Social Jetlag in the Context of Work and Family[1]

Michaela Kudrnáčová[2] - Dana Hamplová[3]
Institute of Sociology of the Czech Academy of Sciences, Prague, Czech Republic

Social Jetlag in the Context of Work and Family. By definition, social jetlag – a misalignment between the social and biological time – is closely linked to social obligations that conflict with the individual's chronotype. It is a widespread phenomenon and is linked to various negative health, cognitive, and psychological outcomes. Although there are studies on social jetlag, they are mostly dominated by biomedical approaches. Therefore, the presented study aims to explore the link between social jetlag and work and family status from an original social perspective. The study explores the link between the magnitude of social jetlag and factors related to the type of occupation and selected family obligations using a representative Czech sample. Using the 4th wave of the Czech Household Panel Survey (CHPS), secondary data analysis in Stata 16 was performed. A sample of 1,441 employed and self-employed respondents was included in the analysis. The multilevel mixed-effects modelling was used to control for members of the same household. Model fit was evaluated by likelihood ratio test and BIC. Self-employed individuals are less likely to experience social jetlag than employees. Professional classes are least likely to suffer from social jetlag. Lower occupational classes experience more severe social jetlag, but its severity is moderated by self-employment. If self-employed, the routine manual and non-manual workers do not experience significantly larger social jetlag than professionals. In contrast to occupation, we found no evidence that family status, such as co-residential partnership, contributes to the severity of social jetlag. Working parents of small children experience lower social jetlag than childless individuals. In conclusion, our results demonstrate that social jetlag is more closely linked to the type of work than to the family status.
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Introduction

The impact of increasing time pressure, accelerating rhythms of daily life, and the ensuing 'sleep deprivation epidemic' have attracted considerable attention in recent decades (Chatzitheochari – Arber 2009; Lyon 2019; Schieman – Glavin 2016). This increasing social pressure not only causes sleep deprivation but also changes the temporal organization of our life causing misalignment between individual biorhythm and daily schedules within the 24-hour period. The individual biorhythm is driven by the endogenous time-keeping (circadian) system that entrains the solar day (Roenneberg et al. 2019). Humans are

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[2] Correspondence: Mgr. Michaela Kudrnáčová MSSc., Institute of Sociology of the Czech Academy of Sciences, Jilská 1, 110 00, Prague, Czech Republic. E-mail: michaela.kudrnacova@soc.cas.cz, ORCID: 0000-0003-0154-6884.

[3] Correspondence: prof. PhDr. Dana Hamplová, PhD., Institute of Sociology of the Czech Academy of Sciences, Jilská 1, 110 00, Prague, Czech Republic. E-mail: dana.hamplova@soc.cas.cz, ORCID: 0000-0002-4212-6475.

diurnal, being active during the light phase and sleeping during the dark phase, but the time when we prefer to sleep and be awake relative to the social time greatly varies in populations, and has been described as a chronotype (Borisenkov et al. 2019; Roenneberg – Merrow 2016; Roenneberg et al. 2019). Although an individual chronotype is partly affected by social factors, there is a significant biological component (Nováková et al. 2013; Zhang et al. 2016). A widely used and validated tool, the Munich ChronoType Questionnaire (MCTQ), has been employed to determine chronotype distribution in large population samples, and data demonstrated that chronotype exhibits almost normal distribution with small over-representation of late over early chronotypes (Roenneberg 2007; Roenneberg et al. 2019). Importantly, the same distribution was recently confirmed for the Czech population examined in this study (Sládek et al. 2020).

Social jetlag mostly occurs when evening types need to conform the beginning of their activity to early hours and morning types need to extend their activity schedules into later hours (Roenneberg et al. 2012; Wittmannet al. 2006). Importantly, social jetlag cannot be equated with sleep deprivation produced by short sleeping hours as even those with adequate sleep duration might suffer from social jetlag (Jankowski 2017). In contemporary society, social jetlag is a widespread phenomenon. About 80 % of the population uses an alarm clock on workdays (Foster et al. 2013; Roenneberg et al. 2013) signalizing the misalignment of biological and social time. Empirical studies suggest that 70 % of the adult population suffers from at least one hour of social jetlag (Roenneberg et al. 2012; Roenneberg et al. 2007; Rutters et al. 2014; Wittmann et al. 2006). It is believed that social jetlag has a major impact on physical and mental health, work productivity, academic outcomes, substance abuse, cognitive performance, and other life outcomes (Beauvalet et al. 2017; Díaz-Morales – Escribano 2015; Haraszti et al. 2014; Haynie et al. 2018; Lang et al. 2018; Levandovski et al. 2011; Rutters et al. 2014; Smarr – Schirmer 2018; Tavares et al. 2020; VoPham et al. 2018). With rare exceptions (Cheng – Hang 2018; Hulsegge et al. 2019), research on social jetlag has been dominated by biomedical approaches. Yet, social jetlag is – by definition – closely linked to social obligations that conflict with the individual's chronotype. In this article, we raise the questions of whether and how the type of work and family status contribute to social jetlag. In particular, we formulate several hypotheses that social class, employment status, the number of working hours, and commuting times are likely predictors of social jetlag and its severity. Furthermore, even though the temporal organization of the labour market is the most obvious determinant of social jetlag (Barber – Jenkins 2014;

Ikeda et al. 2020; Schieman – Young 2013; Virtanen et al. 2009), it is plausible to expect that unpaid work in form of housework, childcare, and other family obligations also affect sleep timing (Barnes et al. 2012). Therefore, using the forth wave of the Czech Household Panel Survey we test a hypothesis that work-family conflict may result from a time-based conflict.

Literature review and hypothesis development

We suggest that social class is an important predictor of social jetlag as it is closely linked to the degree of autonomy and the extent to which work may be monitored and controlled by the employer (Evans 1992; Harrison – Rose 2006). By the definition, the work of professional and service classes is governed by a service contract. The employment relationship is not defined by particular tasks but by a more diffuse exchange that provides the worker with relative autonomy, flexibility, and discretion about the job assignments (Erikson – Goldthorpe 1992). Moreover, the professionals and service classes tend to have jobs that are less connected to a particular time and place. Thus, it is plausible to expect that higher flexibility and autonomy of professional and services workers provide more opportunities to adjust their schedules and working times to their chronotypes. In contrast, the employment relationship between routine non-manual and manual workers is regulated by labour contracts. Their work is defined by particular tasks and their wages are calculated on a 'piece' or time basis (Erikson – Goldthorpe 1992). As these tasks tend to be related to a specific time and place, the level of flexibility is lower, and routine non-manual and manual workers might be more likely to suffer from social jetlag.

Hypothesis 1: Professional and services classes are less likely to suffer from social jetlag than routine manual and non-manual classes.

In addition to social class, we consider the number of hours spent in employment also matter. Several studies demonstrated that long working hours are negatively linked to sleep quality and duration (Afonso et al. 2017; Knutson et al. 2010). We suggest that long working hours might be linked to misalignment between individual biological time and the actual timing of sleep. First, very long working hours might extend to what would be the preferred sleeping times. Individuals with early chronotypes might be forced to work late into the night while those with later chronotypes might need to start their work earlier than would be their preference. Indeed, there is evidence that long working hours are associated with increased job involvement and

communication outside of the standard working schedules (Schieman – Young 2013). Long working hours might also affect the severity of social jetlag indirectly. Spending more hours at work pushes other activities, such as family and personal time, into the early or late hours.

Hypothesis 2: The longer the working hours and commuting times, the higher level of social jetlag.

Self-employment is likely to be a major predictor of social jetlag. Self-employed individuals generally tend to have higher work flexibility and the desire for more autonomy might be an important motivation for self-employment (Dawson – Henley 2012; Nordenmark et al. 2012). Thus, it is plausible to speculate that the self-employed are more likely to adjust their work schedules according to their chronotype and experience lower values of social jetlag. At the same time, it is necessary to consider the heterogeneity of self-employment. Treating the self-employed as a homogenous group conflates entrepreneurial ventures with the more precarious forms of self-employment (Glavin et al. 2019). As self-employment among non-professional classes tends to be more precarious, they might not be able to enjoy as much flexibility as those from professional classes.

Hypothesis 3: Self-employed individuals are less likely to suffer from social jetlag as they have more freedom to adjust their schedules to their time preferences.

Hypothesis 4: Self-employed individuals are heterogeneous groups. The link between self-employment and social jetlag is weaker among non-professional classes. Self-employment tends to be less advantageous and more precarious in these social groups.

Work is not the only life domain that exerts pressure on an individual's finite time resources. The time devoted to unpaid household work also increases the pressure on the individual's schedules and might contribute to social jetlag. Theoretically, social jetlag could arise from the difference between parent and child chronotypes. It is because small children, in general, are inclined toward morning chronotypes (Caci et al. 2005; Randler et al. 2009). Although partial heritability of chronotype has been suggested (Hur 2007; Klei et al. 2005; Von Schantz et al. 2015), there is also evidence that chronotypes in the family often mismatch (Pereira-Morales et al. 2019). Additionally, there are also studies on the parent-child synchrony, which,

however, often have considerable limitations, such as sample size (Leonhard – Randler 2009). There is also no doubt that childcare is one of the most time-consuming activities and the presence of young children decreases sleep, as discretionary time (Burgard – Ailshire 2013) and sleep is considered to be a victim of competing demands of work and family (Barnes et al. 2012). This means that sleeping patterns are most likely to be disrupted if children are small and parents work full time. This is true particularly for women who are responsible for the lion's share of housework and childcare (Hamplová et al. 2019).

In spite of this, studies in parents of young children showed that their chronotype adjusts according to their children's because it becomes earlier than that of childless age-matched subjects (Caci et al. 2005; Feldman 2006; Sládek et al. 2020; Yamazaki 2007). This effect was significant not only for the sleep phase (based on MCTQ) but also for subjective assessment of the best alertness time (Sládek et al. 2020). Therefore, taking care of small children may not increase the size of the social jetlag.

Hypothesis 5: Taking care of young children will not increase social jetlag.

Hypothesis 6: The effect of young children at home is stronger for those working full-time, particularly for mothers.

Data and methods

Design of the study, dataset and participants

The Czech Household Panel Survey (CHPS) is a nationally representative longitudinal survey. The households were selected by a two-stage stratified probability sampling design. Information on respondents' sleeping patterns was collected in Wave 4 (2018) Detailed technical information is available in Czech Social Science Data Archive (Kudrnáčová 2019) and the data are publicly available both in Czech and English.

Since we are interested in the harmonization of work and family in the context of social jetlag, only currently working (employed and self-employed) individuals with numerable sleep determinants that filled Pen-And-Paper-Interviewing (PAPI) self-administered questionnaire where are included in the analysis. In total, we were able to analyze information on 1,441 respondents (for descriptive statistics see Table 1). Statistical analyses were conducted in Stata 16 (Stata Corp. 2021). The multilevel mixed-effect approach was adopted due to individuals nested among households: the model, therefore, controls for members of the same household since this aspect, if not controlled for, may

otherwise distort the results. To address the research questions, two sets of models were created, both having social jetlag as a dependent variable. The first set (Table 3) focuses on the effects of job-related characteristics, while the other set (Table 4) adds the lens of a family context.

Model fit is evaluated by likelihood ratio test and by BIC – Bayesian Information Criterion.

Dependent variable

The dependent variable *social jetlag* was derived from the Munich ChronoType Questionnaire (MCTQ: WEP 2020) following the example of many previous studies (e.g., Borisenkov et al. 2019; Jankowski 2017; Wittmann et al. 2006). Respondents reported their sleep behaviour over 4 weeks prior to the survey. They were asked about workdays and work-free days separately: a workday was defined as a day with a regular schedule (job, school, work as a housewife/househusband). Then, based on the answers to self-reported questions *"At what time do you usually fall asleep/wake up on workdays/free days?"*, social jetlag was calculated as mid-sleep time on free days (MSF) minus the mid-sleep time of workdays (MSW) and was then converted to a numeric variable holding the absolute value of hours of sleep debt (only 1.81 % of the analysed sample suffered from negative social jetlag which represents excess sleep); the result of social jetlag equals zero means no misalignment, values above zero are a sign of social jetlag (accumulation of sleep debt during workdays or free days).

Main explanatory variables

Social class was measured by the European Socio-economic Classifications (ESEC). The variable was derived from the International Standard Classification of Occupations (ISCO-08). The ISCO-08 codes were translated into ESEC using the iscogen module in Stata 16 (Jann 2019). The original ESEC classification consists of nine classes that comprise both occupation and employment status. This article used a reduced 6-category ESEC version for two reasons. First, as we controlled for self-employment in an independent variable, we incorporated self-employed individuals into their occupational groups. Second, only 11 individuals were coded into lower technician occupations, they were included in lower services, sales, and clerical occupations. The transformation produced six following classes: 1) Large employers, higher-grade professional, administrative, and managerial occupations; 2) Lower grade professional, administrative and managerial occupations and higher grade technician and supervisory occupations;

3) Intermediate occupations; 4) Lower services, sales, and clerical occupations; 5) Lower technical occupations, and 6) Routine occupations. In the analyses, the social classes were reduced to three (see the analytical part) since there were no significant differences between them, and the model with merged classes had improved model fit.

Self-employment is a dummy distinguishing between an employee and the self-employed (including liberal professions).

Working hours is a variable combined from answers to two questions: "How many hours weekly, on average, do you work for pay?" and "How many hours weekly, on average, do you work in any additional paid jobs or other gainful activities?" differentiating between those working less than 40 hours per week, those working 40 hours per week, those working over 40 but less than 50 hours a week, and those working 50 or more hours per week. In a supplementary analysis, we also tested a more detailed categorization of part-time jobs. However, the number of respondents with short part-time jobs was small and there were no major differences between short and longer part-time work.

Commute time was captured by the question "How long does it usually take you to get from home to work, door to door? Include only the one-way trip, and if the duration varies between days, count the average." and it was recorded in minutes. Zero commute time represents work from home.

The respondent's family status is measured with two indicators: partnership status and presence of children in the household. *Partnership status* categories distinguished respondents who were single and respondents who lived with a co-residential partner irrespective of the formal marital status. *The presence of minor children* in the household was measured with three variables: the presence of a child aged 0-5, the presence of a child aged 6-11, and the presence of a child aged 12 to 17.

Control variables

As social jetlag is linked to individual chronotype and the chronotype changes during lifetime (Jankowski 2015; Paine et al. 2006), all models are controlled for *age*. In supplementary models, we used a categorical measure of age to test for non-linearity of the relationship (not shown in the article). However, as non-linearity was not detected, age was used as a continuous measure.

Social jetlag is often normalized for ***sex*** (Koopman et al. 2017; Levandovski et al. 2011; Mathew et al. 2019). In this study, we also included sex as a

variable because we were interested in the interaction between socio-demographic characteristics and respondents' sex.

Some of the latest studies show that *municipality size* is another variable worth noting while examining the misalignment between biological and social time. More inhabited areas have a different character from the smaller ones; since business and administrative centres are often located here, people have less daylight exposure due to spending most of the day inside, but higher artificial light exposure during the night. These factors affect the phase-angle of circadian entrainment towards delaying the internal time (Pilz et al. 2018; Roenneberg et al. 2007; Sládek et al. 2020) and, therefore, contribute to social jetlag. Vice versa, there is a positive correlation between living in the countryside and earlier circadian rhythm (Carvalho et al. 2014).

In a supplementary analysis, we included the parameter Best Alertness midpoint (BAmid), which can be best understood as a self-perceived chronotype that could be a confounder in the analysis (Sládek et al. 2020) and it might serve as a controlling supplementary variable to social jetlag (we report on the limitations of social jetlag within Limitations and Discussion section). Importantly, the employment of BAmid did not affect the main findings obtained by using MCTQ parameters (the supplementary models using BAmid are reported in the Appendix).

Weights

The descriptive statistics are weighted by stratification weights to correct deviations from population proportions in terms of sex, age, region of residence, and distribution of days a week (Kudrnáčová 2019). As for the regression models, no weight was applied (see e.g., Evans − Mills, 2000; Grandin et al. 2006).

Results

Descriptive statistics

The descriptive statistics used within the analyses are reported in Table 1. Due to the nature of our research question, solely the working population is included, all non-working individuals (the unemployed, retired, students, housewives, parents on parental leaves, etc.) were excluded. As for the socio-demographic characteristics, the sample consists of 46 per cent of men, and the average age of the sample is 45 years. Most people report living with a partner or a spouse in the household, while about one-fourth are single. About 60 percent of respondents live with at least one minor child. One-quarter of respondents live in the big cities, while the density in the smaller municipalities is about the same. As for the employed work characteristics, the higher grade professionals or employers constitute 22 percent of the sample, routine and lower technical occupations represent nearly one-quarter of the sample. Unsurprisingly, most respondents are employees, only about one in 8 respondents were self-employed. About 65 percent of respondents work between 40 to 50 hours per week. Also, commuting is quite usual among the working population, on average, it takes them almost 25 minutes to get to work. As for the misalignment of social and biological time, the sample's average social jetlag is 1.2 hours.

Table 2 shows the distribution of social jetlag in the sample. Higher occupational classes report lower values of social jetlag than lower service workers, lower technical occupations, or routine workers. Self-employed suffer on average from 48 minutes of social jetlag (0.8 hours), while employees experience around 1 hour and 18 minutes of social jetlag (1.3 hours). Even though respondents without a minor child at slightly more likely to report zero social jetlag, the overall difference among individuals with children is negligible. The appendix shows figures with a detailed distribution of social jetlag.

Table 1: **Descriptive statistics of the analytical sample**

		%
Sex	*Male*	46.2
	Female	53.8
Partnership status	*Single*	26.7
	Partner/spouse in the hh	73.3
At least one child in the hh	*0 to 5 years old*	17.7
	6 to 11 years old	23.4
	12 to 17 years old	21.5
	No child	37.5
		0.0
Municipality size	*up to 999 inhabitants*	15.8
	1 000 - 4 999 inhabitants	18.5
	5 000 - 19 999 inhabitants	18.8
	20 000 - 99 999 inhabitants	20.4
	100 000 inhabitants and more	26.5
European Socio-economic Classification (ESEC)	*Large employers, higher-grade professional, administrative, and managerial occupations*	22.0
	Lower-grade professional, administrative and managerial occupations and higher grade technician and supervisory occupations	21.3
	Intermediate occupations	12.6
	Lower services, sales, and clerical occupations	19.5
	Lower technical occupations	12.1
	Routine occupations	12.5
Self-employed	Yes	12.1
	No	88.0
Weekly working hours	<40	17.3
	40	41.3
	40<->50	23.3
	50+	18.1
Age (years)	(mean ± SEM)	45.1 ± 0.27
Absolute social jetlag (hours)	(mean ± SEM)	1.2 ± 0.02
Commute time (min)	(mean ± SEM)	25.0 ± 0.69

Data are presented in percentages unless the units are explicitly stated. SEM = standard error of mean.
Note: N = 1441, weighted
Source: Czech Household Panel Survey 2018

Table 2: **Distribution of social jetlag in the analytical sample**

Sleep duration (hours per night)	Average SJL (hour)	0m	1-30m	31m-1h	1-2h	2h+
Less than 7 hours	1.3	6.3	15.9	20.7	38.0	19.2
7+ hours	1.2	5.7	17.8	23.3	41.3	11.8
Total	1.2	6.5	17.5	22.0	39.0	15.0
Social class						
Higher professionals	1.1	7.2	19.2	29.2	36.0	8.5
Lower professionals, administrative	1.2	4.8	15.5	27.7	42.6	9.4
Intermediate occupations	1.3	4.1	14.4	22.1	45.0	14.5
Lower services, sales	1.5	9.7	21.8	14.9	37.6	16.0
Lower technical occupations	1.5	7.9	15.8	15.4	34.8	26.1
Routine occupations	1.5	3.9	15.9	17.0	39.0	24.2
Self-employed						
No	1.3	5.1	15.8	22.1	40.6	16.4
Yes	0.8	16.8	29.9	21.1	27.8	4.5
The youngest child at home						
None	1.2	8.7	18.9	20.4	34.7	17.3
0-5	1.2	4.6	20.0	21.8	41.9	11.8
6-11	1.3	3.5	14.7	19.6	49.2	12.9
12-17	1.3	4.4	14.6	22.7	44.3	14.0

Data are presented in percentages unless the units are explicitly stated.
Note: N = 1441, weighted
Source: Czech Household Panel Survey 2018

Multivariate results

Table 3 addresses hypotheses concerning the link between social jetlag and job characteristics. Model 1 entered all control variables (sex, age, and municipality size) and served as a baseline. Among control variables, only the respondent's age was significantly linked to social jetlag. As expected, older individuals were less likely to suffer from the misalignment between biological and social time. This might be partly linked to the shift towards earlier chronotypes as people age (Jankowski 2015; Paine et al. 2006; Taillard et al. 2004).

Model 2 incorporated all work-related variables: social class, employment status, the number of hours worked, and commuting times. Integrating these variables improved the model fit considerably (BIC dropped by 42). Closer inspection of estimates for social class, however, revealed that there was no

significant difference between classes 1 and 2 (large employers, higher-grade professional, administrative, and managerial occupations and lower grade professional, administrative and managerial occupations and higher grade technician and supervisory occupations), class 3 and 4 (intermediate occupations, lower services, sales, and clerical occupations) and classes 5 and 6 (lower technical occupations and routine occupations). Thus, we merged these categories. Reducing the number of classes significantly improved the model fit in terms of BIC (by 19) and the likelihood ratio test did not indicate any loss of information (LR chi2 = 2.85; Prob > chi2 = 0.416). Thus, we continued with the more parsimonious Model 3.

Hypothesis 1 predicted that professional and service classes are less likely to suffer from social jetlag than routine manual and non-manual classes. Model 3 fully supported this expectation. Using marginal prediction, we estimated that a typical professional worker (classes 1 and 2) suffered from approximately 1-hour social jetlag (1.09 hours, CI 1.04-1.16), while those from routine and lower technical occupations (classes 5 – 6) suffered over 1.5 hours of social jetlag on working days on average (1.51; CI 1.42-1.60).

However, Model 3 did not fully collaborate with Hypothesis 2 suggesting that working hours and longer commuting time contribute to social jetlag. First, the coefficient for the commuting time was very small and not significantly linked to social jetlag. In the supplementary models that controlled for the best alertness midpoint, the coefficient for commuting time became significant but substantively stayed very low. As for the number of hours worked per week, the association with social jetlag was non-linear. The data suggest that longer hours meant more severe jetlag. However, those working very long hours (50+ hours per week) seem to suffer from lower jetlag than those working regular 40-hour week. This conclusion holds even if other work characteristics are removed from the model. The negative link between very long working hours and social jetlag is surprising. However, it may be driven by a selection of individuals who spend 50+ hours at work.

Furthermore, Model 3 also tested Hypothesis 3 predicting that self-employed individuals are less likely to suffer from social jetlag. Indeed, using the marginal predictions and keeping other covariates at the mean (see Figure 1), the self-employed experienced on average 0.87 hours of social jetlag on workdays (CI: 0.74-0.99) while the employees suffered 1.27 hours of social jetlag (CI: 1.23-1.32). Model 3 treated the self-employed as a homogenous group. However, in the theoretical discussion, we suggested that the link between self-employment and social jetlag is weaker among non-professional classes (Hypothesis 4). Even though self-employed might be better off on

average, non-professional classes might be less likely to take the advantage of the status. To test this hypothesis, we included an interaction between social class and self-employment (Model 4). Even though the BIC of Model 4 slightly increased, the likelihood ratio test suggested that the interaction was significant and improved the model fit (LR chi2(2) = 11.03; Prob > chi2 = 0.00).

Table 3: **Estimated coefficients from mixed-effects regression with the dependent variable social jetlag – testing work-related characteristics**

	M1	M2	M3	M4
Age	-0.012**	-0.012**	-0.012**	-0.011**
Sex (*male)*				
Female	0.042	0.082	0.077	0.075
Municipality size	-0.006	0.007	0.005	0.004
Average working hours per week (< *40 hours)*				
40 hours		0.121*	0.123*	0.124*
41-49 hours		0.181**	0.181**	0.189**
50 hours or more		0.056	0.052	0.052
Commuting time		0.002	0.001	0.001
Self-employed				
Yes		-0.403**	-0.406**	-0.219*
Social class *(I - managers, higher grade professionals, employers, etc.)*				
II - Lower-grade professionals etc.		0.090		
III - Intermediate occupations		0.154*		
IV - Lower services, sales, clerical		0.170**		
V - Lower technical occupations		0.492**		
VI - Routine occupations		0.427**		
Social class *(I-II)*				
Class III-IV			0.119*	0.152**
Class V-VI			0.412**	0.479**
Social class#Self-employed				
Class III-IV#Self-employed				-0.278
Class V-VI#Self-employed				-0.500**
Constant	1.775**	1.423**	1.475**	1.440**
Log-likelihood				
Bayesian information criterion	3512.1	3469.8	3450.8	3454.3

* p<0.05, ** p<0.01

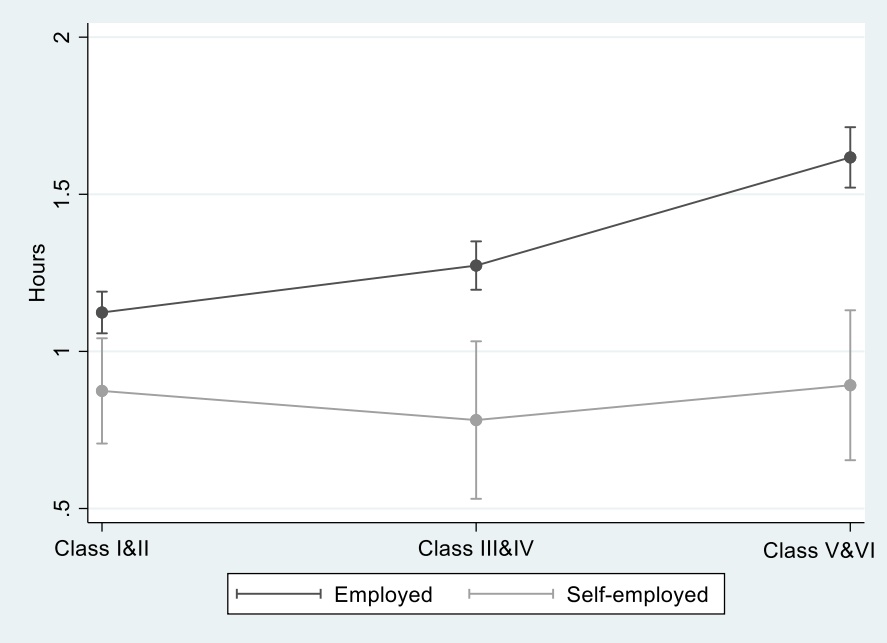
Note: N = 1441

Source: Czech Household Panel Survey 2018

Contrary to our theoretical predictions, this model showed that the effect of self-employment on social jetlag was stronger for intermediate and lower

technical and manual classes. Hence, it is not the professional classes that benefit from self-employment the most but those with lower status jobs. Figure 1 demonstrates these results in more detail. It shows that employed and self-employed professionals do not significantly differ in terms of social jetlag. Yet, self-employment brings benefits to the non-professionals and particularly lower technical or routine workers. Among these workers, self-employment offsets all disadvantages concerning the misalignment between biological and social time. In other words, the self-employed manual workers experienced similar social jetlag levels as higher professional classes.

Figure 1: **Linear prediction of social jetlag among employed and self-employed professionals**



Source: Czech Household Panel Survey 2018
Note: Adjusted predictions with 95% CIs

The family-related characteristics are analysed in Table 4. Model 1 incorporated controls (age and sex) and family-related characteristics (partnership status and the presence of children of various ages). Hypothesis 5 suggested that the presence of small children in the household is likely not to increase the level of social jetlag which was confirmed in Model 1. Parents with smaller children even have a significantly lesser likelihood to report the misalignment between biological and social time. On average, they reported

around 10 minutes lower discrepancy. In contrast, there was no significant difference in the level of social jetlag between those with older children and childless individuals. It may be because chronotype dramatically changes with age - children reaching pubescence turn to more later types. Another possibility is that parents' chronotypes might be already inclined towards morningness due to their age, or the partners' chronotypes are different and so they are more likely to nurture their children without limiting themselves.

Nevertheless, we expected that the family status would interact with the labour force participation, particularly for women, because balancing multiple demands such as housework and childcare along with paid work is demanding (Barnes et al. 2012). In Model 2, all work-related covariates were added, and this model serves as a baseline to address the interactions between work and family domains. Importantly, this model demonstrated that the negative link between social jetlag and the presence of small children remained nearly intact even after controlling for job characteristics. The next three models entered interaction effects into the picture. Model 3 included the interaction between the presence of at least one small child at home and the number of working hours. Model 4 entered the interaction between respondent's sex and the presence of young children. Finally, Model 5 integrated a three-way interaction between working hours, presence of children, and sex. Surprisingly, none of the interactions was significant, and models with interactions had a significantly worse fit than the baseline Model 3. This conclusion is supported by both BIC and log-likelihood ratios tests (see Table 3).

Table 4: **Estimated coefficients from mixed-effects regression with the dependent variable social jetlag – testing family-related characteristics**

	M1	M2	M3	M4	M5
Age	-0.014**	-0.014**	-0.014**	-0.014**	-0.014**
Sex (*male)*					
Female	0.027	0.062	0.065	0.046	-0.120
Partner/Spouse at home	-0.119*	-0.078	-0.077	-0.077	-0.071
At least 1 child of age 0-5	-0.151*	-0.152*	-0.210	-0.196*	-0.243
At least 1 child of age 6-11	-0.035	-0.051	-0.049	-0.051	-0.046
At least 1 child of age 12-17	0.061	0.045	0.040	0.046	0.041
Working hours per week *(< 40 hours)*					
40 hours		0.102	0.094	0.107	-0.036
41-49 hours		0.155*	0.102	0.160*	0.002
50 hours or more		0.033	0.043	0.038	-0.115
Commuting time		0.001	0.001	0.001	0.002
Self-employed (no)					
Yes		-0.411**	-0.412**	-0.410**	-0.413**
Social class *(I-II)*					
Class III-IV		0.107*	0.103*	0.105*	
Class V-VI		0.402**	0.404**	0.400**	0.099*
At least 1 child of age 0-5			-0.208	-0.194*	0.400**
At least 1 child of age 0-5#Working hours per week (< 40 hours)					
child#40 hours			0.016		-0.039
child#40-49 hours			0.316		0.207
child#50 hours or more			-0.073		0.025
At least 1 child of age 0-5#Female				0.089	0.056
Female#Working hours per week (< 40 hours)					
Female#40 hours					0.196
Female#41-49 hours					0.141
Female#50 hours or more					0.263
Female#At least 1 child 0-5 of age#Working hours per week					
(< 40 hours)					
Female#child#40 hours					0.115
Female#child #41-49 hours					0.327
Female#child #50 hours or more					-0.273
Constant	1.950**	1.702**	1.724**	1.708**	1.856**
Bayesian information criterion	3516.5	3458.2	3473.6	3464.7	3517.0

For a description of M1 – M5 models, see section Multivariate results.
* p<0.05, ** p<0.01
Note: N = 1441
Source: Czech Household Panel Survey 2018

Conclusions

In this study, we explored whether the magnitude of social jetlag correlates with work characteristics and family status. Even though social jetlag is closely connected to the temporal organization of social life, studies on its social predictors are relatively rare and nearly all focus on the social jetlag among shift or night workers. Our work shifts the attention towards the general working population. Using data from the Czech Household Panel Survey, we analysed the role of several factors related to work, such as social class, type of employment, working hours, as well as family status, such as parenthood.

We predicted that social jetlag would be systematically connected to social class. In particular, we expected that professional and service classes would experience smaller social jetlag. By definition, 'service relation' is defined by high discretion over work activity and jobs are less connected to a particular time and place. To motivate workers under service contracts, employers tend to create positions with flexible working hours and pay salaries rather than an hourly wage (Evans – Mills 2000). Routine non-manual and manual workers would more likely suffer from jetlag. The employment relation of the wage labour is characterized by less discretion and flexibility. The wages are derived from hours of work, work performed, and extra payment related to contractual bargaining. The trust expectations are low, the work is closely supervised and monitored. Our data fully supported this hypothesis. On average, we estimated that a typical professional suffered from around one hour, while those from routine and lower technical occupations suffered over 1.5 hours of social jetlag.

Furthermore, we hypothesized that social jetlag would be more severe among those with long working hours (Grandin et al. 2006), and longer commute that either contributes to social jetlag directly (Gabud et al. 2015) or is a predictor of shorter sleep (Basner et al. 2007; Chatzitheochari – Arber 2009) and might, therefore, subsequently contribute to higher social jetlag. However, this hypothesis was not fully corroborated. First, the commuting time contributed very little to the level of social jetlag. Second, the link between the number of hours worked per week and social jetlag was positive but non-linear. Surprisingly, those with very long hours (50+ hours) suffered from low levels of social jetlag. We suggest that this unexpected finding might be attributed to the selection effect. Alternative explanation could be those working excessively overtime work every day, not distinguishing between workdays and freedays and therefore their social jetlag is minimal.

We hypothesize that the self-employed individuals would typically experience lower social jetlag, particularly those from the professional and

service class of occupations (i.e., those with service relations and service contracts, such as managers, technicians, journalists, and educational professionals). This prediction was corroborated only partly. As we expected, self-employment was linked to significantly lower social jetlag. However, in discordance with our hypothesis, it was the routine manual and non-manual classes that benefited most. Researchers often portray self-employment among lower occupational classes as low quality and precarious employment (Conen – Schippers 2019; Glavin et al. 2019). However, our results suggest that self-employment might provide some other types of benefits for routine manual and non-manual classes that are not captured by the standard stratification characteristics. Therefore, self-employment might reduce the misalignment between biological and social time for those who would typically work on labour contracts.

We also tested a correlation between the number of family-related characteristics and social jetlag. Even though by common sense, we would expect that the presence of small children might exert major pressure on schedules if the parent cannot go to bed or cannot sleep because the child needs attention, especially full-time working mothers with small children might suffer from a significant misalignment of social and biological time, previous research shows otherwise. Specifically, based on the previous literature (Antypa et al. 2016; Sládek et al. 2020), we expected that the experience of social jetlag would not be more severe among parents in comparison to childless respondents due to their inclination towards morningness. In accordance with previous literature, we find parents of small children are less likely to experience social jetlag. This finding holds for both mothers and fathers. The parents of both sex at age up to 40 years were earlier chronotype compared to age-matched childless subjects (Sládek et al. 2020). This could be due to a secondary effect of childcare which stems from physiology: mothers and fathers need to get up early with their children and are, therefore, exposed to bright light in the morning which advances their circadian clock (Dijk et al. 1989; Gordijn et al. 1999; Revell et al. 2005). Moreover, according to the MCTQ definition, social jetlag is calculated as a difference in mid-sleep time on free days and workdays but childcare does not necessarily distinguish between them and so the effect is similar on all days. Furthermore, we did not find any evidence that the presence of small children would exert higher pressures on the sleeping times of full-time employed fathers or mothers. This could be linked to long parental leaves among Czech parents. The overwhelming majority of mothers take three-year-long parental leave. Thus, they would not be working during the period, when the child's and parent's

chronotypes are likely to be most misaligned. Only mothers with particularly good working conditions or work flexibility tend to keep working. This means that the selection of parents into employment might explain the lack of effect.

Limitations

The presented article brings an original perspective and we consider it a valuable contribution to the understanding of how work conditions and family situation affect the misalignment between individual chronotype and requirements of social time. There are, however, limitations in this study that could be addressed in future research. Firstly, we are unable to determine causal effects and therefore cannot claim if social jetlag contributes to the choice of work and/or family arrangement or if the work and/or results in the social jetlag. Secondly, all analysed variables are self-reported which necessarily poses a question regarding the subjectivity and accuracy of the measures, especially in the case of social jetlag that should be in an ideal measured via a smart mobile device. Social jetlag, after all, is only an estimation and as such, it suffers weaknesses. Future research should aim to eliminate the mentioned problems and also preferably extend the scope of analysis to more countries and explore the changes in time.

Michaela Kudrnáčová *is a PhD student working at a Sociological Institute of the Czech Academy of Social Sciences. At present, she is invested in social inequalities and their link to sleep.*

Dana Hamplová *is a professor of sociology working at the Institute of Sociology, Czech Academy of Sciences. Her research focuses on social stratification, family behaviours, and values. She authored or co-authored a number of books and her works are published in the top journal of the field such as European Sociological Review, Demography, Journal of Marriage and Family, Journal of Happiness Studies, or Journal of Family Issues.*

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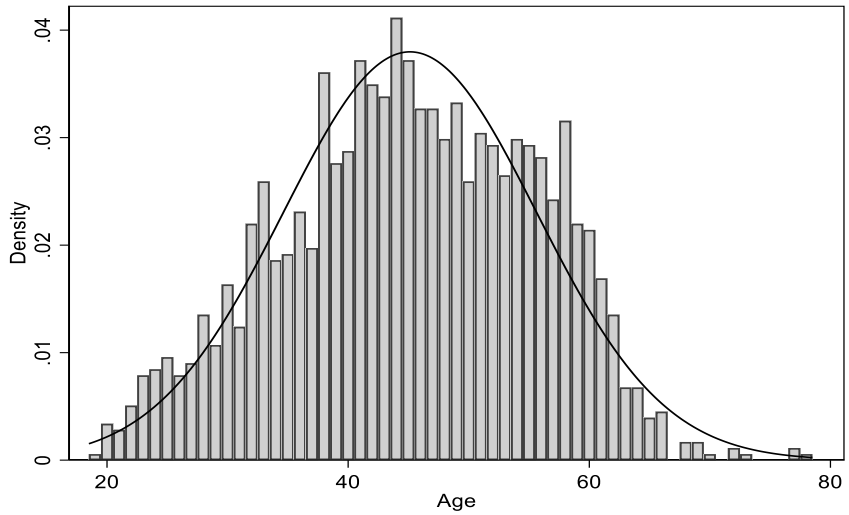
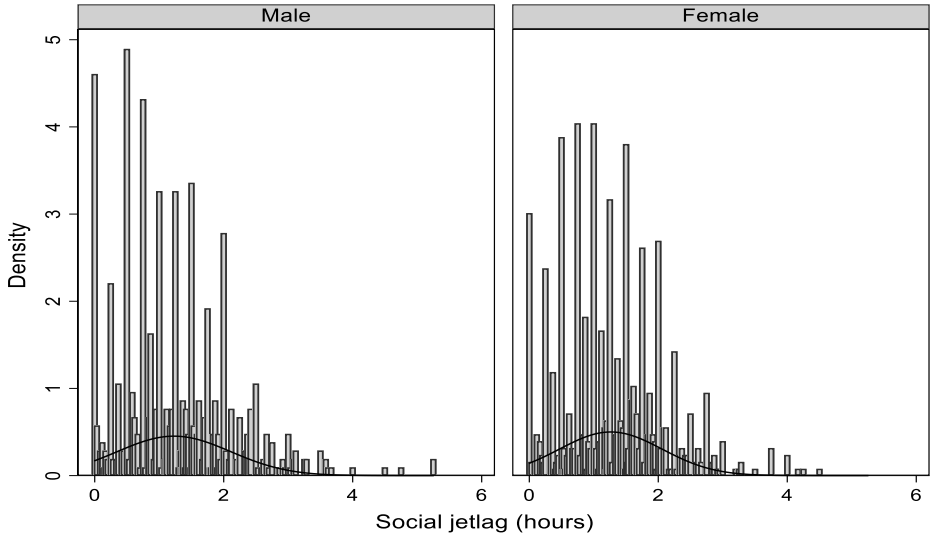
Appendix

Figure A1: **Age distribution of the analytical sample**



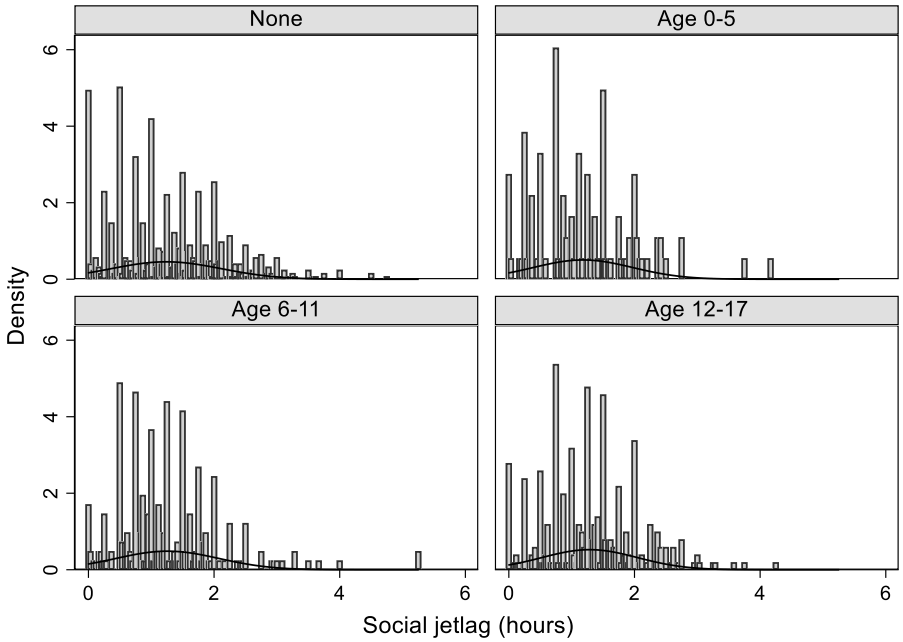
Note: N = 1760, weighted
Source: Czech Household Panel Study 2018

Figure A2: **Age by social jetlag distribution of the analytical sample**



Note: N = 1379, weighted
Source: Czech Household Panel Study 2018

Figure A3: **Households with children age group distribution of the analytical sample**



Age 0-5 = at least one child between the age of 0 to 5
Age 6-11 = at least one child between the age of 6 to 11
Age 12-17 = at least one child between the age of 12 to 17

Note: N = 1760, weighted
Source: Czech Household Panel Study 2018

Table A4: **Estimated coefficients from mixed-effects regression with the dependent variable: social jetlag, controlling for best alertness midpoint** (BAmid)

	M1	M2	M3	M4
Age	-0.012**	-0.012**	-0.011**	-0.011**
Sex (*male)*				
Female	0.042	0.083	0.079	0.077
Best Alertness midpoint	0.009	0.01	0.01	0.01
Average working hours per week *(< 40 hours)*				
40 hours		0.121*	0.123*	0.125*
41-49 hours		0.181**	0.181**	0.189**
50 hours or more		0.051	0.046	0.046
Self-employed				
Yes		-0.398**	-0.403**	-0.215*
Commuting time		0.002*	0.002*	0.002*
Munincipality size	-0.007	0.005	0.004	0.003
Social class *(I - managers, higher grade professionals, employers etc.)*				
II - Lower-grade professionals etc.		0.094		
III - Intermediate occupations		0.160*		
IV - Lower services, sales, clerical		0.161*		
V - Lower technical occupations		0.494**		
VI - Routine occupations		0.438**		
Social class *(I & II)*				
Class III & IV			0.113*	0.147**
Class V & VI			0.416**	0.485**
Social class#Self-employed				
Class III & IV#Self-employed				-0.276
Class V & VI#Self-employed				-0.507**
Constant	1.667**	1.282**	1.335**	1.300**
Bayesian information criterion	3497.10	3451.28	3432.40	3435.58

* p<0.05, ** p<0.01

Note: N = 1435

Source: Czech Household Panel Study 2018

Table A5: **Estimated coefficients from mixed-effects regression with the dependent variable: social jetlag among professional and service classes, controlling for best alertness midpoint** (BAmid)

	M1	M2	M3	M4	M5
Age	-0.014**	-0.013**	-0.013**	-0.013**	-0.014**
Sex (*male)*					
Female	0.026	0.064	0.066	0.049	-0.116
Best Alertness midpoint	0.006	0.008	0.008	0.008	0.007
Partner/Spouse at home	-0.118*	-0.076	-0.075	-0.075	-0.07
At least 1 child of age 0-5	-0.144*	-0.142*			
At least 1 child of age 6-11	-0.028	-0.042	-0.041	-0.042	-0.038
At least 1 child of age 12-17	0.058	0.045	0.039	0.045	0.041
Average working hours per week *(< 40 hours)*					
40 hours		0.104	0.095	0.109	-0.037
41-49 hours		0.156*	0.104	0.161*	0.003
50 hours or more		0.028	0.031	0.033	-0.119
Self-employed					
Yes		-0.407**	-0.408**	-0.406**	-0.410**
Commuting time		0.002*	0.002*	0.002*	0.002*
Social class *(I & II)*					
Class III & IV		0.102*	0.099*	0.101*	0.095*
Class V & VI		0.407**	0.409**	0.405**	0.405**
At least 1 child of age 0-5			-0.208	-0.182*	-0.241
At least 1 child of age 0-5#Working hours per week (< 40 hours)					
child#40 hours			0.017		-0.034
child#41-49 hours			0.313		0.207
child#50 hours or more			-0.036		0.062
At least 1 child of age 0-5#Female				0.081	0.056
Female#Working hours per week (< 40 hours)					
Female#40 hours					0.199
Female#41-49 hours					0.143
Female#50 hours or more					0.244
Female#At least 1 child 0-5 of age#Working hours per week (< 40 hours)					
Female#child#40 hours					0.112
Female#child #41-49 hours					0.32
Female#child #50 hours or more					-0.277
Constant	1.864**	1.572**	1.600**	1.578**	1.741**
Bayesian information criterion	3502.92	3441.538	3457.635	3448.187	3501.188

* p<0.05, ** p<0.01
Note: N = 1435
Source: Czech Household Panel Study 2018