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CHRONOTYPE AND WORK SCHEDULE MISALIGNMENT: EVIDENCE ON PRODUCTIVITY FROM SURVEY DATA

Abstract:

Chronotype and work schedule alignment have emerged as important determinants of workplace performance. This study investigates whether a mismatch between employees' biological preferences and actual work start times reduces productivity and how flexible work arrangements may mitigate these effects. The analysis is based on survey data from 507 respondents, collected using the standardized Morningness–Eveningness Questionnaire (MEQ) and questions on self-perceived productivity, morning difficulties, and the impact of remote work. To the best of our knowledge, this is the first study to analyze chronotype work schedule misalignment and its implications for productivity in a Central European context. Respondents were classified into chronotype categories, and the gap between their preferred and actual work start times was used to quantify the degree of misalignment. Multivariate regression models were applied to estimate the effect of misalignment on perceived productivity and the estimated productivity gain if work schedules were adjusted to biological optima. The findings indicate that employees whose schedules align with their chronotype report higher productivity, whereas misalignment particularly among evening types required to start early is associated with lower performance and reduced perceived efficiency. Model estimates indicate that aligning work start times with chronotype increases productivity by more than 10% in some cases. Remote work partially mitigated the negative effects of misalignment, which can be attributed to greater flexibility. The results clearly demonstrate the importance of considering chronotype diversity in work scheduling to enhance both productivity and employee well-being.

Keywords:

Chronotype, Work schedule misalignment, Productivity, Employee well-being

1. Introduction

Chronotype, defined as an individual's biological preference for morning or evening activity, has become an important topic in research on workplace productivity and well-being. Circadian rhythms governed by the internal biological clock shape sleep–wake cycles, hormonal activity, alertness, and cognitive performance. [1] When work schedules conflict with chronotype, employees may face sleep disturbances, reduced efficiency, lower job satisfaction, and adverse health outcomes.[2] Evening types ("night owls") are particularly disadvantaged by early starts, reporting lower productivity and greater fatigue compared to morning types. [3]

Previous studies confirm that evening chronotypes achieve poorer work outcomes when constrained by early schedules, while morning types benefit from them. [4] Beyond performance, eveningness has also been linked to worse health outcomes, suggesting cumulative disadvantages in standard work environments. [5] Research on the relationship between chronotype and workplace productivity has followed several methodological approaches. The most common are experimental studies, which test participants' performance at different times of the day. These studies have strong internal validity and allow identification of causal effects. However, they often rely on small, non-representative samples, which limits external validity and generalizability. A second widely used approach is survey-based research, often relying on standardized instruments such as fr exmaple the MEQ or Pittsburgh Sleep Quality Index (PSQI), which enables analyses of larger and more diverse samples under real-world working conditions. However, this approach is based on self-reported rather than directly measured performance, which reduces its ability to establish causality. More recently, longitudinal and mixed-method designs (e.g., combining surveys with experimental tasks or data from wearables) have been introduced, offering potential for a more precise analysis of long-term effects, though their application remains limited.
Based on the existing evidence, survey data combined with econometric analysis appear to be the most appropriate design for examining the prevalence of chronotype–schedule misalignment and its economic implications, as this approach allows for large sample sizes and the assessment of perceived productivity across different chronotypes and working conditions. Although the biological and psychological aspects of chronotype have been extensively studied, its economic and organizational implications remain underexplored.

[1] Kiema-Junes et al., 2024
[2] Akiyoshi et al., 2022
[3] Vetter et al., 2015
[4] Ko et al., 2025
[5] Knutson and von Schantz, 2018

The aim of this article is to analyze how misalignment between chronotype and actual work start times affects employees' self-perceived productivity. We draw on data from a large-scale survey and employ econometric analysis to examine whether evening types anticipate a greater improvement in performance if their work schedules were more closely aligned with their biological preferences. Existing evidence shows that evening chronotypes are negatively affected by early work start times; however, systematic research on their direct impact on productivity is lacking.[6]. The role of flexible work arrangements such as remote work also remains insufficiently examined, with existing insights limited mainly to partial findings from the pandemic period.[7] This research gap is particularly pronounced in the Central European context, which has so far received little scholarly attention. The present study therefore seeks to fill this gap and provide new insights into the relationship between chronotype and employee productivity in Central Europe. In this regard, it addresses the following research questions:

- Does misalignment between chronotype and work schedules reduce employee productivity?
- Which chronotypes are most negatively affected by this misalignment?
- Can flexible work arrangements mitigate the adverse effects of misalignment?
- By how much could the productivity of "night owls" increase if they were allowed to start work later, closer to their biological optimum?

2. Metodology

The study employed a cross-sectional survey design. Data were collected in cooperation with the Czech research agency STENMARK between May and June 2025. The questionnaire consisted of 78 items divided into three sections: (1) demographic information (e.g., gender, age, education, employment status), (2) the standardized Morningness–Eveningness Questionnaire (MEQ) to assess chronotype, and (3) additional questions on work schedule, perceived productivity, and working conditions. A total of 507 respondents participated in the survey. Eligibility required that participants were in active employment (excluding the self-employed) across a variety of economic sectors. The demographic structure was balanced by gender (54.8% women, 45.2% men). Educational attainment ranged from secondary to tertiary levels, broadly reflecting the general working population.

[6] Conlin et al., 2023
[7] Janc et al., 2024

Chronotype was assessed using the standardized MEQ (Horne & Östberg, 1976), a 19-item self-report instrument with a total score ranging from 16 to 86. Respondents were classified into three categories: morning, intermediate, and evening types.

Misalignment was calculated as the difference (in hours) between respondents' preferred and actual work start times. It was analyzed both as a continuous variable and as a categorical variable. To account for seasonal influences, five MEQ items (e.g., preferred sleep and wake times) were asked separately for summer and winter. Responses were averaged to produce a single score, ensuring consistency with the original MEQ scale while capturing stable chronotype preferences independent of season. This adjustment was motivated by evidence that photoperiod and seasonal changes affect circadian rhythms and can shift chronotype.

Productivity was measured through survey items asking respondents to estimate potential performance changes if their work schedules were more closely aligned with their biological preferences. The variable was analyzed both as a percentage gain and as a binary outcome (0 = no improvement, 1 = expected improvement). Respondents also reported whether they could work remotely or adjust their start times, allowing us to evaluate the moderating role of workplace flexibility. Control variables included gender or age.

Respondents also reported whether they had the option to work remotely (home office) or to adjust their work start time. These items served to evaluate the moderating effect of workplace flexibility on misalignment. Demographic and job-related controls included gender (0 = male, 1 = female), age (continuous, with categorized groups used for robustness checks) as the nature of work can influence flexibility, schedule, and exposure to misalignment.

The analysis proceeded in three stages. First, descriptive statistics were used to summarize the sample and the distribution of key variables. Second, group differences were tested using t-tests, chi-square tests for categorical variables and Mann–Whitney tests for ordinal or non-normally distributed continuous variables. Finally, multivariate regression models were estimated to test the study hypotheses while controlling for demographic and occupational factors. Logistic regression was applied when the dependent variable was binary (expected productivity improvement), and OLS models were used for continuous outcomes (percentage gain in productivity). All analyses were conducted in Stata 18. Methodological transparency was ensured by reporting confidence intervals, significance tests, and robustness checks.

3. Results

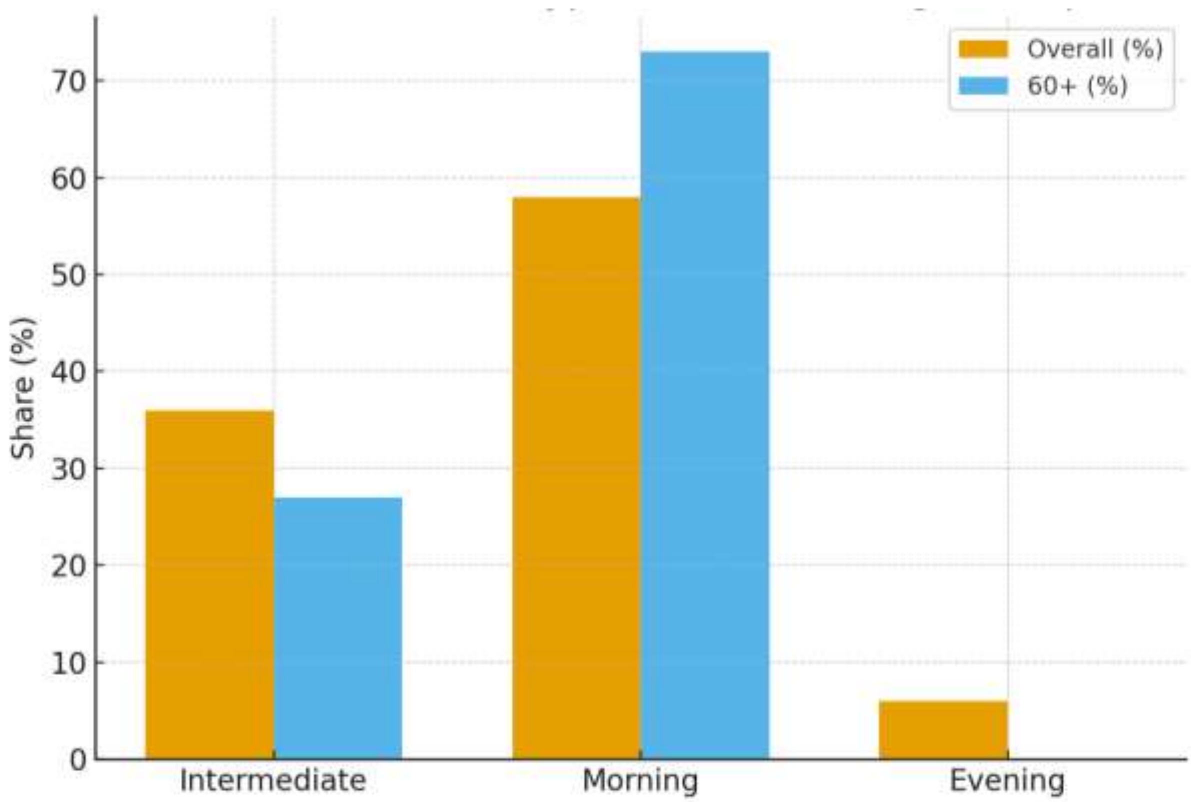
The study included 507 employees (M age = 42.4, SD = 11.5); 54.8% were women and 45.2% men. The largest occupational groups were technical and specialist workers (36%), production/manual workers (31%), administrative staff (19%), and managers (11%). Most participants worked fixed hours (65%), followed by flexible schedules (27%) and irregular hours (7%). Morning chronotypes predominated (57.8%), with 36.5% intermediate and 5.7% evening types. The distribution of chronotypes did not differ by gender ($\chi^2 = 0.07$; $p = 0.965$). See the Table 1.

Table 1.

Variables	N or Mean	% or SD
Age (years), Mean (SD)	42.4	11.5
Sex		
Women	278	54.8
Men	229	45.2
Work Position		
Technicians and associate professionals	184	36.29
Production and manual labor	155	30.57
Administrative	96	18.93
Managers	58	11.44
Non-classification	14	2.76
Work Shift		
Fixed working hours	330	65.1
Flexible working hours	139	27.4
Irregular working hours	37	7.3
Other	1	0.2
Circadian Rhythm		
Morning chronotype	293	57.79
Evening chronotype	29	5.72
Intermediate chronotype	185	36.49

Chronotype was strongly age-related: the share of morning types increased with age, while evening types decreased. Among employees over 60, morning types accounted for 73%, and no evening types were observed ($\chi^2(6) = 25.27$; $p < 0.001$) (See Figure 1). Median ages further confirmed this pattern (morning = 46 years; intermediate = 40; evening = 36).

Figure 1. Distribution of chronotypes in the overall sample (blue) compared to the group of the oldest employees aged 60+ (orange). Older workers show a higher prevalence of morning types and an almost complete absence of evening types.



Misalignment between preferred and actual work start times differed across chronotypes. Morning types showed negligible misalignment (mean absolute deviation ≈ 25 minutes), intermediates about 11 minutes, and evening types the largest at 66 minutes. Overall differences across chronotypes were marginal (ANOVA: $F(2,504) = 2.99$; $p = 0.051$). However, pairwise comparisons revealed a significant difference between morning and evening types (Mann–Whitney $z = -2.56$; $p = 0.011$), while other contrasts were not significant.

Chronotypes also differed in reported peak performance times, which corresponded to their biological preferences (morning types = early morning; evening types = late afternoon/evening). The analysis showed that the greater the gap between preferred and actual start times, the more likely respondents were to expect improved performance if aligned with their biological preferences. Logistic regression demonstrated that with each additional hour of misalignment, the likelihood of expecting improved performance increased approximately 1.8 times (OR = 1.81; $p < 0.001$). When no misalignment was present, the probability of a positive response was around 24%, and it rose substantially with increasing misalignment.

Among evening chronotypes (N = 29), linear regression showed that each additional hour of misalignment corresponded to an average 11.6% expected performance gain ($\beta = 2.32$; $t = 3.61$; $p < 0.001$). The model explained 24% of the variance ($F(1,27) = 13.05$; $p = 0.001$). The analysis also showed that the perceived benefit of working from home depends both on individual attitudes toward home office and on the environment in which people usually work.

On average, respondents reported that their performance when working from home increased by 10.9% (95% CI [10.6; 11.3], $p < 0.001$). The highest values were declared by those who actually used home office (M = 12.7%), while respondents who had the option but did not wish to use it reported significantly lower values (–3.9 p.p.; $p < 0.001$).

Similarly, lower benefits were reported by those who were unable to work from home (–2.3 p.p.; $p = 0.003$). An analysis by work environment further confirmed these differences: the highest performance gains were reported by individuals already working regularly from home (M = 12.8%), while employees in traditional offices (M = 10.5%; $p < 0.001$) and in open-space settings (M = 10.3%; $p < 0.001$) rated the benefit of working from home approximately 2–2.5 percentage points lower.

A paired t-test showed that work-related stress (M = 2.78; SD = 1.19) was significantly higher than home-related stress (M = 2.52; SD = 1.25; $t(506) = 3.68$; $p < 0.001$). This result was confirmed by the non-parametric Wilcoxon paired test ($z = 3.85$; $p < 0.001$). Further analysis of working conditions and stress levels showed that employees whose employers did not allow them to use home office reported significantly higher stress ($\beta = +0.51$; $p = 0.025$) than those who could work from home. Other groups (“do not want,” “not possible,” “partially possible”) did not differ significantly from home office users.

Finally, an analysis based on a simplified division into morning and non-morning chronotypes showed that morning types reported significantly lower work stress than other respondents (M = 2.44 vs. 2.64; $\beta = –0.32$; $p = 0.002$). At home, however, these differences were not significant ($p = 0.067$). A regression model testing the effects of home office policy, chronotype, and work stress on perceived performance further showed that respondents who declared they did not want to use home office ($\beta = –3.80$; $p = 0.014$) and those who could not use it ($\beta = –2.62$; $p = 0.050$) reported significantly lower performance than the group with access to home office.

4. Discussion

Our results reveal differences in the degree of alignment between work schedules and chronotype. Individuals with intermediate chronotypes showed only a small average misalignment of about 11 minutes. Morning types deviated on average by 25 minutes, while evening types faced substantially greater misalignment of about 66 minutes. Although the overall group difference reached only borderline significance in the ANOVA test ($p = 0.051$), pairwise comparisons confirmed a significant gap between morning and evening types ($p \approx 0.01$). These findings suggest that early work start times fit morning types relatively well but pose a pronounced mismatch for evening-oriented individuals, consistent with previous research showing that organizational norms based on early starts advantage “larks” while disadvantaging "owls." Notably, some morning types would prefer even earlier starts, indicating heterogeneity within this group.

The distribution of chronotypes showed a clear age-related shift toward morning orientation. Among respondents over 60, morning types predominated, while evening chronotypes were virtually absent, consistent with chronobiological evidence that circadian rhythms advance with age. This suggests older workers are mostly "morning larks," an important factor for designing age-friendly and flexible schedules. No significant associations were found between chronotype and gender or marital status (chi-square test, $p > 0.05$). Significant differences also appeared in self-assessed productivity. Morning types reported peak performance in early hours, while evening types peaked in late afternoon or evening. Crucially, working outside one's optimal time window was linked to lower perceived performance. Each additional hour of misalignment was associated with about a 1.8-fold increase in the odds of expecting improved performance if schedules were aligned ($OR \approx 1.81$; $p < 0.001$). With no misalignment, only 24% expected improvements, but this share rose sharply with greater misalignment, indicating strong awareness of reduced efficiency.

This effect was strongest among evening types, who faced the largest misalignment: linear regression showed that each additional hour of mismatch corresponded to an expected 11.6% increase in perceived productivity. For example, an evening-type employee starting at 8:00 a.m. but experiencing a two-hour misalignment estimated a 23% improvement if starting at 10:00 a.m. The model was highly significant and explained about one-quarter of the variance, indicating that schedule alignment is an important, though not exclusive, predictor of self-assessed performance. As the estimate is based on a smaller subgroup of evening types, it should be interpreted with caution. From a theoretical perspective, the results confirm the synchrony effect: people perform best when their work hours match their circadian rhythm. Evening types excel later in the day but struggle with early starts, while the opposite holds for morning types. Employees themselves recognize that misalignment lowers their efficiency, reflecting workplace "social jetlag," i.e., the gap between biological clocks and job demands. Previous studies have linked this phenomenon to poorer performance among evening types, and our findings suggest employees are aware of it. Greater flexibility in start times could thus yield substantial productivity gains. Not all tests showed strong significance, but the consistent pattern is striking: morning types aligned, evening types misaligned and disadvantaged. It underscores how standard schedules favor morning types. Allowing evening types to start later would enable them to work at their biological optimum, boosting performance. Respondents' expectations of productivity improvements strongly support this conclusion.

In addition to work schedule timing, our study also examined where people feel they work best. A key finding was the substantial self-reported increase in productivity when working from home. On average, employees estimated that their performance when working remotely was

10.9% higher than in the office, and this difference was statistically significant ($p < 0.001$). This double-digit gain aligns with prior evidence suggesting that remote work can enhance productivity. For example, a well-known study from the large Chinese travel agency Ctrip, involving thousands of call center employees, reported a 13% increase in productivity.[8] In our sample, however, the benefits varied depending on individuals' attitudes and work environments. The highest productivity gains were reported by those who regularly used home office, averaging 12.7%. This suggests that employees who embrace remote work often indeed capitalize on its advantages whether through fewer distractions, a tailored work environment, or saved commuting time.

By contrast, respondents who had the option to work from home but chose not to use it reported substantially lower benefits on average about 3.9 percentage points less than home office users, i.e., approximately 8.8%. Some of them even perceived no improvement, or a negative effect, which lowered the overall mean. This suggests that individuals who decline remote work do so because they do not feel equally productive in that setting. It is not surprising that remote work does not provide the same benefits for everyone. For example, a survey conducted during the COVID-19 pandemic showed that while more than half of employees reported increased productivity when working from home, 27% experienced no improvement..[9]

Our findings confirm this polarization: while most respondents reported a positive effect, a smaller group saw little or no benefit, often those skeptical of or unaccustomed to remote work. Employees whose jobs did not allow home office estimated benefits about 2.3 percentage points lower (≈10.4%) than regular users, likely due to the physical nature of their work or limited experience with this arrangement. Differences also emerged across work environments. Those working predominantly from home reported the largest productivity gains (12.8%), while traditional office workers and especially those in open spaces expected slightly smaller improvements (10.5% and 10.3%).

Respondents also rated work-related stress as significantly higher than stress in the home environment. Although this difference was relatively small (0.26 points on a five-point scale), its consistent occurrence across two independent tests suggests that the workplace represents a more substantial source of psychological strain for most respondents than the home environment. This result is consistent with research emphasizing working conditions as a key factor in occupational stress.[10]

Our results show that work stress is linked less to the specific workplace (office, open space, or home office) than to whether flexible arrangements are allowed. The absence of a home office option increased perceived stress, likely reflecting organizational rigidity and reduced

[8] Bloom et al, 2013
[9] Deole et a., 2023
[10] NIOSH Publication, 1999

autonomy. This aligns with research emphasizing that voluntariness and organizational support are crucial in flexible models: enforced variable schedules raise stress and exhaustion, while voluntary remote work has a protective effect. [11] The results also indicated that individuals with a morning chronotype adapt more easily to standard working hours, which is reflected in their lower levels of work stress. At home, by contrast, the differences in stress levels between morning and other types disappeared. Thus, the influence of chronotype on stress appears to manifest primarily in the workplace context.

A further analysis based on a simplified division into morning and non-morning chronotypes showed that morning types reported significantly lower levels of work stress than other respondents ($M = 2.44$ vs. 2.64; $\beta = -0.32$; $p = 0.002$). At home, however, this difference did not reach statistical significance ($p = 0.067$), suggesting that the effect of chronotype on stress operates mainly in the workplace.

Several limitations should be noted. First, productivity was measured through self-assessments, which are prone to subjective bias. Respondents may have interpreted their performance or the effects of misalignment differently, and answers could be influenced by self-confidence or social desirability. Future research should complement subjective indicators with objective measures (e.g., performance metrics, supervisor evaluations) and possibly physiological data on sleep and circadian rhythms. Second, the sample contained relatively few individuals with a distinctly evening chronotype, limiting statistical power and contributing to some effects not reaching significance. This partly reflects the general population, as extreme evening types are rare, especially among older adults. Still, future studies should target more diverse samples or deliberately include more “night owls.” Third, the cross-sectional design captures relationships at one point in time and cannot establish causality. Misalignment may reduce productivity, but it is also possible that less productive individuals struggle more with standard schedules, or that third variables (e.g., sleep deprivation, health, motivation) play a role. Finally, we did not address other outcomes of chronotype and misalignment, such as physical health effects.

Several directions for future research emerge. First, longitudinal or experimental studies should verify the causal effects of aligning schedules with chronotype. For instance, an intervention where evening types start later and are compared with a control group could reveal impacts on performance, error rates, and stress. Second, future work should examine moderating factors such as job type and organizational culture, since effects may differ across industries (e.g., creative versus shift-based operations). The long-term implications of hybrid and flexible work also warrant attention, including how employees use flexibility and what barriers (e.g., norms, family duties, spillover into late-night work) limit its benefits. Finally,

[11] Kaduk et al, 2019

research should expand to additional outcomes such as well-being, sleep quality, sickness absence, and work engagement, which are closely tied to chronotype and misalignment and directly affect health and working life.

5. Conclusion

This study shows that misalignment between chronotype and actual work start time significantly affects performance. Evening types were most disadvantaged under conventional hours, while morning types benefited and intermediates remained relatively stable. Among evening types, model estimates indicated that aligning schedules with biological preferences could raise perceived productivity by more than 10% per hour of misalignment, corresponding to gains of over 20% in some cases. Both linear and logistic models confirmed that greater misalignment is linked to lower self-assessed productivity and a higher risk of being among less productive employees. The findings also highlight the moderating role of organizational conditions: flexible scheduling and remote work can mitigate misalignment, and quieter environments such as home offices may further enhance alignment benefits. For organizations, this underscores the value of temporal flexibility, hybrid models, and individualized start times as strategies to reduce circadian misalignment and boost both productivity and satisfaction. Finally, this study represents the first systematic investigation of these relationships in the Central European context, a region largely overlooked in previous research. Future studies should validate the findings on larger and more diverse samples.

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