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Time-Use and Subjective Well-Being: Is there a Preference for Activity Diversity?

Naomi Friedman-Sokuler* and Claudia Senik†

October 24, 2022

Abstract

Using the American and the French time-use surveys, we examine whether people have a preference for a more diversified mix of activities, in the sense that, everything else equal, they experience a higher level of well-being when their agenda is multi-activity, rather than concentrated on a very small number of activities. This could be due to decreasing marginal utility, as is assumed for the consumption of goods, if each episode of time is conceived as yielding a certain level of utility *per se*. However, in the presence of returns to specialization, people would face a trade-off between the efficiency of specialization and the taste for diversity, as concerns time arrangements. We test these hypotheses and investigate potential gender differences with regard to these patterns.

Keywords: Time allocation, time-use diversity, subjective well-being, life satisfaction, momentary utility, gender.

JEL: I31, J22

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*Department of Economics, Bar Ilan University, Israel; friedmn6@biu.ac.il

†Sorbonne University and Paris School of Economics; claudia.senik@psemail.eu

1 Introduction

Although how to use one's time is certainly the most important decision a person has to make all along their life time, applied economic research has mostly reflected on a limited number of related issues, namely the global quantity of time people devote to labor supply versus leisure, education as an investment in human capital, and the division of tasks within the household. Beyond these specific topics, where time is considered as a pure input, the concrete mix of activities and their temporal arrangement has attracted less attention. In this paper, we are interested in the direct utility derived from the way people use their time, as opposed to the indirect utility allowed by this choice in terms of consumption. Hence, we are not considering the value of time as an input into the production of a commodity, as in Becker (1965), but rather as a consumption good that produces "experienced utility" (Kahneman et al., 1997) in itself. In consumer theory, convexity of preferences is generally assumed, implying that consumers have a taste for diversity. Is this assumption also relevant when it comes the choice of how to allocate one's time over competing activities? Do people have a preference for diversification of their mix of activities? If each episode of time is conceived as yielding a certain level of utility *per se*, they might reach a higher level of well-being or "experienced utility" by following a more diversified agenda rather than by a concentrating their time on a very small number of activities¹

Under this hypothesis, we would expect people's schedule to be fragmented into many different activities over the day, week or month span, in the way Karl Marx advocated for a (communist) society where it would be possible "to hunt in the morning, fish in the afternoon, rear cattle in the evening, criticise after dinner [...] without ever becoming hunter, fisherman, herdsman or critic"². However, in practice this type of time arrangement remains rare due to the countervailing force of increasing returns to specialized human capital, whereby a person becomes more efficient as she accumulates experience in a given task or type of activity over time. Increasing returns

¹An additional reason why people who have a more diversified mix of activities are happier could be that this complexity goes together with a greater degree of autonomy and control over one's organization, hence a greater sense of agency –known to be an important driver of happiness.

²Karl Marx, The German Ideology / Theses on Feuerbach / Introduction to the Critique of Political Economy, 1845

constitute a powerful driver of concentration of one's time and effort on a few activities. Does this create a trade-off between the efficiency of specialization and the taste for diversity, as concerns time allocation?

We attempt to answer this question by investigating empirically the relationship between the structure of time-use and subjective well-being, using two time-use surveys that contain measures of self-declared life satisfaction and episode-based affect. We test two main hypotheses:

- H1. The association between measures of time-use diversity and life satisfaction is positive, potentially concave.
- H2. Decreasing returns to time spent in an activity- i.e. a concave relationship between subjective well-being and the duration of an episode, versus a convex relationship indicating returns to specialization.

An additional motivation for this study comes from the well-known gender differences, both in time-use and life satisfaction. On the one hand, it is common knowledge that women's and men's time-use differ, notably in the greater share of paid-work in men's time (Blau and Kahn, 2017) and the greater variety of women's activities (Hamermesh and Gronau 2008). On the other hand, a large number of studies, mobilizing many different sources, show that women generally report a higher level of life satisfaction than men, especially in developed countries (Blanchflower and Oswald 2004; Graham and Chattopadhyay 2013; Helliwell and Wang 2015; Fortin et al. 2015; Becchetti and Conzo 2021; Blanchflower and Bryson 2022a), although a recent paper qualifies this observation (Blanchflower and Bryson 2022). Admittedly, women's higher satisfaction may be due to lower expectations (Plagnol and Easterlin, 2008; Stevenson and Wolfers, 2009). However, it could also be due to the specific pattern of their agenda - an hypothesis that we explore in this paper.

The answer to this question will shed light on the desirability of generalizing the current pattern of men's agenda, which is typically concentrated on paid-work, at the expense of diversity. Does this reflect a gendered set of preferences, whereby men do not value diversity of activities as much

as women do, or is it the expression of a traditional social norm, along the lines of the so-called "male breadwinner" norm, whereby men are judged exclusively by the criterion of professional and financial success, as opposed to women who enjoy a broader set of socially accepted combinations of family care and professional commitment³?

We thus test two additional hypotheses:

- H3. Women's mix of activities is more diversified than that of men.
- H4. Women's greater variety of activities accounts for the observed gender gap in life satisfaction.
- H5. Gender difference in activity-diversity reflects different preferences versus different constraints weighting on women and men.

To our knowledge, the only existing study that touches upon the question of diversity in time-use is Gronau and Hamermesh (2008), who used Australian, Israeli and German time-use data, and observed that more educated people engage into a greater number of activities, which they attribute to the higher efficiency of their time, both on the labor market and in household production. They also note the greater variety of women's activities, as compared to men. Of course, a large literature based on time-use data has explored the division of tasks within the household, especially the gendered specialization of spouses into paid-work versus housework (Hamermesh and Lee, 2007; Bianchi and Milkie, 2010, Gimenez-Nadal and Molina, 2020). Several studies have documented the upward trend in time spent on parenting, especially by educated parents (Sanni and Treas, 2016). A few papers have devoted attention to the impact of shocks, such as changes in the legal work time (Lee et al., 2011), economic fluctuations (Aguilar et al., 2013), child birth (Buddelmeyer et al. (2015), or widowhood (Adena et al., 2021). Others have explored people's preferences over different activities. Hammermesh and Biddle (2018) show that sleep and television-watching are uniformly inferior (and time-consuming) goods, especially TV-watching. Hammermesh (2020) showed that spending time with others increases

³See the surveys of cultural gender norms by Fernandez (2013); Goldin (2014, 2021); or Giuliano (2020).

life satisfaction (especially friends and spouse), and Adena et al. (2021) argue that, conversely, spending time alone is the reason for the greater unhappiness of widows.

On the other hand, among the abundant literature on subjective well-being, that has been blooming for the last twenty years, not many papers have focused on time-use related issues. A famous paper by Stutzer and Frey (2008) has illustrated the negative impact of long commuting on life satisfaction. The aforementioned papers by Hammermesh (2020) and Adena et al. (2021) stress the importance of social time. Another stream of research has investigated the subjective quality of the experience associated with the different episodes composing people's diary, a.k.a. "momentary utility" (e.g. Gershuny and Halpin 1996; Robinson and Godbey 1999, Stone et al. 1999; Stratton 2012; Kahneman et al. 2004; Krueger et al. 2009a; Krueger et al. 2009b; Knabe et al. 2010).

This paper thus hopes to contribute a new stylized fact both to the literature dedicated to time-use and to the happiness literature.

We test the aforementioned hypotheses using the American (ATUS) and the French (FTUS) time-use surveys, where people report the duration and succession of activity they have undertaken in a given day, together with a general evaluation of their life satisfaction on a Cantril scale. Each of these survey present distinct advantages. The ATUS offers a large sample size, where each individual is surveyed once, while that FTUS sample is significantly smaller but documents two day-diaries for each individual, one during the week and one on the weekend. The FTUS also collects the emotions felt by respondents during all of the time episodes of the day.

In both countries we find evidence that higher diversity in a person's activity portfolio is associated with higher life satisfaction (validating hypothesis H1). Furthermore, we find no evidence for increasing returns to the duration of activities in terms of "momentary utility"; rather we more often observe a concave relationship (hypothesis H2). We also document a significant gender gap in both countries, where the activity-mix of women is much more diversified than that of men (H3). However there are some specificities to each country sample. In the ATUS, women report on average a higher level of life satisfaction than men, and their greater index of

activity-variety accounts for nearly 20% of this gap (H4). However, in the ATUS, the association between activity-diversity and life satisfaction is not specific to women. In the FTUS sample, on the other hand, there is no gender gap in life satisfaction (an unusual feature), and when examining men and women separately we find that the association between diversity and life satisfaction is fully driven by women (H5). In sum, the general picture is that activity-diversity contributes to life satisfaction, there are no increasing returns to specialization in terms of subjective well-being, women’s agenda is more diversified, and this is associated with a supplement of life satisfaction.

The paper continues as follows: the next section discusses the measurement of activity-diversity and subjective well-being. Section 3 presents the data; Section 4 the estimation strategy; Section 5 the results; and Section 6 concludes.

2 Main Metrics: Diversity and Subjective Well-Being

How to measure Activity-Diversity?

Measuring diversity of time-use poses several empirical and theoretical challenges. The first one is the choice of a measure of diversity. Evidently, diversity in our context is a function of the number of activities with which one engages in throughout the day. However, a measure of diversity also depends on the way in which weights are attached to each activity. Common measures of diversity range from a simple count of activities, which gives equal weights irrespective of the time spent in each activity, to the Herfindahl/Simpson Index of concentration, which places higher weights on predominant activities. We choose to use the weighted Shannon-Wiener index of activity-diversity (S-W). We discuss this choice in Appendix [A](#) (see also Jost, 2006). The S-W index is a z-score that weights activities by the time allocated to them relative to the total amount of available time. The standard formula for the S-W index is given in Equation [1](#)

$$H = - \sum_{i=1}^S p_i \ln(p_i) \quad (1)$$

Where total time during a day is divided into S categories, and p_i denote the share of time spent on category i . We define total time during a day as the number of minutes a day (1,440) minus the number of minutes dedicated to sleep. To compute the S-W index for each diary day, we sum over activities with positive time shares $p_i > 0$, meaning that the diversity index is constructed over a potentially different subset of activities for each individual. The SW-index increases in the number of activity categories S with a positive share, as well as when these single shares are distributed relatively equally among the performed categories. It thus, takes into account two dimensions of diversity: it penalizes the presence of very dominant activities (with high shares) and increases with the number of activities performed.

The second challenge is the categorization of activities that are relevant for diversity. There is a trade-off between using a fine classification, separating tasks that may be part of the same category in terms of the individual experience (e.g. laundering and ironing clothes), and coarse classifications that lump together inherently different activities (i.e. sport and watching TV under the category of leisure). In this paper we use the two-digit classification of activities defined by the French statistical office (INSEE) for the FTUS, and align the ATUS data accordingly to make the country level analyses comparable⁴. Finally, we exclude from our measure of diversity the share of time dedicated to sleep, as it accounts on average for 35% of a day time, and therefore would dominate the index. Instead, we include it as a control in our regressions.

The final challenge relates to the frame of time over which individuals diversify. Admittedly, diversity within a single day is likely to be a very noisy indicator for overall diversification, as people may specialize within days and still diversify over weeks or months. Therefore, estimates that relate single day diversity to life satisfaction should be viewed as lower bounds on the true relationship. However, we also take advantage of the feature of the FTUS that interviews each individual twice, once on a weekend and once on a weekday. This allows us to construct measures of diversity based on each diary, as well as on the two diaries pooled together.

⁴While quite close, the American and French classifications of activities differ, as the former was elaborated by the US Bureau of Labor Statistics, and the latter by INSEE. Our common classification at the 1 and 2-digit levels, largely following the INSEE classification, can be found in Table [A1](#) in the Appendix.

Measures of subjective well-being

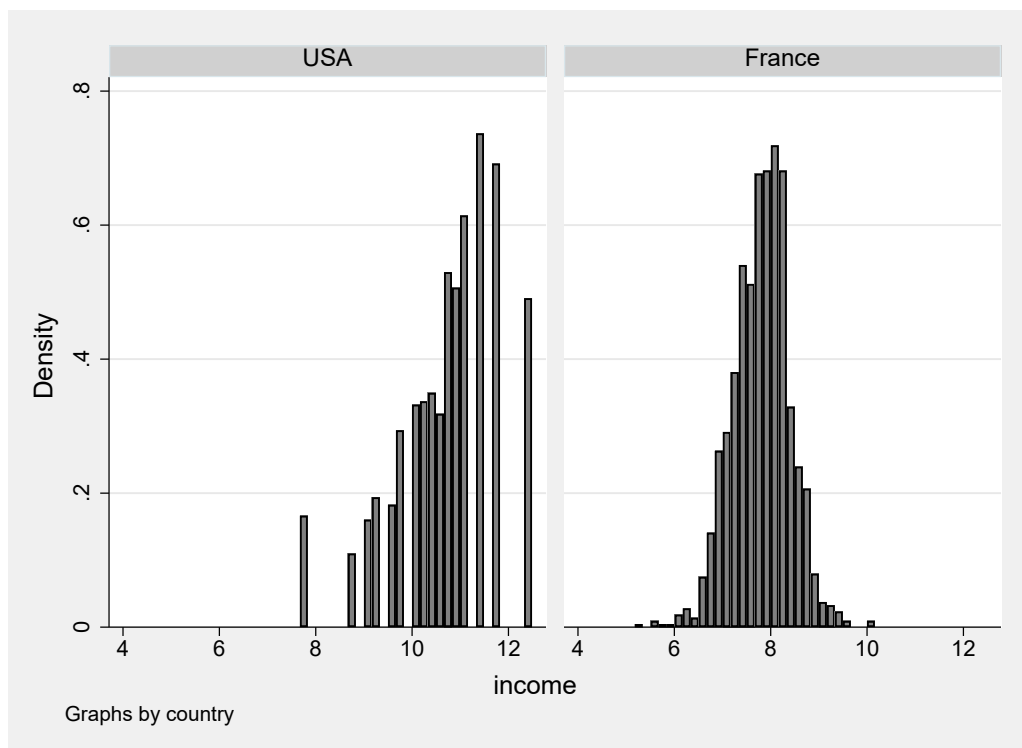
In the abundant literature dedicated to subjective well-being, that has been blooming for the last twenty years, life satisfaction has emerged as the standard metric, one that includes both a cognitive judgemental dimension and a hedonic dimension (van Praag et al., 2003; Layard, 2011). Self-reported evaluations of time episodes, on the other hand, are now classically seen as measures of momentary utility (Gershuny and Halpin, 1996; Robinson and Godbey, 1999), process benefits (Stratton, 2012), or ecological momentary assessments (Stone et al. 1999). They have been conceptualized as “experienced utility” (Kahneman et al. 2004), i.e. *ex-post* utility, as opposed to *ex-ante* decision-utility. Krueger et al. (2009a) have used them to produce so-called National Time Accounts (NTA) that allow comparisons of “evaluated time episodes” across countries, over time, or between groups of people. The relationship between momentary utility and life satisfaction has also received some attention. Most studies conclude to a disconnect between the two types of measures. Krueger et al. (2009b) for instance, find that American women report higher levels of life satisfaction than French women but that the French spend their days in a more positive mood, on average, and spend more of their time in activities that are more enjoyable. Knabe et al. (2010) also note that the unemployed are “dissatisfied with life but having a good time” during weekdays, in their eponymous article. Self-declared life satisfaction and evaluations of momentary time-episodes will be our main outcomes.

3 Data

To analyze the relationship between diversity and subjective well-being, we use two sources of data: the 2012 and 2013 waves of the American time-use survey (ATUS) and the 2010 wave of the French time-use survey (FTUS). Each of these waves includes a well-being module, in addition to detailed time-use diaries. In each survey year, only a sub-sample of respondents were asked to fill the well-being module. Specific weights are used to correct for the composition of the selected sample so as to make it representative of the general population.

Table 1 shows (weighted and unweighted) descriptive statistics for the sample of respondents that were included in the well-being module and completed the survey for at least one full day⁵. The table includes sample means and standard deviations for the set of observable characteristics for which the literature has established a strong link to subjective well-being. These include: gender, age and age squared, log household income (in Euros and USD, respectively)⁶, employment status (full time, part time, unemployed, inactive), cohabitation, and the presence of children under the age of 18 in the household. More than half of the Americans work full time versus 44% of the French, and the French sample comprises a higher proportion of retired people (20% against 13%), and a slightly higher proportion of people living with children (42% versus 38%).

Figure 1: Log income Distribution for ATUS and FTUS Samples



In the ATUS, household annual income is measured in categories; we assigned to each individual the mid-point income of each interval, and $1.5 \times$ the lower bar of the upper open interval. In FTUS, household income (per unit of consumption) is measured as a continuous variable

⁵We drop respondent who did not report time-use for more than 10% of the day as well as respondent for whom key variables were missing, such as household income

⁶In the ATUS, income is initially reported in intervals. We recode this measure into a continuous variable, namely the midpoint of each interval, and $1.5 \times$ the lower bar of the upper open interval.

Table 1: Weighted and Unweighted Sample Descriptive Statistics, by Country

	USA Sample	France	USA Population weights	France
N	19,198	1,273		
Weekend	51.73	50.60		
Female	55.21	53.34	51.41	51.49
Living with partner	55.64	71.01	61.06	64.58
Has children	44.00	37.00	38.00	42.00
N children	1.87	1.78	1.90	1.89
	(0.95)	(0.96)	(1.03)	(1.10)
Age	47.14	48.79	45.08	45.26
	(15.03)	(15.66)	(15.89)	(16.41)
Age group				
18-24	6.00	6.68	12.15	13.81
25-54	59.82	52.32	56.67	53.84
55+	34.18	41.01	31.18	32.35
Employment status				
full-time	52.45	44.62	52.35	44.26
part-time	13.65	10.76	14.66	11.66
unemployed	5.15	6.99	5.65	7.82
retired	14.29	27.34	12.76	20.49
student	1.14	2.99	1.94	7.88
other	13.32	7.31	12.64	7.89
Time use and wellbeing				
Life satisfaction	7.07	7.45	7.08	7.42
(Cantril scale)	(2.02)	(1.79)	(2.02)	(1.83)
Diversity - single day	4.71	5.43	4.57	5.34
(Shannon-Wiener Index)	(1.82)	(1.73)	(1.72)	(1.73)
Diversity - two days		6.88		6.77
(Shannon-Wiener Index)		(1.78)		(1.84)

ATUS: 2012 and 2013; FTUS: 2010. *Number of children is calculated conditional on having children

The ATUS data is one of the most widely used time-use survey, with a large sample size. Here, we have 19,198 respondents from two waves. The survey collects one single diary per person, for either a weekday (48%) or a weekend day (52%). All respondents in ATUS are asked about their life satisfaction and the momentary affects felt during three randomly selected activity episodes during the day. The French time-use survey is much smaller, as it contains 1,280 respondents who had to fill the well-being module. The latter include questions about life satisfaction as well as self-reported pleasantness for each episode of the day. Respondents had to fill two time-diaries: one over a weekday (1,198 diaries) and one over the weekend or holiday (1,255 diaries). In view of analyzing activity-diversity, it is useful to rely on the description of a person's time-use over two days rather than one, especially two days of different nature, that are typically dedicated to different activities.

3.1 Diversity of Activities Index

Figure [2](#) displays the average daily composition of time-use in both countries, for weekdays and for weekends, based on the 1-digit level classification. As expected, in both countries, the most prominent difference between weekends and weekdays is the share of time allocated to paid work. On average, American respondents dedicate a larger share of their time to work and work-related activities, and the French spend more time on meals. Table [A3](#) in the Appendix displays more information.

With the American sample, we only have one diary per person, so that we calculate an S-W index of activity diversity for that day, whether it is a weekend or a weekday. With the French sample, we have two diaries, one for a weekday, and one for a weekend day. We therefore calculate two indices. The first is a S-W index of activity-diversity separately for each day. The second is a "global" index of diversity over the two days during which we observe a person. This latter is likely to be more informative about the variety of a person's agenda than the information collected over a single day.

Figure 2: Day Composition by Country and Week Day

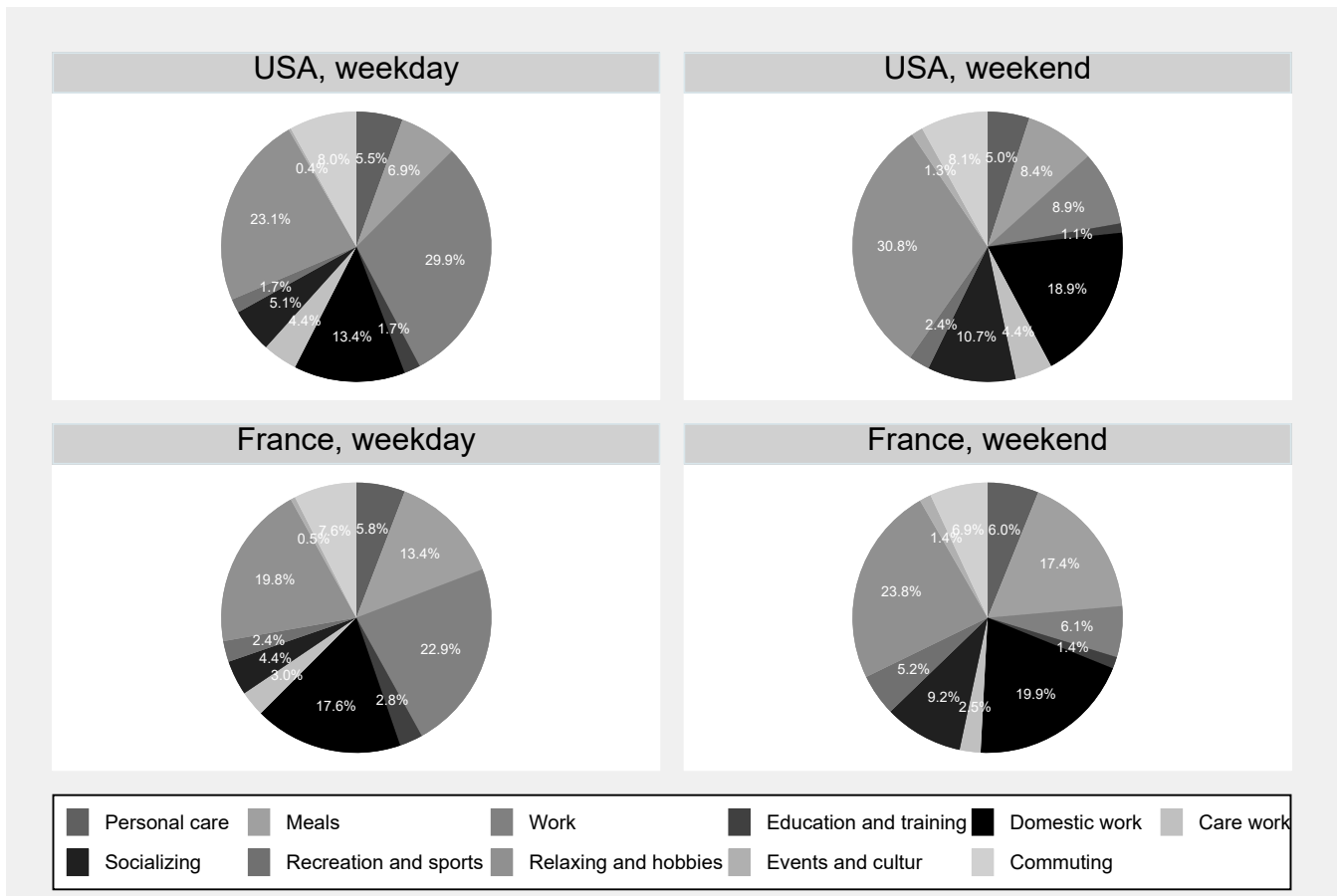
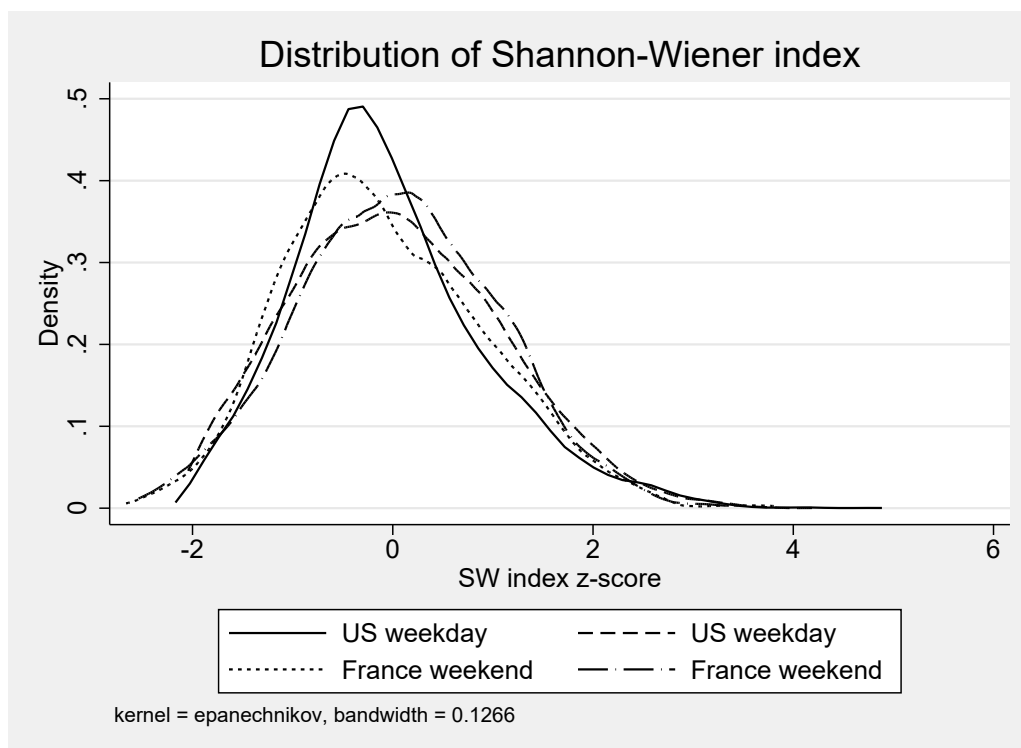


Figure 3 displays the distribution of our measure of diversity by country and weekend-weekday, in the French and American samples. The shapes of the distributions are strikingly similar. The American curve is slightly more concentrated, as compared with the French one, and in both countries, the curves are shifted to the right on weekends, as compared to weekdays, indicating a greater number of activities.

3.2 Life satisfaction

Both the American and the French surveys include, for each respondent, one measure of self-declared life satisfaction (LS) measured on a (0-10 steps) Cantril scale. It is asked only once,

Figure 3: Distribution of the S-W Index

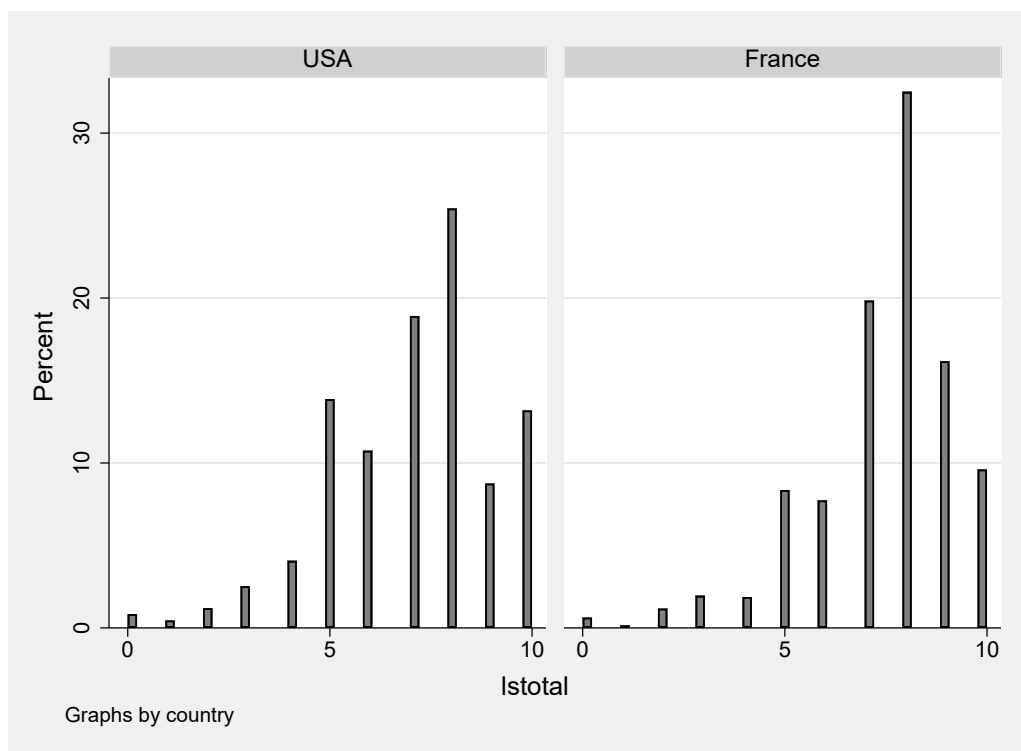


even in the French survey, even though each person fills a time-diary for two different days. In the bottom panel of Table 1 we see that the average level of life satisfaction is higher in France than in the US. Figure 4 displays the distribution of this measure.

3.3 Momentary utility

In ATUS, momentary utility (MU) is, in principle, measured for three randomly drawn activities per respondent. The latter is asked to indicate the duration of the activity and evaluate the latter in terms of: level of pain, tiredness, sadness, stress, and happiness, as well as how meaningful the activity is- each on a 0-6 scale. However, the ATUS documentation acknowledges that, due to a programming error in the data collection software, certain activities were less likely than others to

Figure 4: Distribution of Life Satisfaction



be selected for follow-up questions in the well-being module⁷. For this reason, we choose not to use the MU information from ATUS and rely only on the French source as concerns MU.

In the French survey, respondents are asked to assess the pleasantness of all of the episodes experienced during an entire weekday and weekend day, each day being divided into slots of 10 minutes. For each episode, they are asked to indicate: “*was it a pleasant or unpleasant time? (from -3 very unpleasant to +3 very pleasant)*”.

Table² displays proportion of the respondents who practice each activity (at the 1-digit level), the average duration of the latter, and the average score attributed to each category of activity, as in Kahneman and Krueger (2006). As can be seen, in France, recreation activities and attending events are the most appreciated activities, followed by eating and drinking, social relations and relaxing, whereas education, work, housework, and travel rank last in terms of MU. Most activity

⁷<https://www.bls.gov/tus/wbmintcodebk.pdf>

Table 2: Weighted and Unweighted Sample Descriptive Statistics, by Country

	% reporting		Average time (hours)		Average MU		Correlation LS
	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend	
Sleep	1.00	1.00	8.36 (2.07)	9.25 (2.26)			
Personal care	0.84	0.74	0.85 (0.99)	0.73 (0.99)	1.37 (1.16)	1.53 (1.10)	0.06
Meals	0.96	0.95	1.07 (0.77)	1.22 (0.96)	2.09 (0.82)	2.25 (0.76)	0.09
Work	0.59	0.24	4.64 (4.44)	1.30 (2.99)	1.05 (1.33)	1.09 (1.33)	0.12
Education	0.05	0.04	0.27 (1.41)	0.15 (0.96)	0.55 (1.49)	0.56 (1.33)	-0.05
Domestic work	0.84	0.86	2.07 (2.34)	2.76 (2.68)	1.24 (1.13)	1.27 (1.17)	0.10
Care work	0.38	0.35	0.68 (1.48)	0.65 (1.54)	1.89 (1.05)	1.98 (1.03)	0.08
Social activities	0.45	0.54	0.78 (1.46)	1.57 (2.27)	2.06 (1.10)	2.35 (0.88)	0.11
Sports and recreation	0.19	0.17	0.26 (0.78)	0.35 (1.14)	2.32 (0.82)	2.30 (0.92)	0.24
Relaxing and hobbies	0.91	0.92	3.58 (3.13)	4.50 (3.53)	2.03 (0.93)	2.10 (0.84)	0.09
Events and cultural activities	0.03	0.07	0.07 (0.46)	0.19 (0.87)	2.29 (1.03)	2.62 (0.72)	0.12
Commuting	0.88	0.82	1.23 (1.2)	1.18 (1.43)	1.23 (1.13)	1.44 (1.12)	0.08

*ATUS: 2012 and 2013, FTUS: 2010. *Number of children is calculated conditional on having children*

categories are relevant for the vast majority of respondents, except for events and cultural activities and education, which concern few respondents (up to 5% only), as well as sport and recreation (19%). The last column of the table illustrates the disconnect between life satisfaction and momentary utility, as noticed by Krueger et al. (2009b).

4 Estimation Strategy

4.1 Life Satisfaction and Activity-Diversity

We estimate the relationship between the Shannon-Wiener index of activity-diversity SW_i^w of individual i in survey time w and the latter's life satisfaction LS_i , following Equation 2. We run

these estimates of life satisfaction separately on the French and the American samples. We run two specifications of equation 2: first, on the entire sample, where, for the French survey, the S-W index of diversity has been calculated over the pooled weekday and the weekend day documented by each respondent, and second, separately on the sub-samples of weekend and weekdays.

The estimation equation includes a vector of socio-demographic characteristics, X_i , that comprises: gender, a quadratic function of age, cohabitation, children, employment status and family income. We also include survey waves fixed-effects W_w' . These variables are described in Table 6. Because our activity-diversity index does not count sleep as an activity, we include a quadratic function of time slept as a control. Our main coefficients of interest are β_1 and β_2 ; under hypothesis H1, we expect them to be respectively positive and negative.

$$LS_{iw} = \beta_0 + \beta_1 SW_{iw} + \beta_2 SW_{iw}^2 + X_i' \gamma + W_w' \delta + \epsilon_i \quad (2)$$

Because work is the most time-consuming category, we also run estimates of equation 2 separately on the sub-sample of working age people, i.e. in the 25-55 age category, as well as on the sub-sample of people above 55.

All regressions are weighted using the individual weights included in the ATUS and FTUS for the samples that answer the subjective well-being module.

4.2 Decreasing Returns to Time in Activity

In order to test hypothesis H2 concerning the potential concavity of the relationship between subjective well-being and the time spent on a given activity, we first estimate a Restricted Cubic Spline regression presented in Equation 3 on the FTUS sample. MU_{ijw} is the reported momentary utility of respondent i during activity j occurring on survey day w as a function of time t spent in activity j on the same day. In Equation 3 we suppress the indicators for ease of exposition. For maximum flexibility we use $k = 5$ knots s for the spline at Harrell's recommended percentiles—at the 5th, 27.5th, 50th, 72.5th and 95th percentiles of time in the activity (Harrell,2001).

$$MU = \alpha_0 + \alpha_1 t_1 + \dots \alpha_{k-1} t_{k-1} \quad (3)$$

where

$$t_1 = t$$

$$t_c = (t - s_{c-1})_+^3 - \frac{(t - s_{k-1})_+^3 (s_k - s_{c-1})}{(s_k - s_{k-1})} + \frac{(t - s_k)_+^3 (s_k - s_{c-1})}{(s_k - s_{k-1})}$$

for $c = 2, \dots, k - 1$

We choose to use this (minimally parametric) approach to explore the shapes of the relationship between the duration of an activity and the momentary utility derived from that activity, rather than assume it. Furthermore, the limited number of observations of momentary utility for the different activities, as shown in Table 2, renders linear estimates sensitive to extreme observations within each activity.

Our second approach is to use a Beckerian style equation, as presented in Equation 4 to estimate the relationship between life satisfaction and time spent in different activities.

$$LS_{iw} = \theta_0 + \sum_{j=1}^S (\theta_1 t_{ijw} + \theta_2 t_{ijw}^2) + X_i' \gamma + W_w' \delta + \epsilon_i \quad (4)$$

Where LS_{iw} is the life satisfaction declared by individual i , and t_{ijw} is the time she spends on activity j . For the French sample, we pool the time spent on a given activity on weekend and weekdays. In case of increasing returns, we expect θ_1 and θ_2 to be positive. Conversely, in case of decreasing marginal utility, we expect θ_2 to be negative.

4.3 Diversity, Well-Being and Gender

In order to test hypothesis H3, we simply measure the difference between men and women in terms of the S-W index of activity-diversity. To test hypothesis H4, we introduce the S-W diversity index together with the female dummy in the estimate of life satisfaction as of equation 2. If by

doing this, we see that the coefficient on female is reduced or even loses statistical significance, this would suggest that women's higher life satisfaction (in the ATUS) is partly due to the greater diversity in their time allocation.

Finally, to test hypothesis H5, we ask whether the relationship between diversity and life satisfaction varies between men and women, indicating gender differences in preferences regarding time allocation. If not, we will interpret the lower activity-diversity and greater concentration of men's time on paid-work as a constraint, rather than a revealed preference. To do this, we estimate equation [5](#) where we interact the S-W diversity index with the female dummy in order to see whether the impact of diversity is driven by women, i.e. if coefficient ζ_2 is positive and statistically significant. We also run equation [2](#) separately on the sub-samples of men and women.

$$\begin{aligned}
 LS_{iw} = & \beta_0 + \beta_1 SW_{iw} + \beta_2 SW_{iw}^2 + \zeta_1 female_i + \zeta_2 female_i * SW_{iw} \\
 & + \zeta_2 female_i * SW_{iw}^2 + X_i' \gamma + W_w' \delta + \epsilon_i
 \end{aligned}
 \tag{5}$$

5 Results

5.1 Time-Use Diversity and Subjective Well-Being

Estimates of life satisfaction on both surveys following equation [2](#) are presented in Table [3](#). The first four columns in the upper panel (a) display the estimates on the entire sample, with and without controls, where, for the French one, the index of activity-diversity is calculated over the two (weekend and week) days. Conditional on individual characteristics or not, they tend to confirm the concavity hypothesis H1. The coefficient on the S-W index is positive and statistically significant, and the coefficient on the S-W index squared is negative. The lower panel (b) displays the estimates on the sample-samples of weekdays and weekends, with and without controls. The results are essentially the same.

Table 3: Life Satisfaction and Activity-Diversity

(a)				
	ATUS		FTUS	
	(1)	(2)	(3)	(4)
SW_i	0.230*** (0.016)	0.137*** (0.017)	0.138*** (0.051)	0.166*** (0.052)
SW_i^2	-0.064*** (0.011)	-0.040*** (0.011)	-0.052 (0.033)	-0.053* (0.031)
Constant	7.113*** (0.053)	5.758*** (0.258)	7.490*** (0.095)	5.793*** (1.181)
Controls	No	Yes	No	Yes
Observations	19,198	19,198	1,223	1,223
R-squared	0.012	0.073	0.012	0.136

(b)				
	ATUS		FTUS	
VARIABLES	weekday	weekend	weekday	weekday
	(5)	(6)	(7)	(8)
SW_i	0.133*** (0.025)	0.139*** (0.021)	0.120** (0.060)	0.154*** (0.057)
SW_i^2	-0.035** (0.017)	-0.052*** (0.015)	0.036 (0.040)	-0.074* (0.043)
Constant	5.393*** (0.375)	6.465*** (0.353)	6.468*** (1.018)	6.964*** (1.019)
Controls	No	Yes	No	Yes
Observations	9,267	9,931	1,192	1,194
R-squared	0.073	0.079	0.134	0.125

ATUS: 2012 and 2013, FTUS: 2010.

Controls: wave fixed-effects, year, age, age squared, sex, couple, children, employment status, log household income, time slept.

Table 4: Life Satisfaction and Activity-Diversity, by Age Group

	Age 25-55		Age 55+	
	ATUS	FTUS	ATUS	FTUS
SW_i	0.131*** (0.022)	0.175** (0.073)	0.147*** (0.028)	0.130 (0.086)
SW_i^2	-0.050*** (0.014)	-0.016 (0.042)	-0.037* (0.020)	-0.104* (0.055)
Constant	4.583*** (0.505)	11.507*** (2.249)	-4.098 (2.846)	-9.185 (10.246)
Controls:	Yes	Yes	Yes	Yes
Observations	11,484	644	6,562	498
R-squared	0.078	0.137	0.085	0.167

ATUS: 2012 and 2013, FTUS: 2010.

Controls: wave fixed-effects, year, age, age squared, sex, couple, children, employment status, log household income, time slept.

We also run the same estimates separately on the sub-samples of working-age people (25-55) and of respondent aged 55 and above and obtain similar results, although less precisely measured in the French sample (Table 4).

Table A2 displays the full set of coefficients for the estimate of life satisfaction following Equation 2 and shows that the regressions are “well-behaved”, in the sense that the usual correlations are found in both samples: life satisfaction is positively correlated with income, being employed, and living with a partner, and negatively associated to unemployment; the usual U-shape relationship with age is found.

5.2 Returns to time spent on activities

Hypothesis H2 asks whether the returns to the duration of an activity are convex (increasing) or concave (decreasing). If the former is true, concentration on a few activities is conducive to higher subjective well-being; if it is the latter, then activity-variety is preferable. Of course, the relevant time dimension of these mechanisms could be the week or even the month, however, we can only

test for this possibility within the time span of two days. We experiment with several specifications in order to test this hypothesis.

First, Table 5 displays the estimates of life satisfaction on the duration and duration squared of each category of activity. The general finding is that no activity turns out to be associated with life satisfaction through a convex relationship, i.e. with a positive coefficient on both the duration of the activity and on the squared duration. When the coefficient on the duration is positive, as for meals, socializing, household tasks, or recreation and sports, the coefficient on the squared term is most often negative, and often not statistically significant.

Second, we look at the specific momentary utility associated with the duration of a given activity. As shown by Figure 5, conditional on the usual controls, most relations are concave, i.e. meals, relaxing and hobbies (which includes a large chunk of TV watching), social activities, and recreation and sports. Other relations are simply positive, in the sense that the coefficient on the squared duration is not statistically significant; this is the case of domestic work. Finally, for certain activities, the duration is not statistically correlated with pleasantness: work, education, or care work.

Overall, the results do not support the hypothesis of increasing returns to specialization, as far as life satisfaction and momentary utility are concerned.

5.3 Activity-Diversity and Gender

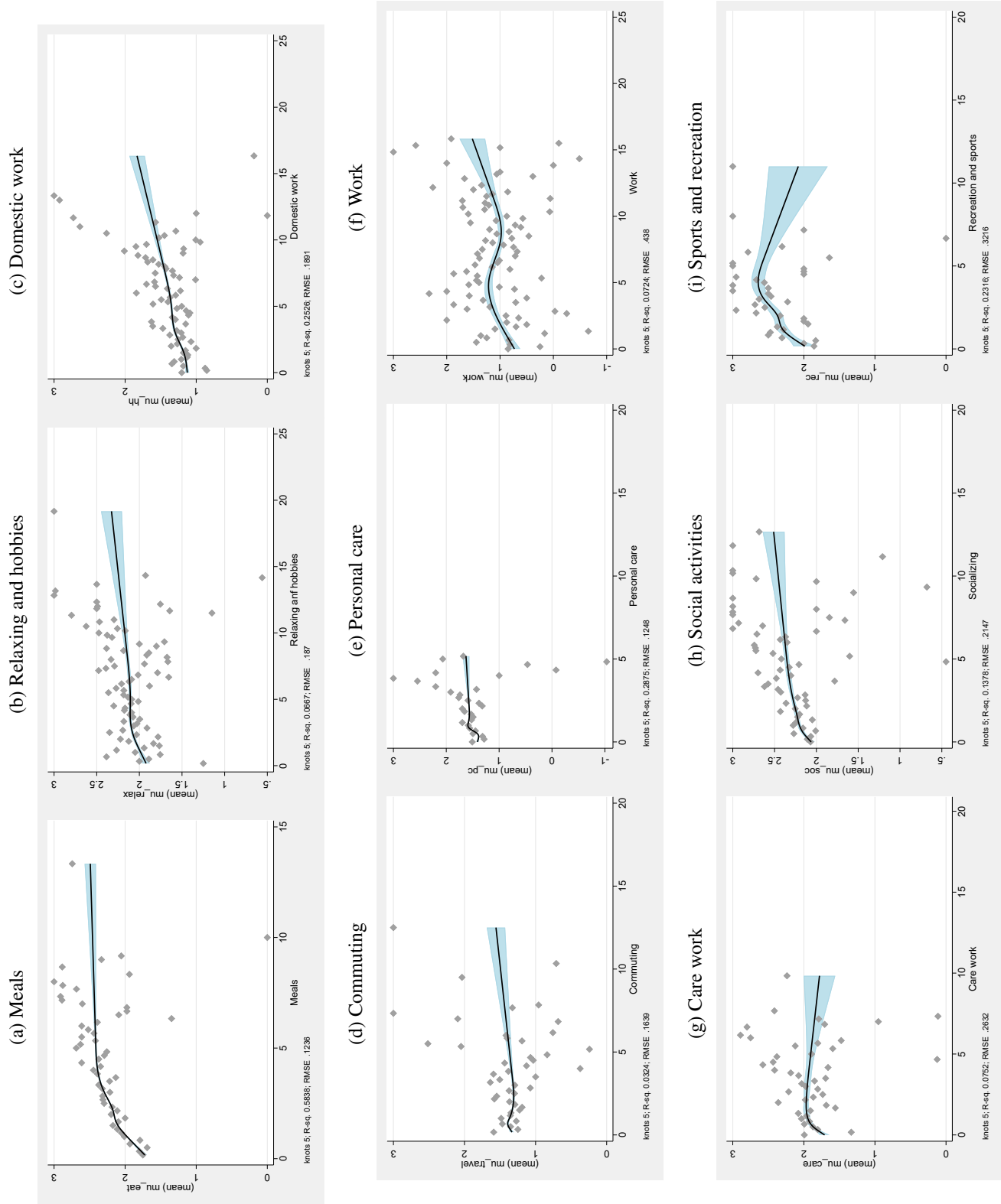
We now turn to the gender dimension of the association between activity-diversity and life satisfaction. We first verify that our measure of activity-diversity is systematically higher for women than for men. Table 6 shows that women in both countries experience more diversity in their time-use. This could be partially explained by the relatively high share of women in part-time employment vs. full-time employment. We therefore compute an alternative diversity index, excluding time spent at work, and find that women still exhibit substantially higher levels of diversity (fourth row in Table 6). In the ATUS, the gender gap in activity-diversity represents 53% of the sample standard deviation of the diversity index over weekdays (62% in the French

Table 5: Life Satisfaction and the Duration of Activities

	ATUS	FTUS
Meals	0.161*** (0.034)	0.093* (0.048)
Meals ²	-0.016** (0.007)	-0.004 (0.003)
Work	0.001 (0.014)	0.023 (0.026)
Work ²	0.001 (0.001)	-0.000 (0.001)
Domestic work	0.045*** (0.017)	0.069* (0.042)
Domestic work ²	-0.002 (0.002)	-0.002 (0.002)
Care work	0.038* (0.021)	0.066 (0.068)
Care work ²	0.000 (0.003)	-0.008 (0.008)
Social activities	0.078*** (0.018)	0.129*** (0.041)
Social activities ²	-0.002 (0.002)	-0.005 (0.004)
Sports and recreation	0.196*** (0.029)	0.101* (0.052)
Sports and recreation ²	-0.010** (0.004)	-0.000 (0.007)
Relaxing and hobbies	-0.005 (0.015)	0.010 (0.031)
Relaxing and hobbies ²	-0.002 (0.001)	0.001 (0.001)
Commuting	-0.019 (0.022)	0.131* (0.073)
Commuting ²	0.007** (0.003)	-0.004 (0.009)
Constant	5.771*** (0.238)	5.993*** (0.911)
Observations	19,198	1,273
R-squared	0.084	0.162

ATUS: 2012 and 2013, FTUS: 2010. Controls: wave fixed-effects, year, age, age squared, sex, couple, children, employment status, log household income, time slept. Also included in the regression are time in educational activities and time in events and cultural activities, coefficients suppressed due to space constraints.

Figure 5: Pleasantness and Time Spent on an Activity



Notes: Splines

Table 6: Descriptive Statistics, by Gender

	USA		France	
	Men	Women	Men	Women
Life satisfaction	6.97 (2.02)	7.18 (2.02)	7.43 (1.76)	7.41 (1.90)
SW_{iw}	4.14 (1.56)	4.97 (1.77)	4.76 (1.55)	5.89 (1.72)
SW_{iw} pooled			6.27 (1.86)	7.25 (1.69)
SW_{iw} no work	4.30 (1.62)	5.14 (1.77)	4.77 (1.55)	5.90 (1.58)
Employment				
Full-time	62.79	42.49	56.51	32.73
Part-time	10.30	18.78	2.93	19.88

ATUS: 2012 and 2013; FTUS: 2010. Weighted statistics

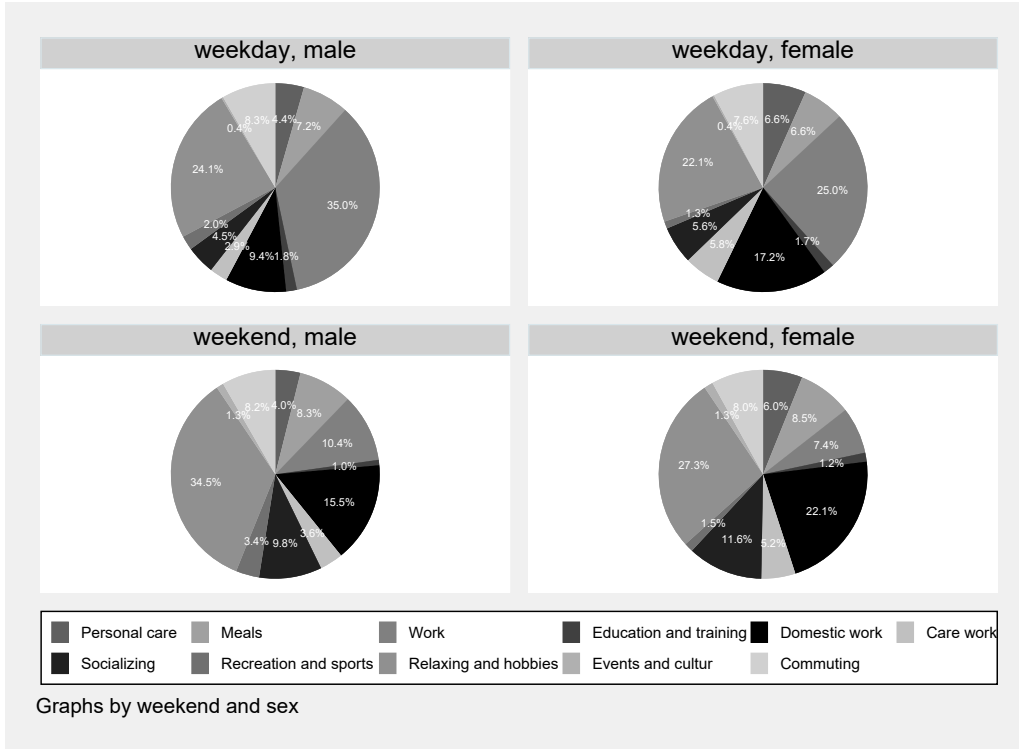
survey), and 39% over weekends (49% in the French survey). Figure 6 shows the average share of time dedicated to each activity category by country, gender and day of the week. In both countries, women devote a significantly larger share of their time to domestic and household work, as well as care, and less to paid-work.

Table 7 shows that, conditional on observable individual characteristics, American women report a higher level of life satisfaction on average. The gap is about 10% of the standard deviation of the variable. Surprisingly, there is no gender gap in life satisfaction among the French respondents, and the coefficient on female is actually statistically insignificant).

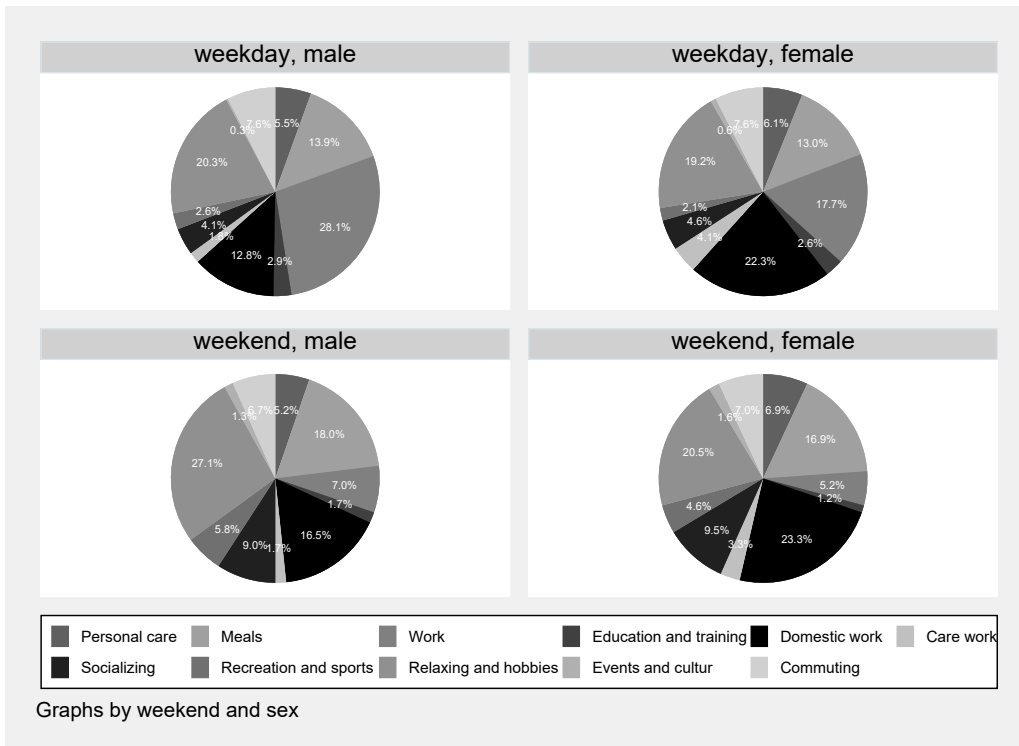
In both samples the introduction of the S-W index of diversity reduces the average satisfaction level of women relative to that of men. The same patterns hold when running the same estimation on the sub-samples of weekends and weekdays. These results suggest that the higher diversity of women's time-use contributes to their subjective well-being, and in the case of the American survey, it explains part of the gender gap.

Figure 6: Day Composition, by Gender

(a) USA



(b) France



Notes: Weighted statistics

Table 7: Gender, Activity-Diversity and Life Satisfaction

	ATUS - Life Satisfaction				FTUS - Life Satisfaction			
	All	All	Men	Women	All	All	Men	Women
Female	0.283*** (0.029)	0.226*** (0.036)			-0.003 (0.105)	-0.154 (0.122)		
SW_i		0.121*** (0.024)	0.116*** (0.025)	0.148*** (0.023)		0.061 (0.078)	0.055 (0.076)	0.270*** (0.081)
SW_i^2		-0.047** (0.019)	-0.032 (0.020)	-0.051*** (0.014)		-0.101** (0.047)	-0.103** (0.045)	-0.044 (0.051)
$SW_i * Female$		0.028 (0.033)				0.000 (0.000)		
$SW_i^2 * Female$		0.006 (0.024)				0.179* (0.107)		
Constant	5.467*** (0.256)	5.763*** (0.258)	5.839*** (0.387)	5.962*** (0.349)	5.340*** (1.181)	5.915*** (1.187)	5.252*** (1.595)	6.584*** (1.860)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	19,198	19,198	8,598	10,600	1,223	1,223	573	650
R-squared	0.070	0.073	0.080	0.071	0.124	0.138	0.195	0.113

ATUS: 2012 and 2013; FTUS: 2010. Weighted estimates

Is activity-diversity more appreciated by women than by men? In ATUS, the interaction term between female and activity-diversity does not attract a statistically significant coefficient, and does not change the estimated concave relationship between S-W and life satisfaction. This suggests that the association between activity-diversity and life satisfaction is general, and not due to gendered preferences.

In the French sample however, the interaction terms is positive and statistically significant, and when the estimates are run on the sub-samples of men and women separately, the coefficient on activity-diversity is only statistically significant in the women sample. The same patterns hold when performing the same estimation on the sub-samples of weekends and weekdays (not shown).

Overall, these results indicate that the higher diversity of women's time use contributes to their subjective well being, and that, in the case of the American survey, it explains part of the gender gap. Concerning hypothesis H5, the results are ambivalent and suggest, a minima, that the association between diversity and life satisfaction is likely to reflect both preferences (in the French case) and constraints (in the American case). In other words, the greater diversity of women's

agenda cannot be entirely attributed to a difference in preferences; it also points to the different constraints weighting on men's and women's time-use.

6 Conclusions

This paper presents a first descriptive approach to the relationship between time-use variety and subjective well-being. It tends to support the hypothesis that allocating one's time to a more diversified set of activities is likely to yield a higher level of life satisfaction and momentary utility. The relationship between subjective well-being and the duration of an activity seems to be concave rather than convex, hence supporting the hypothesis of decreasing marginal utility rather than increasing returns. Finally, the results (especially on the American data) are suggestive of the fact that women's higher level of happiness is partly due to their more diversified agenda. However, this cannot fully be attributed to gendered preferences, as the positive association of diversity with subjective well-being is not specific to women, in the American data. This suggests that the less diversified agenda of men, and their lower life satisfaction, are at least partly the outcome of the specific constraints that weight on their time allocation, rather than on their specific preferences.

7 References

Aguiar, M., Hurst, E. (2007). Measuring trends in leisure: The allocation of time over five decades. *Quarterly Journal of Economics*, 122(3), 969–1006.

Aguiar, Mark, Erik Hurst, and Loukas Karabarbounis. "Time use during the great recession." *American Economic Review* 103, no. 5 (2013): 1664-96.

Batz, C., Tay, L. (2018). Gender differences in subjective well-being. In E. Diener, S. Oishi, L. Tay (Eds.), *Handbook of well-being*. Salt Lake City, UT: DEF Publishers.

Becchetti, L. and G. Conzo (2021), 'The gender life satisfaction/depression paradox,' *Social Indicators Research*.

- Becker, G. S. (1965), A Theory of the Allocation of Time, *The Economic Journal*, 75(299): 493-517.
- Becker, Gary S. (1973), "A Theory of Marriage: Part I." *Journal of Political Economy* 81:813-846.
- Biddle, Jeff E., and Daniel S. Hamermesh. "Sleep and the Allocation of Time." *Journal of Political Economy* 98, no. 5, Part 1 (1990): 922-943.
- Blanchflower, D.G. and A.J. Bryson (2021), 'Taking the pulse of nations: a biometric measure of well-being,' NBER working paper 29587.
- Blanchflower, D.G. and A.J. Bryson, Alex (2022). *The Female Happiness Paradox*. NBER Working Paper w29893.
- Blau F. Kahn L. (2017). The Gender Wage Gap: Extent, Trends, and Explanations, *Journal of Economic Literature*, 55(3), 789-865.
- Browning, M., P-A Chiappori and Y. Weiss (2014), *Economics of the Family*, Cambridge University Press.
- Chiappori, Pierre-Andre, Bernard Fortin and Guy Lacroix (2002), "Marriage market, divorce legislation, and household labor supply." *Journal of Political Economy* 110: 37-71.
- Choo, E., and A. Siow. (2006), "Who Marries Whom and Why." *Journal of Political Economy* 114(1): 175-201.
- Fernandez R. (2013). Cultural Change as Learning: The Evolution of Female Labor Force Participation over a Century. *American Economic Review* 2013, 103(1): 472–500.
- Fortin, Helliwell and Wang (2015), 'How does subjective well-being vary around the world by gender and age,' *World Happiness Report, 2015*, edited by J.F. Helliwell, R. Layard, and J. Sachs, Sustainable Development Solutions Network, New York.
- Gershuny, J.I. (2000). *Changing times, work and leisure in post industrial society*. Oxford, Oxford University Press.
- Giulia Dotti and Sani Treas (2016). Educational Gradients in Parents' Child-Care Time Across Countries, 1965–2012, *Journal of Marriage and Family* 78: 1083–1096.

Goldin C. (2014). A Grand Gender Convergence: Its Last Chapter. *American Economic Review*.104 (4) :1091-1119.

Goldin C. (2021). *Career Family: Women's Century-Long Journey toward Equity*. Princeton NJ: Princeton University Press.

Goldin, C. (2020), Journey across a century of women, 20th Marty Feldstein Lecture,

Graham, C.L and S. Chattopadhyay (2013), Gender and well-being around the world, *International Journal of Happiness and Development*, 1(2): 213-232.

Gronau R. Hamermesh D. (2008). The Demand for Variety: A Household Production Perspective. *The Review of Economics and Statistics*, 90.3 562–572.

Hamermesh D. (2016). What's to know about time use? *Journal of Economic Surveys*, 30, 1, 198–203.

Hamermesh, D. J. Lee. (2007). Stressed Out on Four Continents: Time Crunch or Yuppie Kvetch. *Review of Economics and Statistics*. 89(2): 374–383.

Hamermesh, D.S., 2019. *Spending Time: The Most Valuable Resource*. Oxford University Press, Oxford, New York.
<https://www.nber.org/lecture/2020-martin-feldstein-lecture-journey-across-century-women>

Harrell FE (2001) *Regression Modeling Strategies: With Applications to Linear Models, Logistic Regression, and Survival Analysis*. New York: Springer.

Jost, Lou. 2006. "Entropy and Diversity." *Oikos* 113 (2): 363–75.

Juster, F., Stafford, F., 1991. The Allocation of Time: Empirical Findings, Behavioral Models, and Problems of Measurement. *Journal of Economic Literature* 29, 471-522.

Kahneman, D. and Krueger, A.B. (2006), Developments in the measurement of subjective well-being, *Journal of Economic Perspectives*, 20(1), 3-24. Kahneman, D. and Thaler, R.H. (2006). "Anomalies: utility maximization and experienced utility", *Journal of Economic Perspectives*, vol. 20, pp. 221–34.

Kahneman, D., Krueger, A.B., Schkade, D.A., Schwarz, N. and Stone, A. (2004). A survey method for characterizing daily life experience: The Day Reconstruction Method, *Science*, vol. 3, 1776-1780.

Kahneman, D., Krueger, A.B., Schkade, D.A., Schwarz, N. and Stone, A.A. (2006). “Would you be happier if you were richer? A focusing illusion”, *Science*, vol. 312, pp. 1908–10.

Kahneman, D., Wakker, P. P., Sarin, R. (1997). Back to Bentham? Explorations of Experienced Utility. *The Quarterly Journal of Economics*, 112(2), 375–405.

Knabe A, Ratzel S, Schob R and Weiman J. (2010). Dissatisfied with Life but Having a Good Day: Time Use and Well-Being of the Unemployed. *Economic Journal*, 120:867-89.

Knabe, A. and Rätzl, S. (forthcoming). OScarring or scaring? The psychological impact of past unemployment and future unemployment riskO, *Economica*.

Kooreman, Peter, and Arie Kapteyn, “A Disaggregated Analysis of the Allocation of Time within the Household,” *Journal of Political Economy* 95 (April 1987), 223-249.

Krueger, A., Kahneman, D. Schkade, D. Schwarz, N. and Stone, A. (2009a). “National time accounting: the currency of life” in (A. Krueger, ed.), *Measuring the Subjective Well-Being of Nations: National Accounts of Time Use and Well-Being*, pp. 9–86, Chicago: University of Chicago Press.

Krueger, A.B. and Mueller, A. (2008). “The lot of the unemployed: a time use perspective”, IZA Discussion Paper No. 3490, May.

Krueger, Alan B, Daniel Kahneman, Claude Fischler, David Schkade, Norbert Schwarz, and Arthur A Stone. (2009b). “Time Use and Subjective Well-Being in France and the US.” *Social Indicators Research* 93 (1): 7–18.

OECD - Social Policy Division - Directorate of Employment, Labour and Social Affairs, MF2.1: Usual working hours per week by gender

OECD (2018). Family Database www.oecd.org/els/family/database.htm

Plagnol, A. and R. Easterlin. 2008. “Aspirations, Attainments, and Satisfaction: Life Cycle Differences Between American Women and Men”. *Journal of Happiness Studies*. 9: 601–619.

Senik C. (2017). Gender gaps in subjective wellbeing: a new paradox to explore. *Review of Behavioral Economics*, 4(4), 349-369.

Stevenson, B. J. Wolfers. (2009). The Paradox of Declining Female Happiness, NBER wp14969.

Stevenson, B. and J. Wolfers (2009), 'The paradox of declining female happiness,' *American Economic Journal: Economic Policy*, 1:2: 190-225.

Stewart, Jay, "Assessing Alternative Dissimilarity Indexes for Comparing Activity Profiles," *Electronic International Journal of Time Use Research* 3 (2006), 49-59.

Stratton L. (2012). The Role of Preferences and Opportunity Costs in Determining the Time Allocated to Housework, *American Economic Review: Papers Proceedings*, 102(3): 606–611 <http://dx.doi.org/10.1257/aer.102.3.606>.

Stutzer A. and Frey B. (2008). Stress that Doesn't Pay: The Commuting Paradox, *Scandinavian Journal of Economics*, 110(2), 339-366.

Van Praag, Bernard MS, Paul Frijters, and Ada Ferrer-i-Carbonell. 2003. "The Anatomy of Subjective Well-Being." *Journal of Economic Behavior Organization* 51 (1): 29–49.

A Diversity indices

The objective is to build an index of diversity in time-use for each respondent in the surveys.

A general diversity equation of order q can be computed as the sum of the relative shares of time spent in activity i , p_i , where S stands for overall richness of activities (the total number of activities performed by respondent i).

$${}^qD = \left(\sum_{i=1}^S p_i^q \right)^{\frac{1}{1-q}}$$

According to Jost (2006) and Tuomisto (2010), qD measures the "effective number of activities" performed by respondent i .

Depending on the order q , the index will be sensitive to dominant or rare activities.

The index of order $q = 0$ is insensitive to the frequency of time spent in each activity, but will merely count the overall number of activity categories performed. More generally, all indexes with $q < 1$ favor activities on which relatively little time is spent, while all indexes with $q > 1$ do the reverse - i.e. they favor activities on which relatively more time is spent (see Jost, 2006).

For the following indexes, we convert the measures to what Jost (2006) refers to as "true diversities" or "effective numbers" to make different measures of diversity more comparable. Note, that when computing these indexes, sleep is not taken into account. We are thus only measuring diversity in daily time-use when awake/not sleeping.

1. Simple count of different activities

The simplest measure is the simple count of the number of different activity categories performed by a given respondent on the diary day (i.e. when the time spent on the activity is > 0). This measure obviously does not weigh the activities by their duration. Thus, a day in which an individual spends the same share of time in 4 different activities is as diverse as a day in which an individual spends e.g. 40% at work 40% sleeping and 10% eating and socializing respectively.

2. Herfindahl/Simpson Index of concentration

The index is defined as

$$C = \sum_{i=1}^S p_i^2$$

where p_i stands for the share of a given activity i among the overall diary day. First the shares p_i - the time spent in minutes on activity i over the overall time available on a day, i.e. $24 \times 60 = 1440$ - are computed. The square of all shares over all activities then enter a index of concentration that lies between $1/S$ and 1. The maximum value indicates perfect concentration of activities on one activity, while the minimum value indicates that time equally shared among all the activity categories, i.e. :

$$\sum_{i=1}^S \left(\frac{1440}{1440} \right)^2 = \sum_{i=1}^S \frac{1}{S^2} = S \frac{1}{S^2} = \frac{1}{S}$$

By taking the inverse of the concentration index

$$D^H = \frac{1}{C}$$

we obtain the true diversity according to the Herfindahl/Simpson index. Consider the example of respondent A who spends her time equally in 4 activities, i.e. $p_i = 0.25$ and respondent B who spends her time mostly in one activity, i.e. $p_1 = 0.9$, and $p_2, p_3, p_4 = 0.1$. The activity-variety for respondent A according to the Herfindahl/Simpson index will be equal to $\frac{1}{4 \times 0.25^2} = 4$, while for respondent B, it will be equal to $\frac{1}{0.9^2 + 3 \times 0.1^2} \approx 1.19$.

Using the inverse of the concentration index, a higher Simpson/Herfindahl diversity index will indicate a higher diversity in time-use of a given respondent. The index will range between 1 - lowest possible variety, and S - the highest possible variety, whereby a respondent spends an equal amount of time in each of the activity categories of the survey.

As outlined above, the Herfindahl/Simpson index weighs activities on which a higher share of time is spent more strongly than the simple activity count. It thus associates diversity quite strongly with the absence of dominance of a certain species/activity: unlike the number of activity count it

will give a low diversity count for a respondent who performs all of the activities but does so very unevenly (i.e. spends a large share in one activity and only very small shares in all others).

3. Shannon-Wiener Index

Let N denote the total time (in min) spent a day (= 1440). Let i denote the category of activity an individual has spent their time on: there are S categories recorded. Let p_i denote the share of time spent by an individual in a given category of activities (share = actual time (in min) spent over total time (in min) available on the diary day, i.e. = 1440). The standard formula is:

$$H = - \sum_{i=1}^S p_i \ln(p_i)$$

Note that in the data, there are activities on which some individuals spend no time. As $\log(0)$ is not defined, we need to leave these out of the computation, i.e. we only sum over positive shares $p_i > 0$. The number of effective activities according to the SW-index increases both in the number of activity categories S with a positive share of time, as well as if time is distributed relatively equally among the performed categories. It thus takes into account two dimensions of diversity: it penalizes the presence of very dominant activities (with high shares) and increases with the number of activities performed.

Taking the exponential of the the Shannon-Wiener entropy index converts it to its true diversity/effective : $D^{SW} = \exp(H)$. This allows compare it with the other indexes aforementioned. Referring back to the previous example, for respondent A who spends her time equally in 4 activities, we obtain a Shannon-Wiener diversity index of $\exp(-(4 \times 0.25 \times \ln(0.25))) = 4$. For respondent B, we obtain a diversity index of $\exp(-(0.9 \times \ln(0.9) + 3 \times 0.1 \times \ln(0.1))) \approx 2.19$.

This example shows that the Shannon-Wiener index does not over-weigh dominant activities, as opposed to the Simpson/Herfindahl index. It also does not over-weigh rare activities, unlike the activity number count. It is a diversity index of order $q = 1$.

If time is equally shared among activities, all three indexes will yield the same results. Indexes with a higher q will yield lower values in the presence of dominant activities.

4. Gini index

Let n denote the total number of activity categories, i denote the activity category i ordered by the share of time spent in that category (with $i = 1$ to n), and y_i denote the share of total time spent on activity i on the diary day. We can then compute the Gini index according to the following formula:

$$G = \frac{2 \sum_i^n i y_i}{n \sum_i^n y_i} - \frac{n+1}{n}$$

Gini = 0: an individual spends the exact same share of time on all of the activity categories.

Gini = 1: perfect inequality in time use, i.e. a respondent spends all their time on the same activity (for $n \rightarrow \infty$).

A caveat of the Gini index is that it is sensitive to the categorization of activities. The higher the granularity of the classification of categories, the higher the Gini index will be. Moreover, it is not clear that activity-variety should imply a perfectly equal distribution of time among categories. The Herfindahl/Simpson, as well as Shannon index, are better able to take into account the fact that diversity depends both on the number of activities and on the dominance of activities.

Table A1: Tier 1 and 2 activity category definitions

Tier 1	Tier 2	FTUS- Tier 2 description	ATUS categories
Sleep	11	sleep	0101
Personal care	12	personal care	0102, 0104,0105,0805
Personal care	13	medical care	0103,0804
Personal care	15	other personal activities	0199
Eating and drinking	14	Meals	1101,1102,1199
Work	21	normal work	0501
Work	22	other work	0503,0599
Work	23	non-work at the workplace	0502
Work	24	job search	0504
Education and training	26	professional training	
Education and training	26	study and studying internships	0601,0602,0603,0604,0699
Education and training	26	non-vocational training and courses	
HH work	31	Meal preparation	0202
HH work	32	cleaning and laundry	
HH work	32	washing, ironing, clothes cleaning	0201,0901
HH work	34	housekeeping activities	0209
HH work	35	groceries and shopping	0701,0702,0703,0799
HH work	36	Use of administrative services	0801,0802,0803,0806,0807,0808,0899,1501
HH work	37	construction, repair and maintenance work	0203,0204,0207,0208,0902,0905,1503
HH work	38	gardening, artistic creations, pet care	0205,0206,0904,0903
HH work	39	other domestic activities	0299,0999
Care work	41	care of child of own and/or other household	0301,0303,0401,0403
Care work	42	Play and instruction activities for children	0302,0402
Care work	43	care of adults	0304,0305,0404,0405,0399,0499,1502
Socializing	51	social events and outings	1202,1505,1506,1599
Socializing	52	different forms of conversations	1201,1601,1699
Socializing	53	Religious practises, civil ceremonies	1401,1499
Socializing	54	Civic, and political activities and meetings	1001,1002,1003,1004,1099
Recreation and sports	61	Different sports	
Recreation and sports	61	Recreation Walks, fishing, camping, motorized rides	1301, 1303,1304,1399
Relaxing and hobbies	63	Reading, Watching TV, listening to music	
Relaxing and hobbies	63	doing nothing	
Relaxing and hobbies	63	Hobbies: playing	1203,1205,1299,1504
Relaxing and hobbies	63	computer activities	
Cultural activities	65	Visits & events	1204,1302
Commuting	81	Commuting for associative purposes	18XX

Table A2: Life satisfaction and diversity, full regression

	(1)	(2)	(3)		(4)		(5)		(6)	
	ATUS Pooled	FTUS	ATUS		ATUS		FTUS		FTUS	
			Weekday	Weekend	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend
SW_i	0.137*** (0.017)	0.166*** (0.052)	0.133*** (0.025)	0.139*** (0.021)	0.120** (0.060)	0.154*** (0.057)				
SW_i^2	-0.040*** (0.011)	-0.053* (0.031)	-0.035** (0.017)	-0.052*** (0.015)	0.036 (0.040)	-0.074* (0.043)				
age	-0.063*** (0.006)	-0.061** (0.024)	-0.064*** (0.009)	-0.061*** (0.009)	-0.077*** (0.025)	-0.038 (0.025)				
age ²	0.001*** (0.000)	0.000* (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.001** (0.000)	0.000 (0.000)				
Female	0.228*** (0.030)	-0.107 (0.107)	0.249*** (0.043)	0.183*** (0.041)	-0.125 (0.114)	-0.008 (0.113)				
Living with partner	0.584*** (0.033)	0.581*** (0.124)	0.561*** (0.048)	0.636*** (0.045)	0.805*** (0.128)	0.583*** (0.136)				
Has children	0.118*** (0.033)	-0.202* (0.119)	0.097** (0.048)	0.169*** (0.045)	-0.426*** (0.122)	-0.135 (0.127)				
Employment										
Part-time	-0.125*** (0.044)	0.192 (0.168)	-0.058 (0.064)	-0.268*** (0.061)	0.085 (0.181)	0.137 (0.185)				
Unemployed	-0.781*** (0.065)	-1.298*** (0.192)	-0.711*** (0.096)	-0.902*** (0.085)	-1.265*** (0.216)	-1.291*** (0.204)				
Retired	0.118* (0.062)	0.380* (0.213)	0.149 (0.091)	0.070 (0.085)	0.219 (0.229)	0.328 (0.234)				
Student	0.136 (0.106)	0.847*** (0.236)	0.174 (0.153)	0.085 (0.150)	0.646** (0.258)	1.084*** (0.252)				
Other	-0.436*** (0.048)	0.124 (0.210)	-0.400*** (0.070)	-0.483*** (0.064)	-0.271 (0.212)	-0.201 (0.217)				
HH income	0.178*** (0.016)	0.256*** (0.092)	0.206*** (0.023)	0.115*** (0.022)	0.250*** (0.097)	0.152 (0.096)				
Time sleep	0.050* (0.028)	0.142* (0.084)	0.086** (0.041)	-0.006 (0.038)	0.148* (0.087)	0.103 (0.107)				
Time sleep ²	-0.003** (0.001)	-0.005** (0.002)	-0.006*** (0.002)	0.001 (0.002)	-0.008* (0.004)	-0.012** (0.006)				
Weekend	-0.031 (0.031)									
Constant	5.758*** (0.258)	5.793*** (1.181)	5.393*** (0.375)	6.465*** (0.353)	6.468*** (1.018)	6.964*** (1.019)				
Observations	19,198	1,223	9,267	9,931	1,192	1,194				
R-squared	0.073	0.136	0.073	0.079	0.134	0.125				

ATUS: 2012 and 2013; FTUS: 2010. Weighted statistics.

Table A3: Weighted and Unweighted Sample Descriptive Statistics, by Country

		USA weekday	USA weekend	France weekday	France weekend
S-W Index 2 digit classification		4.529 (1.671)	4.659 (1.835)	5.280 (1.689)	5.486 (1.706)
S-W Index 2 digit FR pooled				6.748 (1.839)	6.745 (1.841)
1 digit classification					
Sleep	% reporting	1	1	1	1
Sleep	Average duration (hours)	8.4	9.2	8.3	8.7
Personal care	% reporting	0.84	0.74	0.95	0.94
Personal care	Average duration (hours)	0.85	0.73	0.90	0.92
Meals	% reporting	0.96	0.95	0.99	0.99
Meals	Average duration (hours)	1.07	1.22	2.10	2.66
Work	% reporting	0.59	0.24	0.50	0.17
Work	Average duration (hours)	4.64	1.30	3.58	0.94
Education	% reporting	0.05	0.04	0.08	0.04
Education	Average duration (hours)	0.27	0.15	0.43	0.22
Domestic work	% reporting	0.84	0.86	0.83	0.86
Domestic work	Average duration (hours)	2.07	2.76	2.75	3.04
Care work	% reporting	0.38	0.35	0.26	0.24
Care work	Average duration (hours)	0.68	0.65	0.47	0.38
Social activities	% reporting	0.45	0.54	0.44	0.59
Social activities	Average duration (hours)	0.78	1.57	0.68	1.41
Sports and recreation	% reporting	0.19	0.17	0.21	0.35
Sports and recreation	Average duration (hours)	0.26	0.35	0.37	0.80
Relaxing and hobbies	% reporting	0.91	0.92	0.91	0.91
Relaxing and hobbies	Average duration (hours)	3.58	4.50	3.09	3.64
Events and cultural activities	% reporting	0.03	0.07	0.03	0.09
Events and cultural activities	Average duration (hours)	0.07	0.19	0.08	0.22
Commuting	% reporting	0.88	0.82	0.85	0.77
Commuting		1.23	1.18	1.18	1.05

Activity duration is measured in hours. ATUS: 2012 and 2013; FTUS: 2010. Weighted statistics.