyle, P. (2014). Do long journeys to work have adverse effects on mental health?. Environment and Behavior, 46(5), 609-625. https://doi.org/10.1177/0013916512472053

Frijters, P., Lalji, C., & Pakrashi, D. (2020). Daily weather only has small effects on wellbeing in the US. Journal of Economic Behavior & Organization, 176, 747-762. https://doi.org/10.1016/j.jebo.2020.03.009

Friman, M., Gärling, T., Ettema, D., & Olsson, L. E. (2017). How does travel affect emotional well-being and life satisfaction?. Transportation Research Part A: Policy and Practice, 106, 170-180. https://doi.org/10.1016/j.tra.2017.09.024

Gimenez-Nadal, J. I., & Molina, J. A. (2019). Daily feelings of US workers and commuting time. Journal of Transport & Health, 12, 21-33. https://doi.org/10.1016/j.jth.2018.11.001

Gimenez-Nadal, J.I., Molina, J.A., & Velilla, J. (2021). Two-way commuting: Asymmetries from time use surveys. Journal of Transport Geography, 95, 103146. https://doi.org/10.1016/j.jtrangeo.2021.103146

Grube, A., Schroer, J., Hentzschel, C., & Hertel, G. (2008). The event reconstruction method: An efficient measure of experience-based job satisfaction. Journal of Occupational and Organizational Psychology, 81(4), 669-689. https://doi.org/10.1348/096317907X251578

Handy, S., & Thigpen, C. (2019). Commute quality and its implications for commute satisfaction: Exploring the role of mode, location, and other factors. Travel Behaviour and Society, 16, 241-248. https://doi.org/10.1016/j.tbs.2018.03.001

Heyes, A., & Saberian, S. (2022). Hot Days, the ability to Work and climate resilience: Evidence from a representative sample of 42,152 Indian households. Journal of Development Economics, 155, 102786. https://doi.org/10.1016/j.jdeveco.2021.102786

Hua, Y., Qiu, Y., & Tan, X. (2022). The effects of temperature on mental health: evidence from China. Journal of Population Economics, 36, 1293-1332. https://doi.org/10.1007/s00148-022-00932-y

Ingenfeld, J., Wolbring, T., & Bless, H. (2019). Commuting and life satisfaction revisited: Evidence on a non-linear relationship. Journal of Happiness Studies, 20, 2677-2709. https://doi.org/10.1007/s10902-018-0064-2

Kahneman, D., & Krueger, A. B. (2006). Developments in the measurement of subjective well-being. Journal of Economic perspectives, 20(1), 3-24. https://doi.org/10.1257/089533006776526030

Kahneman, D., Diener, E., Schwartz, N. (1999). Well-being: Foundations of Hedonic Psychology. Russell Sage Foundation, New York, NY.

Kahneman, D., Krueger, A. B., Schkade, D. A., Schwarz, N., & Stone, A. A. (2004). A survey method for characterizing daily life experience: The day reconstruction method. Science, 306(5702), 1776-1780. https://doi.org/10.1126/science.1103572

Kämpfer, S., & Mutz, M. (2013). On the sunny side of life: Sunshine effects on life satisfaction. Social Indicators Research, 110(2), 579-595. https://doi.org/10.1007/s11205-011-9945-z

Krueger, A. B., Kahneman, D., Fischler, C., Schkade, D., Schwarz, N., & Stone, A. A. (2009). Time use and individual's well-being in France and the US. Social Indicators Research, 93, 7-18. https://doi.org/10.1007/s11205-008-9415-4

Lades, L. K., Kelly, A., & Kelleher, L. (2020). Why is active travel more satisfying than motorized travel? Evidence from Dublin. Transportation Research Part A: Policy and Practice, 136, 318-333. https://doi.org/10.1016/j.tra.2020.04.007

Lancée, S., Veenhoven, R., & Burger, M. (2017). Mood during commute in the Netherlands: What way of travel feels best for what kind of people?. Transportation Research Part A: Policy and Practice, 104, 195-208. https://doi.org/10.1016/j.tra.2017.04.025

Legrain, A., Eluru, N., & El-Geneidy, A. M. (2015). Am stressed, must travel: The relationship between mode choice and commuting stress. Transportation Research Part F: Traffic Psychology and Behaviour, 34, 141-151. https://doi.org/10.1016/j.trf.2015.08.001

Li, M., Ferreira, S., & Smith, T. A. (2020). Temperature and self-reported mental health in the United States. PloS one, 15(3), e0230316. https://doi.org/10.1371/journal.pone.0230316

Liao, H., Zhang, C., Burke, P. J., Li, R., & Wei, Y. M. (2023). Extreme temperatures, mortality, and adaptation: Evidence from the county level in China. Health Economics. https://doi.org/10.1002/hec.4649

Lorenz, O. (2018). Does commuting matter to subjective well-being?. Journal of Transport Geography, 66, 180-199. https://doi.org/10.1016/j.jtrangeo.2017.11.019

Mokhtarian, P. L., Papon, F., Goulard, M., & Diana, M. (2015). What makes travel pleasant and/or tiring? An investigation based on the French National Travel Survey. Transportation, 42, 1103-1128. https://doi.org/10.1007/s11116-014-9557-y

Morris, E. A. (2015). Should we all just stay home? Travel, out-of-home activities, and life satisfaction. Transportation Research Part A: Policy and Practice, 78, 519-536. https://doi.org/10.1016/j.tra.2015.06.009

Morris, E. A., & Guerra, E. (2015a). Mood and mode: does how we travel affect how we feel?. Transportation, 42(1), 25-43. https://doi.org/10.1007/s11116-014-9521-x

Morris, E. A., & Guerra, E. (2015b). Are we there yet? travel duration and mood during travel. Transportation Research Part F: Traffic Psychology and Behaviour, 33, 38-47. https://doi.org/10.1016/j.trf.2015.06.003

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. https://doi.org/10.1016/j.tbs.2015.07.002

Mouratidis, K., Ettema, D., & Næss, P. (2019). Urban form, travel behavior, and travel satisfaction. Transportation Research Part A: Policy and Practice, 129, 306-320. https://doi.org/10.1016/j.tra.2019.09.002

Mullins, J. T., & White, C. (2019). Temperature and mental health: Evidence from the spectrum of mental health outcomes. Journal of health economics, 68, 102240. https://doi.org/10.1016/j.jhealeco.2019.102240

Nie, P., & Sousa-Poza, A. (2018). Commute time and individual's well-being in urban China. China Economic Review, 48, 188-204. https://doi.org/10.1016/j.chieco.2016.03.002

Noelke, C., McGovern, M., Corsi, D. J., Jimenez, M. P., Stern, A., Wing, I. S., & Berkman, L. (2016). Increasing ambient temperature reduces emotional well-being. Environmental Research, 151, 124-129. https://doi.org/10.1016/j.envres.2016.06.045

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. https://doi.org/10.1007/s11205-012-0003-2

Otrachshenko, V., Popova, O., & Tavares, J. (2021). Extreme temperature and extreme violence: evidence from Russia. Economic Inquiry, 59(1), 243-262. https://doi.org/10.1111/ecin.12936

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. https://doi.org/10.1016/j.tra.2010.04.003

Roberts, J., Hodgson, R., & Dolan, P. (2011). "It's driving her mad": Gender differences in the effects of commuting on psychological health. Journal of Health Economics, 30(5), 1064-1076. https://doi.org/10.1016/j.jhealeco.2011.07.006

Sandberg, B., Hurmerinta, L., Leino, H. M., Lehtonen, E., & Lyytimäki, J. (2023). Time-related aspects of commute well-being. Transportation Research Part F: Traffic Psychology and Behaviour, 95, 177-187. https://doi.org/10.1016/j.trf.2023.04.010

Schwarz, N., & Xu, J. (2011). Why don't we learn from poor choices? The consistency of expectation, choice, and memory clouds the lessons of experience. Journal of Consumer Psychology, 21(2), 142-145. https://doi.org/10.1016/j.jcps.2011.02.006

Sevilla, A., Gimenez-Nadal, J. I., & Gershuny, J. (2012). Leisure inequality in the United States: 1965–2003. Demography, 49(3), 939-964. https://doi.org/10.1007/s13524-012-0100-5

Simón, H., Casado-Díaz, J. M., & Lillo-Bañuls, A. (2020). Exploring the effects of commuting on workers' satisfaction: evidence for Spain. Regional Studies, 54(4), 550-562. https://doi.org/10.1080/00343404.2018.1542128

Singleton, P. A. (2019). Walking (and cycling) to well-being: Modal and other determinants of individual's well-being during the commute. Travel Behaviour and Society, 16, 249-261. https://doi.org/10.1016/j.tbs.2018.02.005

Smith, O. (2017). Commute well-being differences by mode: Evidence from Portland, Oregon, USA. Journal of Transport & Health, 4, 246-254. https://doi.org/10.1016/j.jth.2016.08.005

Stiglitz, J. E., Sen, A., & Fitoussi, J. P. (2009). Report by the commission on the measurement of economic performance and social progress. Paris, France: Commission on the Measurement of Economic Performance and Social Progress.

St-Louis, E., Manaugh, K., van Lierop, D., & El-Geneidy, A. (2014). The happy commuter: A comparison of commuter satisfaction across modes. Transportation Research Part F: Traffic Psychology and Behaviour, 26, 160-170. https://doi.org/10.1016/j.trf.2014.07.004

Stone, A. A., & Schneider, S. (2016). Commuting episodes in the United States: Their correlates with experiential wellbeing from the American Time Use Survey. Transportation Research Part F: Traffic Psychology and Behaviour, 42, 117-124. https://doi.org/10.1016/j.trf.2016.07.004

Stutzer, A., & Frey, B. S. (2008). Stress that doesn't pay: The commuting paradox. Scandinavian Journal of Economics, 110(2), 339-366. https://doi.org/10.1111/j.1467-9442.2008.00542.x

Tweten, C., Anusic, I., Lucas, R. E., & Donnellan, M. B. (2016). A direct comparison of the Experience Sampling Method (ESM) and the Day Reconstruction Method (DRM). Retrieved from https://osf.io/5mjys/

Westman, J., Olsson, L. E., Gärling, T., & Friman, M. (2017). Children's travel to school: satisfaction, current mood, and cognitive performance. Transportation, 44(6), 1365-1382. https://doi.org/10.1007/s11116-016-9705-7

Xu, J., & Schwarz, N. (2009). Do we really need a reason to indulge?. Journal of Marketing Research, 46(1), 25-36. https://doi.org/10.1509/jmkr.46.1.25

Ye, R., & Titheridge, H. (2017). Satisfaction with the commute: The role of travel mode choice, built environment and attitudes. Transportation Research Part D: Transport and Environment, 52, 535-547. https://doi.org/10.1016/j.trd.2016.06.011

Zhu, J., & Fan, Y. (2018). Daily travel behavior and emotional well-being: Effects of travel mode, duration, purpose, and companionship. Transportation Research Part A: Policy and Practice, 118, 360-373. https://doi.org/10.1016/j.tra.2018.09.019

Zijlstra, T., & Verhetsel, A. (2021). The commuters' burden: The relationship between commuting and wellbeing in Europe. Travel Behaviour and Society, 23, 108-119. https://doi.org/10.1016/j.tbs.2020.12.007

Table 1. Travel categories characteristics based on purpose

	Total	Commuting	Unpaid work	Personal care	Childcare	Leisure
Number of episodes	14,752	2,185	5,256	1,915	1,148	4,248
Percentage	100.000	14.812	35.629	12.981	7.782	28.796
Duration (minutes)	57.207	40.421	49.176	60.190	24.691	83.590
% car	0.853	0.870	0.894	0.867	0.850	0.787
% public mode of transit	0.037	0.068	0.022	0.048	0.001	0.040
% active mode of transport	0.036	0.026	0.037	0.030	0.084	0.033
With other	0.618	0.152	0.655	0.802	0.824	0.731
Happiness	4.459	4.126	4.396	4.664	4.680	4.602
Meaningfulness	4.113	3.778	3.969	4.092	4.767	4.353
Sadness	0.614	0.673	0.641	0.580	0.393	0.609
Fatigue	2.321	2.560	2.217	2.441	2.324	2.251
Stress	1.403	1.818	1.386	1.078	1.651	1.249
Pain	0.793	0.796	0.832	0.747	0.611	0.804

Notes: Sample consists of respondents from the Well-Being Modules of the American Time Use Survey 2010, 2012, 2013 and 2021. Statistics are sample weighted using sampling demographic weights at the activity level.

Table 2. Main estimates: Commuting episodes

	(1) Happiness	(2) Meaningfulness	(3) Sadness	(4) Fatigue	(5) Stress	(6) Pain
Maximum temperature	-0.010	-0.012	0.001	-0.004	0.014	-0.024**
	(0.012)	(0.012)	(0.011)	(0.012)	(0.012)	(0.012)
Maximum temperature squared	0.008	0.012	0.002	0.001	-0.013	0.020**
	(0.009)	(0.009)	(0.009)	(0.010)	(0.010)	(0.009)
(log) commuting episode	-0.211***	-0.005	0.088**	0.114**	0.179***	0.064
	(0.056)	(0.044)	(0.044)	(0.053)	(0.057)	(0.053)
Public mode of transit	-0.210	-0.326***	0.145	0.295*	0.053	0.030
	(0.155)	(0.125)	(0.136)	(0.174)	(0.178)	(0.148)
Active mode of transport	-0.095	-0.093	0.247	0.137	0.114	0.083
	(0.116)	(0.115)	(0.168)	(0.177)	(0.203)	(0.155)
With other	0.372***	0.179*	0.017	0.039	-0.125	0.108
	(0.102)	(0.093)	(0.096)	(0.100)	(0.105)	(0.110)
Socio-demographics	X	X	X	X	X	X
State F.E.	X	X	X	X	X	X
Month F.E.	X	X	X	X	X	X
Year F.E.	X	X	X	X	X	X
R^2	0.141	0.177	0.080	0.119	0.119	0.139
Number of observations	2,185	2,185	2,185	2,185	2,185	2,185

Notes: OLS regressions of affective well-being measures. Each column represents coefficients in a separate regression. Dependent variables are standardized (z-score). Robust standard errors clustered at the individual level in parentheses. Sample consists of respondents from the Well-Being Modules of the American Time Use Survey 2010, 2012, 2013 and 2021. * Statistically significant at the 10% level; ** at the 5% level; *** at the 1% level.

Table 3. Main estimates: Unpaid work travel episodes

	(1) Happiness	(2) Meaningfulness	(3) Sadness	(4) Fatigue	(5) Stress	(6) Pain
Maximum temperature	0.023**	0.023**	-0.010	-0.005	0.004	-0.004
	(0.011)	(0.011)	(0.011)	(0.010)	(0.010)	(0.009)
Maximum temperature squared	-0.021**	-0.020**	0.007	0.008	-0.003	0.005
	(0.008)	(0.008)	(0.008)	(0.008)	(0.007)	(0.007)
(log) unpaid work travel episode	-0.009	-0.028	0.071*	0.079***	0.048	-0.008
	(0.041)	(0.035)	(0.038)	(0.029)	(0.031)	(0.027)
Public transit	-0.305	-0.006	0.336	0.287	0.440*	0.323
	(0.253)	(0.199)	(0.328)	(0.241)	(0.259)	(0.292)
Active mode of transport	0.022	0.191**	0.171	0.097	0.016	0.217*
	(0.117)	(0.094)	(0.126)	(0.126)	(0.116)	(0.117)
With other	0.367***	0.421***	-0.108*	0.007	-0.169***	-0.011
	(0.074)	(0.068)	(0.058)	(0.059)	(0.061)	(0.059)
Socio-demographics	X	X	X	X	X	X
State F.E.	X	X	X	X	X	X
Month F.E.	X	X	X	X	X	X
Year F.E.	X	X	X	X	X	X
R^2	0.115	0.164	0.128	0.138	0.124	0.132
Number of observations	5,256	5,256	5,256	5,256	5,256	5,256

Notes: OLS regressions of affective well-being measures. Each column represents coefficients in a separate regression. Dependent variables are standardized (z-score). Robust standard errors clustered at the individual level in parentheses. Sample consists of respondents of the Well-Being Modules of the American Time Use Survey 2010, 2012, 2013, 2021. * Statistically significant at the 10% level; ** at the 5% level; *** at the 1% level.

Table 4. Main estimates: Personal care travel episodes

	(1) Happiness	(2) Meaningfulness	(3) Sadness	(4) Fatigue	(5) Stress	(6) Pain
Maximum temperature	-0.032**	0.016	0.049**	-0.012	0.047***	0.033**
	(0.015)	(0.015)	(0.019)	(0.015)	(0.017)	(0.016)
Maximum temperature squared	0.022*	-0.020*	-0.032**	0.009	-0.035**	-0.027**
	(0.012)	(0.012)	(0.015)	(0.012)	(0.014)	(0.013)
(log) personal care travel episode	-0.049	-0.097*	0.212***	0.191***	0.105**	0.170***
	(0.049)	(0.053)	(0.065)	(0.047)	(0.051)	(0.061)
Public mode of transit	0.065	0.249	-0.187	0.003	0.080	-0.294
	(0.240)	(0.226)	(0.231)	(0.236)	(0.246)	(0.212)
Active mode of transport	0.158	0.383*	0.168	-0.304	0.201	-0.262
	(0.163)	(0.231)	(0.286)	(0.186)	(0.232)	(0.164)
With other	0.265***	0.192	-0.134	0.023	-0.152	-0.057
	(0.095)	(0.119)	(0.113)	(0.101)	(0.107)	(0.124)
Socio-demographics	X	X	X	X	X	X
State F.E.	X	X	X	X	X	X
Month F.E.	X	X	X	X	X	X
Year F.E.	X	X	X	X	X	X
R^2	0.148	0.291	0.196	0.276	0.144	0.208
Number of observations	1,915	1,915	1,915	1,915	1,915	1,915

Notes: OLS regressions of affective well-being measures. Each column represents coefficients in a separate regression. Dependent variables are standardized (z-score). Robust standard errors clustered at the individual level in parentheses. Sample consists of respondents of the Well-Being Modules of the American Time Use Survey 2010, 2012, 2013, 2021. * Statistically significant at the 10% level; ** at the 5% level; *** at the 1% level.

Table 5. Main estimates: Childcare travel episodes

	(1) Happiness	(2) Meaningfulness	(3) Sadness	(4) Fatigue	(5) Stress	(6) Pain
Maximum temperature	-0.016	-0.019	0.000	0.027	-0.022	0.016
	(0.016)	(0.015)	(0.018)	(0.019)	(0.022)	(0.017)
Maximum temperature squared	0.009	0.017	0.001	-0.017	0.024	-0.014
	(0.013)	(0.012)	(0.015)	(0.015)	(0.017)	(0.013)
(log) childcare travel episode	-0.016	-0.019	-0.107*	0.177***	0.199***	-0.066
	(0.058)	(0.061)	(0.057)	(0.065)	(0.073)	(0.056)
Public mode of transit	0.610**	0.133	1.888***	-0.726*	-0.641	0.101
	(0.270)	(0.335)	(0.668)	(0.389)	(0.396)	(0.234)
Active mode of transport	0.088	0.109	0.370*	0.005	0.150	0.534**
	(0.144)	(0.122)	(0.206)	(0.185)	(0.190)	(0.241)
With other	-0.041	0.215*	0.019	-0.130	0.132	-0.158
	(0.105)	(0.114)	(0.105)	(0.117)	(0.126)	(0.109)
Socio-demographics	X	X	X	X	X	X
State F.E.	X	X	X	X	X	X
Month F.E.	X	X	X	X	X	X
Year F.E.	X	X	X	X	X	X
R^2	0.265	0.287	0.236	0.288	0.276	0.246
Number of observations	1,148	1,148	1,148	1,148	1,148	1,148

Notes: OLS regressions of affective well-being measures. Each column represents coefficients in a separate regression. Dependent variables are standardized (z-score). Robust standard errors clustered at the individual level in parentheses. Sample consists of respondents from the Well-Being Modules of the American Time Use Survey 2010, 2012, 2013 and 2021. * Statistically significant at the 10% level; ** at the 5% level; *** at the 1% level.

Table 6. Main estimates: Leisure travel episodes

	(1) Happiness	(2) Meaningfulness	(3) Sadness	(4) Fatigue	(5) Stress	(6) Pain
Maximum temperature	-0.002	0.006	-0.002	0.044**	-0.034*	-0.041
	(0.013)	(0.013)	(0.016)	(0.018)	(0.019)	(0.025)
Maximum temperature squared	0.008	-0.001	-0.005	-0.038**	0.028*	0.035
	(0.011)	(0.010)	(0.013)	(0.015)	(0.015)	(0.021)
(log) leisure travel episode	-0.063	0.037	0.196***	0.195***	0.158***	0.128***
	(0.042)	(0.038)	(0.053)	(0.046)	(0.045)	(0.046)
Public mode of transit	0.000	-0.229	-0.323**	-0.508***	-0.283*	-0.307**
	(0.269)	(0.141)	(0.129)	(0.153)	(0.160)	(0.138)
Active mode of transport	0.006	-0.113	0.171	0.136	-0.103	-0.023
	(0.124)	(0.126)	(0.176)	(0.136)	(0.126)	(0.101)
With other	0.241***	0.269***	-0.294***	-0.061	-0.094	0.089
	(0.075)	(0.080)	(0.095)	(0.069)	(0.083)	(0.074)
Socio-demographics	X	X	X	X	X	X
State F.E.	X	X	X	X	X	X
Month F.E.	X	X	X	X	X	X
Year F.E.	X	X	X	X	X	X
R^2	0.143	0.187	0.245	0.188	0.206	0.221
Number of observations	4,248	4,248	4,248	4,248	4,248	4,248

Notes: OLS regressions of affective well-being measures. Each column represents coefficients in a separate regression. Dependent variables are standardized (z-score). Robust standard errors clustered at the individual level in parentheses. Sample consists of respondents from the Well-Being Modules of the American Time Use Survey 2010, 2012, 2013 and 2021. * Statistically significant at the 10% level; ** at the 5% level; *** at the 1% level.

APPENDIX

Table A1. Classification of travel episodes

Travel categories	Time use activity description
Commuting	Travel related to working
Unpaid work travel	Travel related to housework; Travel related to food and drink preparation, clean-up, and presentation; Travel related to interior maintenance, repair, and decoration; Travel related to exterior maintenance, repair, and decoration; Travel related to lawn, garden, and houseplant care; Travel related to care for animals and pets (not veterinary care); Travel related to vehicle care and maintenance (by self); Travel related to appliance, tool, and toy set-up, repair, and maintenance (by self); Travel related to household management; Travel related to household activities, n.e.c.; Travel related to caring for household adults; Travel related to helping household adults; Travel related to caring for and helping household members, n.e.c.; Travel related to caring for and helping non-household children; Travel related to caring for non-household adults; Travel related to helping non-household adults; Travel related to registration or administrative activities; Travel related to grocery shopping; Travel related to other shopping; Travel related to purchasing food; Travel related to shopping, ex groceries, food, and gas; Travel related to purchasing gas; Travel related to consumer purchases, n.e.c.; Travel related to using financial services and banking; Travel related to using legal services; Travel related to using medical services; Travel related to using real estate services; Travel related to using veterinary services; Travel related to using household services; Travel related to using home maintenance, repair, decoration, or construction services; Travel related to using pet services (not veterinary care); Travel related to using lawn and garden services; Travel related to using vehicle maintenance and repair services; Travel related to using household services, n.e.c.; Travel related to using government services; Travel related to civic obligations and participation; Travel related to government services and civic obligations, n.e.c.; Security procedures related to traveling; Security procedures related to traveling, n.e.c.
Personal care travel	Travel related to personal care; Travel related to personal care, n.e.c.; Travel related to using personal care services; Travel related to using professional and personal care services, n.e.c.; Travel related to eating and drinking; Travel related to eating and drinking, n.e.c.
Childcare travel	Travel related to caring for and helping household children; Travel related to household children's education; Travel related to household children's health; Travel related to non-household children's education; Travel related to non-household children's health; Travel related to using childcare services
Leisure travel	Travel related to socializing and communicating; Travel related to attending or hosting social events; Travel related to relaxing and leisure; Travel related to arts and entertainment; Travel as a form of entertainment; Travel related to relaxing and leisure; Travel related to socializing, relaxing, and leisure, n.e.c.; Travel related to participating in sports, exercise, or recreation; Travel related to attending sporting or recreational events; Travel related to sports, exercise, and recreation, n.e.c.; Travel related to religious or spiritual practices; Travel related to religious or spiritual activities, n.e.c.; Travel related to volunteering; Travel related to volunteer activities, n.e.c.; Travel related to phone calls; Travel related to phone calls, n.e.c.; Traveling, n.e.c.

Source: Author's elaboration

Table A2. Variable description from ATUS

Variable	Description
Happy	Ordinal variable scaled 0-6 (7-point Likert scale); 0 = not at all, 6 = very
Meaningful	Ordinal variable scaled 0-6 (7-point Likert scale); 0 = not at all, 6 = very
Sad	Ordinal variable scaled 0-6 (7-point Likert scale); 0 = not at all, 6 = very
Tired	Ordinal variable scaled 0-6 (7-point Likert scale); 0 = not at all, 6 = very
Stressed	Ordinal variable scaled 0-6 (7-point Likert scale); 0 = not at all, 6 = very
Pain	Ordinal variable scaled 0-6 (7-point Likert scale); 0 = not at all, 6 = very
Male	Dummy variable: 1 if respondent is male, 0 if not
Age	Continuous variable: age of respondent in years as of his/her last birthday
Primary education	Dummy variable: 1 if highest level of school completed equal to 'Less than 1st grade', '1st, 2nd, 3rd, or 4th grade', '5th or 6th grade', '7th or 8th grade', '9th grade', '10th grade', '11th grade', '12th grade - no diploma', 0 if not
Secondary education	Dummy variable: 1 if highest level of school completed equal to 'High school graduate – GED', 'High school graduate – diploma', 0 if not
University education	Dummy variable: 1 if highest level of school completed equal to 'Some college but no degree', 'Associate degree - occupational vocational', 'Associate degree - academic program', 'Bachelor's degree (BA, AB, BS, etc.)', 'Master's degree (MA, MS, Meng, Med, MSW, etc.)', 'Professional school degree (MD, DDS, DVM, etc.)', 'Doctoral degree (PhD, EdD, etc.)', 0 if not
Foreign born	Dummy variable: 1 if citizenship status equal to 'Foreign born, U.S. citizen by naturalization', 'Foreign born, not a U.S. citizen', 0 if not
Employed	Dummy variable: 1 if labor force status equal to 'Employed - at work', 'Employed – absent', 0 if not
Living in couple	Dummy variable: 1 if spouse or unmarried partner present in household, 0 if not
Number of children < 18	Continuous variable: number of children under 18 in household
Family size	Continuous variable: number of people in household
Low family income	Dummy variable: 1 if family income equal to 'Less than $5,000', '$5,000 to $7,499', '$7,500 to $9,999', '$10,000 to $12,499', '$12,500 to $14,999', '$15,000 to $19,999', '$20,000 to $24,999', 0 if not
Medium family income	Dummy variable: 1 if family income equal to '$25,000 to $29,999', '$30,000 to $34,999', '$35,000 to $39,999', '$40,000 to $49,999', '$50,000 to $59,999', '$60,000 to $74,999', 0 if not
High family income	Dummy variable: 1 if family income equal to '$75,000 to $99,999', '$100,000 to $149,999', '$150,000 and over', 0 if not
Public mode of transit	Dummy variable: 1 if travelled by 'Bus', 'Subway, train', 0 if not
Active mode of transport	Dummy variable: 1 if travelled by 'Walking', 'Bicycle', 0 if not
With other	Dummy variable: 1 if trip was made with to 'Spouse', 'Unmarried partner', 'Own household child', 'Grand child', 'Parent', 'Brother sister', 'Other related person', 'Foster child', 'Housemate, roommate', 'Roomer, boarder', 'Other nonrelative', 'Own non-household child under 18', 'Parents (not living in household)', 'Other non-household family members under 18', 'Other non-household family members 18 and older (including parents-in-law)', 'Friends', 'Co-workers, colleagues, clients (non-work activities only)', 'Neighbors, acquaintances', 'Other non-household children under 18', 'Other non-household adults 18 and older', 'Boss or manager (work activities only, 2010+)', 'People whom I supervise (work activities only, 2010+)', 'Co-workers (work activities only, 2010+)', 'Customers (work activities only, 2010+', 0 if not
Weekend day	Dummy variable: 1 if diary day equal to 'Sunday', 'Saturday', 0 if not

Source: Author's elaboration

Table A3. Sum stats of sub-samples

	Commuting		Unpaid work		Personal care		Childcare		Leisure	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Maximum temperature	71.658	17.406	71.820	17.503	72.038	17.633	70.632	16.483	71.338	17.899
Male	0.594	0.491	0.465	0.499	0.482	0.500	0.309	0.462	0.560	0.496
Age	42.365	13.384	42.673	17.916	42.284	18.060	37.845	9.871	41.564	18.684
Primary education	0.109	0.312	0.165	0.371	0.145	0.352	0.167	0.373	0.195	0.396
Secondary education	0.239	0.427	0.256	0.437	0.215	0.411	0.232	0.422	0.255	0.436
University education	0.651	0.477	0.578	0.494	0.641	0.480	0.601	0.490	0.550	0.498
Foreign born	0.277	0.447	0.191	0.393	0.154	0.361	0.288	0.453	0.205	0.404
Employed	0.999	0.033	0.572	0.495	0.653	0.476	0.667	0.472	0.558	0.497
Living in couple	0.640	0.480	0.577	0.494	0.582	0.493	0.752	0.432	0.548	0.498
Number of children < 18	0.834	1.173	1.200	1.755	0.967	1.314	2.350	1.184	1.036	1.326
Family size	3.226	1.726	3.658	2.568	3.264	1.585	4.617	1.721	3.516	1.748
Low family income	0.142	0.349	0.169	0.375	0.105	0.307	0.244	0.429	0.172	0.377
Medium family income	0.441	0.497	0.430	0.495	0.460	0.499	0.358	0.480	0.401	0.490
High family income	0.417	0.493	0.402	0.490	0.435	0.496	0.398	0.490	0.427	0.495

Notes: Statistics are sample weighted using sampling demographic weights at the activity level.

Table A2. Full set of estimates: Commuting travel episodes

	(1) Happiness	(2) Meaningfulness	(3) Sadness	(4) Fatigue	(5) Stress	(6) Pain
Maximum temperature	-0.010	-0.012	0.001	-0.004	0.014	-0.024**
	(0.012)	(0.012)	(0.011)	(0.012)	(0.012)	(0.012)
Maximum temperature squared	0.008	0.012	0.002	0.001	-0.013	0.020**
	(0.009)	(0.009)	(0.009)	(0.010)	(0.010)	(0.009)
(log) commuting episode	-0.211***	-0.005	0.088**	0.114**	0.179***	0.064
	(0.056)	(0.044)	(0.044)	(0.053)	(0.057)	(0.053)
Male	-0.024	0.129*	-0.010	-0.095	-0.103	0.051
	(0.069)	(0.066)	(0.058)	(0.068)	(0.068)	(0.069)
Age	0.003	0.037***	0.005	-0.020	-0.017	0.026*
	(0.017)	(0.014)	(0.014)	(0.015)	(0.015)	(0.015)
Age squared	0.014	-0.029*	-0.002	0.004	0.009	-0.024
	(0.018)	(0.015)	(0.015)	(0.016)	(0.017)	(0.017)
Secondary education	0.096	-0.117	-0.302**	-0.195	-0.005	-0.489***
	(0.176)	(0.120)	(0.153)	(0.144)	(0.152)	(0.158)
University education	0.068	-0.276**	-0.345**	-0.289**	-0.019	-0.559***
	(0.160)	(0.120)	(0.144)	(0.132)	(0.148)	(0.153)
Foreign born	0.109	0.236***	0.011	-0.123	0.012	0.001
	(0.098)	(0.087)	(0.080)	(0.087)	(0.089)	(0.088)
Employed	-0.112	-0.315	0.452**	0.776***	-0.104	0.407**
	(0.377)	(0.239)	(0.194)	(0.293)	(0.298)	(0.193)
Living in couple	0.005	-0.004	-0.004	0.187**	0.109	0.021
	(0.078)	(0.071)	(0.064)	(0.083)	(0.085)	(0.075)
Number of children < 18	-0.007	-0.100**	-0.067	-0.069	-0.006	-0.152***
	(0.054)	(0.044)	(0.059)	(0.055)	(0.054)	(0.053)
Family size	0.053	0.076**	0.013	-0.019	-0.051	0.039
	(0.036)	(0.033)	(0.043)	(0.040)	(0.038)	(0.036)
Medium family income	0.012	-0.357***	0.012	0.065	0.089	-0.234*
	(0.112)	(0.091)	(0.095)	(0.105)	(0.124)	(0.121)
High family income	-0.118	-0.438***	0.069	0.084	0.178	-0.272**
	(0.114)	(0.103)	(0.102)	(0.111)	(0.137)	(0.126)
Public mode of transit	-0.210	-0.326***	0.145	0.295*	0.053	0.030
	(0.155)	(0.125)	(0.136)	(0.174)	(0.178)	(0.148)
Active mode of transport	-0.095	-0.093	0.247	0.137	0.114	0.083
	(0.116)	(0.115)	(0.168)	(0.177)	(0.203)	(0.155)
With other	0.372***	0.179*	0.017	0.039	-0.125	0.108
	(0.102)	(0.093)	(0.096)	(0.100)	(0.105)	(0.110)
Weekend day	-0.128	0.081	0.182**	0.062	-0.047	0.084
	(0.104)	(0.086)	(0.086)	(0.083)	(0.094)	(0.084)
Constant	0.638	-0.225	0.163	-1.138*	0.366	-0.379
	(0.735)	(0.617)	(1.502)	(0.628)	(1.251)	(0.757)
State F.E.	X	X	X	X	X	X
Month F.E.	X	X	X	X	X	X
Year F.E.	X	X	X	X	X	X
R^2	0.141	0.177	0.080	0.119	0.119	0.139
Number of observations	2,185	2,185	2,185	2,185	2,185	2,185

Notes: OLS regressions of affective well-being measures. Each column represents coefficients in a separate regression. Dependent variables are standardized (z-score). Robust standard errors clustered at the individual level in parentheses. Sample consists of respondents from the Well-Being Modules of the American Time Use Survey 2010, 2012, 2013 and 2021. * Statistically significant at the 10% level; ** at the 5% level; *** at the 1% level.

Table A3. Full set of estimates: Unpaid work travel episodes

	(1) Happiness	(2) Meaningfulness	(3) Sadness	(4) Fatigue	(5) Stress	(6) Pain
Maximum temperature	0.023**	0.023**	-0.010	-0.005	0.004	-0.004
	(0.011)	(0.011)	(0.011)	(0.010)	(0.010)	(0.009)
Maximum temperature squared	-0.021**	-0.020**	0.007	0.008	-0.003	0.005
	(0.008)	(0.008)	(0.008)	(0.008)	(0.007)	(0.007)
(log) unpaid work travel episode	-0.009	-0.028	0.071*	0.079***	0.048	-0.008
	(0.041)	(0.035)	(0.038)	(0.029)	(0.031)	(0.027)
Male	-0.059	0.178***	-0.064	-0.112*	-0.174***	-0.054
	(0.070)	(0.064)	(0.055)	(0.060)	(0.057)	(0.055)
Age	0.021**	0.050***	0.039***	0.028***	0.027***	0.060***
	(0.011)	(0.010)	(0.010)	(0.009)	(0.010)	(0.009)
Age squared	-0.019*	-0.042***	-0.033***	-0.030***	-0.028***	-0.052***
	(0.011)	(0.010)	(0.010)	(0.009)	(0.010)	(0.010)
Secondary education	0.070	0.068	-0.173	-0.201**	-0.293***	-0.355***
	(0.121)	(0.115)	(0.118)	(0.099)	(0.109)	(0.102)
University education	-0.022	-0.036	-0.186*	-0.159	-0.088	-0.436***
	(0.110)	(0.106)	(0.101)	(0.097)	(0.102)	(0.094)
Foreign born	0.194**	0.145	0.167*	0.005	0.140	0.081
	(0.093)	(0.094)	(0.091)	(0.084)	(0.092)	(0.085)
Employed	0.075	0.033	-0.092	0.205***	-0.021	-0.064
	(0.072)	(0.068)	(0.064)	(0.065)	(0.067)	(0.062)
Living in couple	0.026	-0.046	-0.223***	-0.210***	-0.093	-0.114*
	(0.079)	(0.074)	(0.072)	(0.063)	(0.066)	(0.062)
Number of children < 18	-0.018	0.076	0.098**	0.019	0.076*	-0.013
	(0.051)	(0.051)	(0.045)	(0.044)	(0.045)	(0.044)
Family size	0.016	-0.049	0.000	0.047	-0.012	0.036
	(0.037)	(0.038)	(0.032)	(0.033)	(0.032)	(0.032)
Medium family income	0.057	0.040	-0.183**	-0.068	-0.140*	-0.133*
	(0.088)	(0.080)	(0.082)	(0.075)	(0.082)	(0.079)
High family income	0.191**	0.082	-0.289***	-0.101	-0.152*	-0.260***
	(0.093)	(0.084)	(0.082)	(0.082)	(0.090)	(0.081)
Public transit	-0.305	-0.006	0.336	0.287	0.440*	0.323
	(0.253)	(0.199)	(0.328)	(0.241)	(0.259)	(0.292)
Active mode of transport	0.022	0.191**	0.171	0.097	0.016	0.217*
	(0.117)	(0.094)	(0.126)	(0.126)	(0.116)	(0.117)
With other	0.367***	0.421***	-0.108*	0.007	-0.169***	-0.011
	(0.074)	(0.068)	(0.058)	(0.059)	(0.061)	(0.059)
Weekend day	0.023	-0.090	-0.002	-0.060	-0.087	-0.090*
	(0.064)	(0.064)	(0.054)	(0.059)	(0.057)	(0.052)
Constant	-2.288**	-1.837***	-0.709	-1.359***	-0.691	-1.379***
	(0.979)	(0.426)	(0.453)	(0.446)	(0.499)	(0.444)
State F.E.	X	X	X	X	X	X
Month F.E.	X	X	X	X	X	X
Year F.E.	X	X	X	X	X	X
R^2	0.115	0.164	0.128	0.138	0.124	0.132
Number of observations	5,256	5,256	5,256	5,256	5,256	5,256

Notes: OLS regressions of affective well-being measures. Each column represents coefficients in a separate regression. Dependent variables are standardized (z-score). Robust standard errors clustered at the individual level in parentheses. Sample consists of respondents of the Well-Being Modules of the American Time Use Survey 2010, 2012, 2013, 2021. * Statistically significant at the 10% level; ** at the 5% level; *** at the 1% level.

Table A4. Full set of estimates: Personal care travel episodes

	(1) Happiness	(2) Meaningfulness	(3) Sadness	(4) Fatigue	(5) Stress	(6) Pain
Maximum temperature	-0.032**	0.016	0.049**	-0.012	0.047***	0.033**
	(0.015)	(0.015)	(0.019)	(0.015)	(0.017)	(0.016)
Maximum temperature squared	0.022*	-0.020*	-0.032**	0.009	-0.035**	-0.027**
	(0.012)	(0.012)	(0.015)	(0.012)	(0.014)	(0.013)
(log) personal care travel episode	-0.049	-0.097*	0.212***	0.191***	0.105**	0.170***
	(0.049)	(0.053)	(0.065)	(0.047)	(0.051)	(0.061)
Male	-0.094	0.008	-0.012	-0.277***	0.002	-0.023
	(0.093)	(0.086)	(0.119)	(0.090)	(0.095)	(0.099)
Age	-0.012	0.046***	0.035*	-0.006	0.007	0.051***
	(0.016)	(0.014)	(0.019)	(0.018)	(0.017)	(0.018)
Age squared	0.020	-0.036**	-0.038*	-0.005	-0.015	-0.051***
	(0.016)	(0.014)	(0.020)	(0.020)	(0.018)	(0.019)
Secondary education	-0.051	-0.025	-0.038	0.302	0.009	-0.111
	(0.234)	(0.154)	(0.251)	(0.194)	(0.215)	(0.219)
University education	-0.044	-0.197	-0.450**	0.346**	-0.009	-0.330*
	(0.205)	(0.143)	(0.205)	(0.149)	(0.193)	(0.184)
Foreign born	-0.026	0.078	-0.087	-0.127	0.058	-0.199*
	(0.135)	(0.118)	(0.157)	(0.112)	(0.131)	(0.115)
Employed	0.146	0.080	0.060	0.067	-0.020	-0.225
	(0.120)	(0.103)	(0.147)	(0.109)	(0.127)	(0.141)
Living in couple	0.204*	0.068	0.023	-0.023	0.076	-0.161
	(0.114)	(0.102)	(0.134)	(0.115)	(0.102)	(0.120)
Number of children < 18	-0.006	-0.023	-0.111	0.006	-0.016	0.011
	(0.060)	(0.056)	(0.097)	(0.063)	(0.074)	(0.072)
Family size	0.028	0.045	0.033	0.043	-0.039	0.017
	(0.046)	(0.050)	(0.080)	(0.052)	(0.062)	(0.055)
Medium family income	-0.050	0.107	-0.013	-0.058	-0.011	0.115
	(0.147)	(0.162)	(0.154)	(0.116)	(0.120)	(0.123)
High family income	-0.062	-0.149	-0.060	-0.177	0.037	0.003
	(0.152)	(0.172)	(0.176)	(0.124)	(0.140)	(0.151)
Public mode of transit	0.065	0.249	-0.187	0.003	0.080	-0.294
	(0.240)	(0.226)	(0.231)	(0.236)	(0.246)	(0.212)
Active mode of transport	0.158	0.383*	0.168	-0.304	0.201	-0.262
	(0.163)	(0.231)	(0.286)	(0.186)	(0.232)	(0.164)
With other	0.265***	0.192	-0.134	0.023	-0.152	-0.057
	(0.095)	(0.119)	(0.113)	(0.101)	(0.107)	(0.124)
Weekend day	0.087	0.305***	0.080	-0.244***	-0.039	0.073
	(0.093)	(0.095)	(0.119)	(0.090)	(0.095)	(0.107)
Constant	-0.159	-1.658***	-3.077***	1.466**	-2.101**	-2.579***
	(0.706)	(0.642)	(1.132)	(0.656)	(0.880)	(0.871)
State F.E.	X	X	X	X	X	X
Month F.E.	X	X	X	X	X	X
Year F.E.	X	X	X	X	X	X
R^2	0.148	0.291	0.196	0.276	0.144	0.208
Number of observations	1,915	1,915	1,915	1,915	1,915	1,915

Notes: OLS regressions of affective well-being measures. Each column represents coefficients in a separate regression. Dependent variables are standardized (z-score). Robust standard errors clustered at the individual level in parentheses. Sample consists of respondents of the Well-Being Modules of the American Time Use Survey 2010, 2012, 2013, 2021. * Statistically significant at the 10% level; ** at the 5% level; *** at the 1% level.

Table A5. Full set of estimates: Childcare trip travel episodes

	(1) Happiness	(2) Meaningfulness	(3) Sadness	(4) Fatigue	(5) Stress	(6) Pain
Maximum temperature	-0.016	-0.019	0.000	0.027	-0.022	0.016
	(0.016)	(0.015)	(0.018)	(0.019)	(0.022)	(0.017)
Maximum temperature squared	0.009	0.017	0.001	-0.017	0.024	-0.014
	(0.013)	(0.012)	(0.015)	(0.015)	(0.017)	(0.013)
(log) childcare travel episode	-0.016	-0.019	-0.107*	0.177***	0.199***	-0.066
	(0.058)	(0.061)	(0.057)	(0.065)	(0.073)	(0.056)
Male	0.039	0.078	-0.059	-0.278**	-0.261*	0.017
	(0.105)	(0.115)	(0.128)	(0.124)	(0.138)	(0.130)
Age	-0.029	0.016	0.038**	0.009	0.014	-0.025
	(0.025)	(0.024)	(0.019)	(0.022)	(0.029)	(0.036)
Age squared	0.029	-0.021	-0.042**	-0.020	-0.009	0.038
	(0.029)	(0.027)	(0.021)	(0.025)	(0.034)	(0.044)
Secondary education	-0.239	-0.101	-0.108	0.260	-0.045	0.487**
	(0.182)	(0.172)	(0.220)	(0.199)	(0.236)	(0.248)
University education	-0.452**	-0.164	-0.209	0.181	0.208	0.267
	(0.176)	(0.169)	(0.223)	(0.215)	(0.231)	(0.237)
Foreign born	0.192*	0.153	0.321**	-0.062	0.031	0.364***
	(0.110)	(0.122)	(0.134)	(0.128)	(0.139)	(0.141)
Employed	-0.078	-0.109	0.009	0.176	0.058	0.087
	(0.114)	(0.103)	(0.155)	(0.120)	(0.146)	(0.134)
Living in couple	0.368***	-0.037	-0.110	-0.272**	-0.043	-0.068
	(0.132)	(0.116)	(0.141)	(0.135)	(0.147)	(0.144)
Number of children < 18	-0.014	-0.105	0.032	-0.147*	0.203**	0.034
	(0.070)	(0.066)	(0.055)	(0.080)	(0.081)	(0.065)
Family size	-0.046	0.038	-0.042	0.151***	-0.142***	-0.009
	(0.042)	(0.038)	(0.032)	(0.053)	(0.041)	(0.037)
Medium family income	-0.223	-0.333**	0.028	0.192	-0.099	-0.409**
	(0.148)	(0.129)	(0.185)	(0.154)	(0.211)	(0.190)
High family income	-0.473***	-0.746***	0.024	0.259	-0.118	-0.428**
	(0.154)	(0.133)	(0.179)	(0.175)	(0.214)	(0.191)
Public mode of transit	0.610**	0.133	1.888***	-0.726*	-0.641	0.101
	(0.270)	(0.335)	(0.668)	(0.389)	(0.396)	(0.234)
Active mode of transport	0.088	0.109	0.370*	0.005	0.150	0.534**
	(0.144)	(0.122)	(0.206)	(0.185)	(0.190)	(0.241)
With other	-0.041	0.215*	0.019	-0.130	0.132	-0.158
	(0.105)	(0.114)	(0.105)	(0.117)	(0.126)	(0.109)
Weekend day	0.046	-0.034	-0.119	-0.195*	-0.458***	0.048
	(0.096)	(0.111)	(0.082)	(0.109)	(0.107)	(0.099)
Constant	2.911***	1.967**	-0.560	-1.663**	-1.341	0.549
	(0.757)	(0.866)	(0.749)	(0.827)	(0.922)	(1.007)
State F.E.	X	X	X	X	X	X
Month F.E.	X	X	X	X	X	X
Year F.E.	X	X	X	X	X	X
R^2	0.265	0.287	0.236	0.288	0.276	0.246
Number of observations	1,148	1,148	1,148	1,148	1,148	1,148

Notes: OLS regressions of affective well-being measures. Each column represents coefficients in a separate regression. Dependent variables are standardized (z-score). Robust standard errors clustered at the individual level in parentheses. Sample consists of respondents from the Well-Being Modules of the American Time Use Survey 2010, 2012, 2013 and 2021. * Statistically significant at the 10% level; ** at the 5% level; *** at the 1% level.

Table A6. Full set of estimates: Leisure travel episodes

	(1) Happiness	(2) Meaningfulness	(3) Sadness	(4) Fatigue	(5) Stress	(6) Pain
Maximum temperature	-0.002	0.006	-0.002	0.044**	-0.034*	-0.041
	(0.013)	(0.013)	(0.016)	(0.018)	(0.019)	(0.025)
Maximum temperature squared	0.008	-0.001	-0.005	-0.038**	0.028*	0.035
	(0.011)	(0.010)	(0.013)	(0.015)	(0.015)	(0.021)
(log) leisure travel episode	-0.063	0.037	0.196***	0.195***	0.158***	0.128***
	(0.042)	(0.038)	(0.053)	(0.046)	(0.045)	(0.046)
Male	-0.052	-0.059	-0.005	-0.285***	-0.259***	-0.246***
	(0.078)	(0.063)	(0.077)	(0.080)	(0.078)	(0.094)
Age	0.000	0.041***	0.003	-0.022*	0.018	0.054***
	(0.013)	(0.010)	(0.016)	(0.013)	(0.013)	(0.014)
Age squared	0.003	-0.031***	-0.005	0.014	-0.026*	-0.050***
	(0.014)	(0.010)	(0.016)	(0.013)	(0.014)	(0.015)
Secondary education	0.108	0.212*	0.023	-0.103	0.205	0.090
	(0.131)	(0.116)	(0.174)	(0.139)	(0.149)	(0.186)
University education	-0.099	-0.073	-0.210	0.147	0.136	-0.098
	(0.132)	(0.107)	(0.151)	(0.120)	(0.121)	(0.123)
Foreign born	-0.017	0.077	0.036	0.033	0.151	0.071
	(0.113)	(0.083)	(0.136)	(0.106)	(0.101)	(0.109)
Employed	0.072	-0.044	-0.005	0.159	-0.153	-0.292***
	(0.085)	(0.076)	(0.099)	(0.099)	(0.093)	(0.111)
Living in couple	0.205***	0.020	-0.018	0.017	-0.240**	-0.360***
	(0.078)	(0.078)	(0.107)	(0.095)	(0.103)	(0.114)
Number of children < 18	0.061	0.020	-0.124**	-0.095	0.025	0.025
	(0.051)	(0.041)	(0.054)	(0.062)	(0.052)	(0.058)
Family size	-0.042	0.013	0.065	0.102***	-0.023	0.020
	(0.038)	(0.031)	(0.043)	(0.038)	(0.036)	(0.039)
Medium family income	0.008	0.005	-0.301*	-0.148	-0.069	0.219
	(0.100)	(0.096)	(0.155)	(0.114)	(0.133)	(0.155)
High family income	0.021	0.014	-0.495***	-0.079	-0.256**	-0.050
	(0.109)	(0.106)	(0.150)	(0.116)	(0.128)	(0.116)
Public mode of transit	0.000	-0.229	-0.323**	-0.508***	-0.283*	-0.307**
	(0.269)	(0.141)	(0.129)	(0.153)	(0.160)	(0.138)
Active mode of transport	0.006	-0.113	0.171	0.136	-0.103	-0.023
	(0.124)	(0.126)	(0.176)	(0.136)	(0.126)	(0.101)
With other	0.241***	0.269***	-0.294***	-0.061	-0.094	0.089
	(0.075)	(0.080)	(0.095)	(0.069)	(0.083)	(0.074)
Weekend day	0.056	-0.170**	-0.079	-0.325***	-0.162*	-0.171**
	(0.078)	(0.068)	(0.087)	(0.096)	(0.085)	(0.087)
Constant	-0.885*	-3.040***	0.115	-0.615	0.986	0.210
	(0.535)	(0.541)	(0.587)	(0.739)	(0.754)	(0.933)
State F.E.	X	X	X	X	X	X
Month F.E.	X	X	X	X	X	X
Year F.E.	X	X	X	X	X	X
R^2	0.143	0.187	0.245	0.188	0.206	0.221
Number of observations	4,248	4,248	4,248	4,248	4,248	4,248

Notes: OLS regressions of affective well-being measures. Each column represents coefficients in a separate regression. Dependent variables are standardized (z-score). Robust standard errors clustered at the individual level in parentheses. Sample consists of respondents from the Well-Being Modules of the American Time Use Survey 2010, 2012, 2013 and 2021. * Statistically significant at the 10% level; ** at the 5% level; *** at the 1% level.