Effects of Work Arrangements on Creative R&D Work Outcomes

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Favorable working conditions for R&D employees help to improve the use of their creative potential, supporting knowledge intensification in the economy at large. This article presents fully observed recursive structural equation estimates, based on data from the authors’ original repeated survey of Estonian creative R&D employees on a sample of 153 individuals from eleven entities. It finds that opting for flexible working time is strongly driven by gender—males are more likely than females to opt for R&D jobs with flexible schedules. R&D employees who mainly work remotely are more satisfied with their work results. Noncreative work tasks reduce R&D employees’ contentment with their work outcomes and lower—at least in their own perception—the productiveness of their work in terms of creating value or new knowledge. Employees of both evening and morning types are found to have much more satisfaction with their work results than employees with no distinct morning-evening profile. These findings stress the benefits of flexible work arrangements in creative R&D jobs in order to account for individual differences and stimulate R&D output.

Keywords: employee performance, Estonia, flexibility, R&D jobs, working time

JEL Classification: O32, M50, O15

While price-sensitive manual labor is increasingly channeled from developed to developing countries, a key task for more mature economies is to find and sustain global competitive advantages arising from intellectual capital. Fostering innovativeness and capturing the intellectual potential in society have become crucial challenges in increasingly knowledge-based modern economies. Governments have launched various programs to support innovation, and many companies encourage new initiatives by management and employees. However, the role of working arrangements for knowledge employees has attracted relatively little attention in academic research. Creating more favorable working conditions for R&D employees may offer a major contribution to using their creative potential, thus supporting research and development output as well as the knowledge intensification of economies.
The present empirical article is primarily concerned with the flexibility that a creative R&D employee is allowed in terms of both working time and workplace. It hypothesizes that higher flexibility improves the results of work, as the employee can use his or her creative capacity at a more preferable time and location. Moreover, as Tan (2017) suggests in his recent theoretical article, knowledge employees achieve improved work results when they enjoy more freedom at work. More flexible working arrangements and less control over the employee cause informational asymmetry between the employer as principal and the knowledge employee as agent. Tan (2017) argues that the employer can benefit from this, as the need to share the output of innovative work more fairly with the employees under informational asymmetry functions as a key incentive for the employee to innovate.

The present article is also interested in the impact of the share of creative work, as opposed to administrative tasks, on the outcome of work in creative R&D jobs. Building on the results of Andrews and Farris (1967) and subsequent literature, the authors hypothesize that administrative and other noncreative tasks distract employees from achieving creative work results.

The following section summarizes the key literature. The third section outlines the data and methodology. The fourth section provides the study results and discussion, followed by the conclusion.

**LITERATURE**

Research on working-time arrangements and the consequent work-related as well as non-work-related outcomes has its roots in the United States in the mid-1970s. Summarizing these initial results in a comprehensive literature review, Golembiewski and Proehl (1978) highlight that several studies have demonstrated a positive relationship between flexible working time and productivity. However, many of the early studies lacked empirical substantiation, and none of them specifically considered creative R&D jobs. Since then there have been many other studies employing various methodological approaches (see Grant and Parker (2009) for a thorough overview). Some of the studies have investigated the direct link between flexible working time and productivity, while others have searched for indirect factors that mediate the effects of flexible work arrangements.

Looking at the direct flexibility-productivity link, Chow and Chew (2006) find that employees with more time flexibility exhibit higher productivity and organizational commitment, based on a study in the service industry in Singapore. As an expected result, they show in parallel that employee productivity tends to increase along with the employee’s higher educational level. In a recent study on Belgian data in the field of technology, Coenen and Kok (2014) likewise conclude that flexible work, and remote work in particular, has a positive impact on new product development. Gajendran and Harrison (2007) and Ollo-Lopez, Bayo-Moriones, and Larraza-Kintana (2010) find a positive relationship between remote work and work outcomes. Furthermore, Konrad and Mangel (2000) and Yang and Zheng (2011) find a positive connection between flextime and productivity. Peculiarly, Konrad and Mangel (2000) find the relationship to be stronger when there is a higher share of women in the workforce, as well as when there is a higher percentage of professionals, thus pointing to gender- and education-related individual factors influencing the flexibility-productivity nexus. Scandura and Lankau (1997) present similar results, noting that the relationship between flexible work options and productivity is
largely gender-driven, and that offering flexible work arrangements results in increased commitment and job satisfaction for women in particular. They explain their results via the psychological contract between employer and employee, which encourages employees to offer higher commitment and improved work results after being offered flexible work options. This fits well with the theoretical framework presented by Tan (2017), arguing that employees who have been granted more freedom at work exhibit improved results from their creative initiatives. Although flexible work options seem to have a larger impact on the work results of women, Golden (2009) claims that flextime options are more likely to be granted to males, especially those at a managerial level who work long hours and are compensated generously. To shed light on this seemingly controversial topic, Sarbu (2014) theorized that while men are more likely to get flexible work options (particularly remote working), women use these options more intensively, which seems to explain the somewhat mixed results in previous articles. In addition, Sarbu (2014) and Golden (2009) note, similarly to Konrad and Mangel (2000), that higher educational levels tend to increase the likelihood that employees will use flexible working options.

Based on a case study of a U.K. software company, Kelliher and Anderson (2008) find a positive association between flexible work options and the perceived quality of work results. In their study, flexible work options refer to both informal and formal working-time flexibility as well as working remotely. They arrived at this conclusion by establishing a positive link between flexible work options and increased control over individual work, increased job satisfaction, improved organizational commitment, and better work-life balance, all of which they considered to improve the employees’ work efforts. Baltes et al. (1999) arrive at a similar conclusion and establish that flexible work is positively correlated with lower absenteeism, higher job satisfaction, and increased productivity. Focusing on police officers, De Carufel and Schaan (1990) find that the relationship between the flexibility and results of work is mediated mainly by job autonomy—an association that is also claimed by Clark (2005). Alternatively, Hobson, Delunas, and Kesic (2001) claim that work-life balance is the key mediating factor in the flexibility–output association.

Some studies, like those of Kim and Campagna (1981), Narayanan and Nath (1982), and Shepard, Clifton, and Kruse (1996), have demonstrated no statistically significant relationship between flexibility and productivity. These studies point to the additional monitoring costs related to offering flexible work options. However, the development of information and communication technologies since the publication of these articles may have a significant impact on the relevance of their results today. Exploring the experiences of employees who have started to use flexible work options, Kelliher and Anderson (2008) arrived at the conclusion that the work of those employees has intensified. Golden (2009) claims that employees with flexible work options work longer hours in order to demonstrate their appreciation for having those possibilities. Kelliher and Anderson (2008) note that many flexible employees perceive themselves to be facing deteriorated career prospects, further complicating attempts to understand the relationship between flexibility and work results.

In an extensive summary of the research on flexible work and performance, De Menezes and Kelliher (2011) conclude that out of the forty-two studies they surveyed, thirteen noted a positive relationship between flexible work options and individual productivity, while twenty-nine found no support for that relationship. More support has been found for an indirect rather than a direct effect of flexibility on performance, referring to intermediating factors such as organizational commitment, job satisfaction, and work-life balance.
The previous studies considered employees from various sectors, and only a few specifically included R&D employees. Andrews and Farris (1967) found in their study of NASA researchers that administrative tasks distract from innovation. Amabile, Hadley, and Kramer (2002) focus on jobs that involve creativity, concluding that stress and increasing time pressure are the key variables that negatively affect work outcomes. Interestingly, they claim that rigid work schedules magnify the adverse effect of the factors that suppress creative work. Both Deci and Ryan (1987) in their literature review article and Shalley, Gilson, and Blum (2000) in their later empirical study highlight the finding that job autonomy tends to support creative activities in innovative jobs. Nätti, Anttila, and Tammelin (2012) indicate that knowledge employees must work extended hours and make tradeoffs with family life due to the demands of creative work. This could lead to reduced sleep hours, which in turn may have an effect on work-related factors (Kivistö et al. 2008).

Another approach in the flexibility and work outcome research is the person–job fit literature, such as Caldwell and O’Reilly (1990), who claim that the fit between personal characteristics and the environment offered by the employer is what leads to better work performance. Flexible work time can be clearly seen as one of the factors contributing to a suitable work environment, as employees are allowed to adjust their working time according to their circadian rhythms and therefore work at their times of peak productivity. This stream of literature suggests potential selection for jobs based on the fit of that work for the particular employee.

DATA AND METHODOLOGY

This article is based on a repeated survey among creative R&D employees in Estonia. The starting point for compiling the sample for the study was the latest available (2012) Statistics Estonia data on R&D. Based on Statistics Estonia criteria, an employee is regarded as engaged in R&D if at least 10% of the employee’s working time is spent on R&D tasks. The focus here is on the “researchers” category of R&D employees; “technicians” and “supporting staff” are disregarded, since their work tasks may not be of a creative nature. According to the Statistics Estonia definition, a “researcher” is “a professional with an academic degree or higher education diploma, engaged in basic or applied research or experimental development to create new knowledge, products, processes, methods and systems; all academic staff engaged in R&D activities, as well as managers and administrators engaged in planning and management of the scientific and technical aspects; postgraduate students and persons attending doctoral courses, who perform original research mainly.” From 2010 to 2014, the number of creative R&D employees in Estonia in full-time equivalent ranged between 4,100 and 4,600, with a five-year average of 4,400.

Excluded from the population were creative R&D employees working in the fields of higher education and healthcare, because teaching schedules at educational institutions and schedules of appointments and procedures at medical institutions significantly interfere with the working-time and workplace choices that the study is focused on. From 2010 to 2014, in full-time equivalent, the number of such employees ranged between 2,200 and 2,500, with a five-year average of 2,400. Also excluded from the population were the approximately 1,000 employees (in full-time equivalent) working at microenterprises and research institutes with less than fifteen creative R&D employees (working arrangements are substantially different at microentities as compared
to larger organizations). As a result of the above exclusions, the population of creative R&D employees of interest for the study totaled approximately 1,000.

This population represents a total of twenty-three employers, including both private companies and public research institutes. All of these employers were invited to take part in the study. A total of eleven employers agreed to participate in the study—eight in the first wave in spring and summer 2015, and another three employers in the identical second wave in winter 2016.

The two waves of the study were timed so as to facilitate capturing the potential differences in responses between the time of year with the most daylight (the first wave in spring and summer 2015) and that with the least daylight (winter 2016). In order to identify the statistical significance of the differences in the responses of the thirty-four recurring respondents, Mann–Whitney U-tests (Mann and Whitney 1947) were performed on the three alternative work-outcome variables of interest. Interestingly, the differences in the participants’ responses under the two waves were found to be statistically insignificant. Therefore the data from both waves of the survey were pooled, selecting randomly which of the recurring participants’ responses would be used for the analysis.

Further eliminations from the unique participants’ completed surveys were made if the respondents

- answered “Rather not” or “Not at all” to the question “Do you consider your work a research and development activity that requires creativity?” (twenty such responses);
- indicated that they were working for another employer for more than twenty hours a week (three such responses);
- responded that the share of creative work was less than 10% of their total working time (ten such responses); or
- expressed logical inconsistencies in the fixed vs. flexible nature of their working schedule (fifty-nine such responses).

The final sample retained only those respondents who gave consistent answers to the three control questions on the working schedule. This elimination contributes to ensuring the validity of the survey responses, as according to a common notion in survey methodology, validity is best estimated in survey-based research by designing several questions for the same underlying construct (Couper 2000).

The sample of 153 employees whose responses to the survey were taken into account thus represents approximately 15% of the total population of 1,000. Table 1 outlines the final pooled sample by participating entities.

Note that the employees in the population were approached not randomly but on a company basis. Individuals in the population were included in the sample only if their employer agreed to participate in the study. Moreover, completion of the survey by a respondent might incur some selection bias. The related selection biases were addressed to some extent by weighting the sample to reflect the population in terms of respondent’s gender and employer’s sector and industry. In addition, the econometric models employ clustering of standard errors by employers to account for dependencies in clusters by employers.

Participation by the employees invited to complete the Internet-based electronic survey was voluntary and confidential. The questionnaire consisted of ninety questions on the organization of work, work satisfaction, work results, sleepiness, sleep patterns, tiredness, health, and other sociodemographic information.
Three alternative dependent variables were employed, representing employees’ perceptions on different output indicators of their creative work. The first dependent variable (satisfied; see Table A1 in the Appendix) measures the employee’s general perceived satisfaction with the results of his/her work. The second (posfeedback) addresses how the employee perceives others’ recognition of the results of his/her creative work. The third (value) captures the employee’s perception of the new value created as a result of his/her creative work. Admittedly, perceived indicators are subjective instruments; however, the authors concur with the reasoning of Clark (2005) that while much of the previous research on the quality of work results focused on objective measurements, such as pay and hours of work, the subjective experiences of individual employees are equally important. For example, in a recent study, Seo, Chae, and Lee (2015) show that an individual’s subjective belief that he/she has innovative capabilities can be strongly associated with the results of that person’s creative work.

The dependent and explanatory variables are outlined in Table A1 and their pairwise linear correlations in Table A3 in the Appendix. The selection of independent variables derives from the research hypotheses and control variables based on the extant literature (Chow and Chew 2006; Scandura and Lankau 1997; Yang and Zheng 2011). Age, gender, number of family members, and educational level have been incorporated as key control variables of sociodemographic characteristics, and the health factor controls for the general health condition of the employee. Salary level is introduced as a control variable of the employee’s satisfaction with his/her work results. The remaining explanatory variables reflect various aspects of the arrangement of work with flextime (flexible vs. fixed working-time arrangement of the employee) and creatime (creative intensity of the work of the employee) as selection and mediator variables. Following the approach by Kellihier and Anderson (2008), flextime represents both formal flexibility, which is regulated in employment contracts or other job-related documents, and informal flexibility, which is explicitly agreed upon or implicitly mutually accepted by the employer and the employee.

The starting point was a series of OLS (ordinary least squares) estimations, where the 5-level Likert-type dependent variables were estimated as continuous. Since the dependent variables were ordered discrete categories, the study proceeded with ordered probit maximum likelihood
estimations. The ordered probit estimations led to better descriptive power for dependent variables with skewed and highly abnormal patterns of distribution (see Table A1 in the Appendix). A coupling selection mechanism arising from certain employees opting for flextime and creativity-intensive positions led the authors to set up a three-dimensional model with a work-outcome variable as the ultimate outcome variable (see the path diagram in Figure 1).

The study’s recursive structural equation model (SEM) estimated the dependencies between the following two selection choices and work outcome. First, a certain type of employee tends to select positions with a flexible working-time option, while flexibility in working time is expected, in turn, to have a potential effect on work outcome. Second, many employees choose their positions based on creative work intensity (as opposed to administrative and other noncreative tasks), whereas satisfaction with work results is expected to be, in turn, impacted by the creative intensity of work, building on the job autonomy and job satisfaction nexus literature (e.g., Clark 2005; De Carufel and Schaan 1990). In the fully observed recursive SEM model, the simultaneous regression model consists of (1) satisfaction with work results as an

![FIGURE 1 SEM Model Path Diagrams.](image)

Note: * only for “satisfied”; some explanatory variables for which a nonlinear pattern was present are included in the models in both linear and squared terms—see the model results in the Appendix.
ordered probit or OLS estimate of the main equation containing the two endogenous selection and mediator variables \textit{(flextime and creatime)} as explanatory variables among others; (2) \textit{flextime} as a probit estimation, and (3) \textit{createtime} as an OLS estimation. Only the final-stage regression is therefore structural. Standard errors have been adjusted for the eleven clusters based on employers (Table 1) to control for employer-specific dependencies among the observations.

The Stata14 cmp (conditional mixed process) module (see Roodman 2011) was used for the estimations. The cmp module overall addresses SUR (seemingly unrelated regression) models; however, it also fits for recursive SEM models like the authors’, where all endogenous variables are observed (Roodman 2011).

\section*{RESULTS AND DISCUSSION}

The three alternative work-outcome measures were subjected, in the main equation of the SEM models, to both OLS (Models 1, 3, and 5) and ordered probit (Models 2, 4, and 6) estimates, as outlined in Table A2 in the Appendix. The models show qualitatively similar results in coefficient estimates and model fit. Out of the pairs of Models 1–2 (\textit{satisfied}), 3–4 (\textit{posfeed-back}), and 5–6 (\textit{value}), the ordered probit and OLS estimations of the main equation in the SEM models reach at rather similar results with similar pseudo-log-likelihoods. Model 5 (with all dependent variable cut-point estimations statistically significant and a lower absolute terms pseudo-log-likelihood) outperforms Model 6, though, and Model 4 may be regarded as superior to Model 3, where the dependent variable cut-point estimations remain statistically insignificant in most cases.

The availability of flexible working-time options appears to be a significant gender-driven job-selection factor, as male employees are apparently more likely than female employees to opt for flexible schedules. This corresponds to the findings by Golden (2009) and may be explained by the potentially better bargaining position of men in negotiating employment conditions. Another significant driver of selecting flexible working schedules appears to be the context of work. Those who seek work as members of teams consisting mostly of non-R&D employees (e.g., in banks or private non-R&D companies) are less likely to seek flexible working-time options. The explanation may be that employees recognize the tradeoff that creative R&D positions in a more commercial work environment (like IT or product development in a bank or a private enterprise) come at the expense of less flexibility in working time but provide other benefits to offset this disadvantage. The selection patterns of flexible working options addressed in the model may explain why previous studies on the relationship between flexible work options and individual work productivity arrived at mixed results (see the literature survey by De Menezes and Kelliher 2011), as the previous studies did not consider the respective selection issues.

Opting for positions with a higher share of creative work in total working time appears to be strongly positively impacted by the educational level of the employee. In other words, those who have devoted more years to their studies appear to seek, in return for their time investment in education, a position enabling them to apply their creative potential and to reduce the burden of administrative and other noncreative tasks. The fewer years invested in education, the less disturbing administrative tasks seem to be.
Looking at the determinants of satisfaction with work results (Model 2 with better descriptive power than Model 1), after controlling for the selection patterns in the availability of flexible working-time options and the share of creative work, finds some support for the hypothesis that the higher the share of creative work in total working time, the higher the employee’s satisfaction with the work outcome. Distracting R&D employees with excessive administrative and noncreative tasks decreases their contentment with the outcome of their work. Having a large proportion of creative tasks or being able to affect the division of individual working time between creative and administrative activities is linked to job autonomy, which is commonly appreciated by the employees (Clark 2005; Kelliher and Anderson 2008) and tends to support innovative activities (Deci and Ryan 1987; Shalley, Gilson, and Blum 2000).

While the availability of flexible working-time options appeared to be a significant driver of job selection, in the post-selection context, flexible working schedules did not have any substantial impact on satisfaction with work results. Flexibility in the workplace, however, is important. Employees who do a higher share of work at the official workplace (as opposed to working remotely) are significantly less satisfied with their creative work results. Office context thus appears to decrease creative work outcome. As illustrated in Figure 2, the effect is nonlinear, with over 60% of work performed at the official workplace gradually and substantially reducing satisfaction with the outcomes of one’s own work. Granting creative employees flexibility in the workplace (which is often associated with time flexibility) may thus have a considerable positive effect on their assessments of their work results. This corresponds to the results of Coenen and Kok (2014), Gajendran and Harrison (2007), and Ollo-Lopez, Bayo-Moriones, and Larraza-Kintana (2010).

Considerable gender differences are evident from the results, with women being an average of 13% (at significance level $p < 0.05$) less satisfied with their work results (Figure 2). This may be an inherent gender-based feature (e.g., Scandura and Lankau 1997). Satisfaction with the results of one’s creative work appears to be negatively correlated with age (Models 1 and 2). This is an expected result in alignment with previous research (see the literature review by Clark, Oswald, and Warr 1996), showing overall lower satisfaction by older people. The higher the employee’s educational level, the higher the satisfaction with the creative work results (however, not statistically significant for all educational levels)—an expected result in line with past research that links increasing education levels to higher productivity (e.g., Moretti 2004). See Figure 2, showing the probability of an employee being “rather often” satisfied with his/her creative work results for different ages and educational levels, holding other factors at their means.

An interesting and statistically significant effect (in both Models 1 and 2) is the role that the employee’s sleep regime has on his/her satisfaction with the work results. The assessment is based on the Reduced Morningness-Eveningness Questionnaire (rMEQ) by Adan and Almirall (1991), frequently used in sleep research internationally. Evening-type people (“night owls”) prefer to stay up late at night and sleep late in the morning. Morning-type people (“early birds”), in contrast, like to go to sleep at an early hour and arise early in the morning. The study finds that employees of evening type (rMEQ<11—moderately to definitely evening type) as well as those of morning type (rMEQ>18—moderately to definitely morning type) have considerably higher satisfaction with their work results than employees who are of neither strongly morning nor strongly evening type. One may hypothesize that the explanation lies in the lower work-environment stress factors for employees working outside normal office hours, or in the
potentially higher creative potential of strongly evening- or morning-type individuals. However, such linkages have not been explained by any available studies. This article is part of a larger project seeking to identify connections between R&D work results, pay, sleep, tiredness, and...
individual wellbeing (Hazak et al. (2016) and Virkebau and Hazak (2017) provide some preliminary insights), as well as drivers of the efficiency of R&D and human capital use (e.g., Avarmaa, Hazak and Männasoo 2013; Hazak and Männasoo 2010; Männasoo and Meriküll 2014; Männasoo, Maripuu and Hazak 2017) in some Central and Eastern European countries.

Another interesting finding is the positive relationship between working hours and satisfaction with work results (see Figure 3). It seems that creative R&D employees with remarkably high average working hours (ten hours per day) are oriented toward satisfaction with quality output, at the expense of potentially adverse health consequences and work-life imbalances relating to excessive working hours. This accords with the results of Ng and Feldman (2008), who find some support for the notion that complex jobs (such as R&D) require more effort to achieve quality results, but also provide more intrinsic motivation in the work process and thereby stimulate the final outcome.

Models 3 and 4 measure another dimension of work output—the employee’s perception that he/she is receiving positive feedback from others on his/her work results. As in the case of Models 1 and 2, there is a positive linear relationship between working hours and positive feedback on the work results. A relatively large number of working hours thus seems to relate to the need to achieve one’s own as well as others’ satisfaction with the outcome of work. At the
same time, the more hours of sleep a creative employee gets, the more external recognition there is of his/her work results (see Figure 4). This relationship is evident from the ordered probit estimates of the main equation in SEM Model 3 and is supported by the alternative OLS estimate of the main equation in Model 4. Duration of sleep, however, does not appear to be a statistically significant determinant of employees’ own contentment with their work results (Models 1 and 2), and the effort put into work at the expense of sleep seems instead to diminish external recognition of the work output.

Age appears negatively correlated with external recognition of work results, concurring with the aforementioned results of Models 1 and 2 and indicating that the work results of younger (and thus, perhaps, more motivated and enthusiastic) creative employees might be better. The more family members living with the employee, the more he/she perceives that he/she is getting positive feedback on his/her work results. This result is difficult to explain without further inquiry, as it might indicate that people with more family members produce better work outcomes, or it might mean that people with larger families seek out and appreciate feedback more.

Similar to Models 1 and 2, except for the important job-selection effect, flexible working schedules do not appear to have any additional substantial impact on external recognition of employees’ work results, while flexibility in the workplace is important. The higher the share of work done outside the office, the more often employees hear positive feedback on their work outcome. This finding stresses once again the need to provide as much flexibility as possible for employees to work outside the official workplace.

Another aspect of work output addressed in this article (Models 5 and 6) is the employee’s perception of the new knowledge and value created as a result of his/her work. As with the outcomes of Models 1–4, the number of working hours is positively correlated with new knowledge and value created from work, but Model 5 provides support for a nonlinear relationship (see Figure 5). It appears that within the standard working hours, working time has either no effect or a negative effect on value created, while a considerable increase (at least in the employees’ perception) is achieved only starting from the eleventh working hour. This confirms the aforementioned results that the high average working hours in creative R&D jobs appear to be a norm to achieve a desirable outcome of work. As expected, educational level is positively correlated with the value created, concurring with the results of Models 1 and 2. Other individual control variables like age, gender, family, and health characteristics do not appear to be significant drivers of value creation in creative R&D work, at least not from the employee’s perspective.

CONCLUSION

Providing favorable working conditions for R&D employees may result in better utilization of their creative potential for improved R&D output and, as well, improve their individual well-being. This article presents fully observed recursive structural equation modeling estimates based on data from an original repeated survey of Estonian creative R&D employees on a sample of 153 individuals from eleven entities.

The availability of a flexible working-time option appears to be a significant gender-driven job-selection factor. Male employees are more likely than females to opt for jobs with flexible schedules. In the post-selection context, however, gender has no additional substantial impact on satisfaction with work results. Flexibility in the workplace, which is often associated with time
flexibility, is, however, an important driver of satisfaction with the resulting work. Providing remote work options along with time flexibility could have an important effect on job selection and achieving better work outcomes in R&D.

A preference for positions with a higher share of creative work in total working time appears to be strongly, positively impacted by the educational level of the individual. Distracting R&D employees with administrative and noncreative tasks significantly decreases their contentment with the outcome of their work, and also decreases the new knowledge and value created as their work output. Avoiding excessive administrative and noncreative tasks for creative R&D employees could therefore significantly improve their work results, as well as attract highly qualified employees for creative R&D jobs.

The high daily working hours in creative R&D jobs (a mean and median of ten hours in the sample) appear to be a norm, motivated by the employee’s need to achieve satisfaction with the work output as well as external recognition and desirable new value creation. While employees appear to need long working hours in order for themselves and others to appreciate their work results, adverse health consequences may arise in the longer term. This remains an important area for future research. Both employees of the evening type and those of the morning type have considerably higher satisfaction with their work results than do employees who are neither strongly morning nor evening type. Overall, in the interest of improved R&D output, it is important to account for individual differences in preferences for work arrangements.

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### Table A1
Model Variables and Description of Sample

| Variable | Description | All: M/SD | Men: M/SD | Women: M/SD |
|----------|-------------|-----------|-----------|-------------|
| n        |             | 153 (100%) | 87 (57%)  | 66 (43%)    |

#### Dependent

- **satisfied**
  - “How often do you feel that you are satisfied with the results of your creative work?”
  - “Never” (=1, base)
  - “Rarely” (=2)
  - “Sometimes” (=3)
  - “Rather often” (=4)
  - “Often” (=5)

- **posfeedback**
  - “My creative work often receives positive feedback”
  - “Not at all” (=1, base)
  - “To a small extent” (=2)
  - “Somewhat” (=3)
  - “To a large extent” (=4)
  - “Totally” (=5)

- **value**
  - “My creative work creates new knowledge or other reusable value”
  - “Not at all” (=1, base)
  - “To a small extent” (=2)
  - “Somewhat” (=3)
  - “To a large extent” (=4)
  - “Totally” (=5)

#### Explanatory

- **flextime**
  - Flexible (=1) vs fixed (=0) working-time arrangement of employee

- **creatime**
  - Employee-reported share of creative work in total working time of employee (%)

- **age**
  - Age in years

- **gender**
  - Male (=1) vs female (=0)

- **family**
  - Employee-reported number of people living together with employee

- **education**
  - Educational level:
    - Primary education (base)
    - Secondary education (=2)
    - Vocational education (=3)
    - Undergraduate degree (=4)
    - Master’s degree (=5)
    - PhD (=6)

(Continued)
| Description | All: M/% (SD) | Men: M/% (SD) | Women: M/% (SD) |
|-------------|--------------|--------------|----------------|
| **Variable** | **n** 153 (100%) | **87 (57%)** | **66 (43%)** |
| educationy  | Years of education starting from primary education | 16.58 (2.66) | 15.96 (2.85) | 17.39 (2.14) |
| thealth     | General health condition factor with overall Kaiser-Meyer-Olkin measure of sampling adequacy of factor 0.6; comprising (1) “Do you have high blood pressure or have you ever used medicine for high blood pressure?” (yes = 1); (2) “Do you suffer or have you suffered from diseases that significantly affect your mental fatigue?” (5-level Likert-type scale, “Never” = 1, “Often” = 5); (3) “Does your disease or injury interrupt you while doing your daily job?” (5-level Likert-type scale, No obstacles = 1, Not able to work = 5); (4) “How many workdays have you been absent from work due to disease or medical examination in the past 12 months?”(5-level scale, None = 1, 100–365 days = 5); (5) Body-Mass Index (continuous) | 0.00 (0.81) | 0.05 (0.81) | −0.07 (0.81) |
| meq         | rMEQ score, 1…25 scale ranging from “Definitely an evening type” to “Definitely a morning type” | 14.73 (3.53) | 14.98 (3.57) | 14.39 (3.49) |
| sleephours  | Employee reported average sleeping hours per day on the scale: “Less than 6 hours” (base) | 7% | 6% | 8% |
|             | “6–7 hours” (2) | 50% | 49% | 50% |
|             | “7–8 hours” (3) | 38% | 39% | 36% |
|             | “8–9 hours” (4) | 6% | 6% | 6% |
|             | “over 9 hours” (5) | 0% | 0% | 0% |
| workhours   | Employee-reported average working hours per working day | 10.10 (1.67) | 10.10 (1.44) | 10.11 (1.95) |
| atwork      | Employee-reported share of working hours at workplace out of total working hours per working day | 0.82 (0.13) | 0.81 (0.14) | 0.84 (0.11) |
| salary      | Employee-reported monthly gross salary on - scale: “Below 1,000 euros” (1, base) | 7% | 1% | 14% |
|             | “1,000–2,000 euros” (2) | 58% | 59% | 56% |
|             | “2,000–3,000 euros” (3) | 23% | 24% | 23% |
|             | “3,000–5,000 euros” (4) | 11% | 15% | 6% |
|             | “above 5,000 euros” (5) | 1% | 1% | 0% |
| context     | “Work as part of a R&D team” (base) | 78% | 76% | 80% |
|             | “Work as part of team comprised mostly of non-R&D employees” (2) | 16% | 18% | 14% |
| nature      | “Individual employee in R&D area” (3) | 6% | 6% | 6% |
|             | “Permanent work” (base) | 90% | 92% | 87% |
|             | “Nonpermanent work, with duration of more than 1 year” (2) | 7% | 5% | 11% |
|             | “Nonpermanent work, with duration of less than 1 year” (3) | 3% | 3% | 2% |

**Notes:** Mean and standard deviation shown for continuous and ordered variables; percentage of respondents shown for binary and categorical variables.
### TABLE A2

**SEM Estimates**

| Dependent variable | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 |
|--------------------|---------|---------|---------|---------|---------|---------|
|                    | satisfied | satisfied | posfeedback | posfeedback | value | value |
| **Main equation estimation** | oprobit | OLS | oprobit | OLS | oprobit | OLS |
| flextime (yes = 1) | 0.158 | 0.033 | 0.586 | 0.336 | 0.279 | 0.129 |
| (0.75) | (0.29) | (0.53) | (0.33) | (0.52) | (0.40) |
| creatime | 0.007*** | −0.007 | −0.002 | −0.053*** | −0.012 |
| (0.01) | (0.00) | (0.01) | (0.00) | (0.01) | (0.02) |
| creatime² | 0.001*** | 0.000* | (0.00) |
| age | −0.041*** | −0.019*** | −0.022*** | −0.015*** | −0.007 | −0.006 |
| (0.01) | (0.00) | (0.01) | (0.00) | (0.01) | (0.01) |
| gender (male = 1) | 0.550*** | 0.216** | −0.236 | −0.130 | 0.203 | 0.102 |
| (0.21) | (0.09) | (0.23) | (0.15) | (0.30) | (0.16) |
| family | 0.105* | 0.044* | 0.142*** | 0.091*** | 0.075 | 0.005 |
| (0.06) | (0.03) | (0.03) | (0.02) | (0.06) | (0.04) |
| education = 3² | 1.231*** | 0.488*** | 1.470*** | 0.842*** | 3.224*** | 1.911*** |
| (0.438) |
| education = 4 | 0.551** | 0.193* | −0.581** | −0.383*** | 0.963*** | 0.690*** |
| (0.25) | (0.11) | (0.23) | (0.15) | (0.29) | (0.20) |
| education = 5 | 0.744*** | 0.261** | −0.203 | −0.165 | 1.052*** | 0.747*** |
| (0.26) | (0.11) | (0.30) | (0.19) | (0.32) | (0.22) |
| education = 6 | 0.528 | 0.123 | −0.368 | −0.310* | 1.443*** | 0.892** |
| (0.34) | (0.13) | (0.32) | (0.17) | (0.50) | (0.36) |
| Scores for factor fhealth | −0.001 | 0.015 | −0.187¥ | −0.114¥ | −0.133 | −0.100 |
| (0.10) | (0.05) | (0.13) | (0.07) | (0.15) | (0.10) |
| fhealth² | 0.227 | 0.124 | 0.227 | 0.124 | (0.16) | (0.11) |
| meq | −0.466** | −0.217** | −0.031* | −0.020¥ | −0.310¥ | −0.184 |
| (0.22) | (0.10) | (0.02) | (0.01) | (0.21) | (0.13) |
| meq² | 0.017** | 0.008*** | 0.011¥ | 0.007¥ |
| (0.01) | (0.00) | (0.01) | (0.00) |
| sleephours | 0.092 | 0.042 | 0.341** | 0.207* | 0.014 | 0.045 |
| (0.14) | (0.06) | (0.17) | (0.11) | (0.15) | (0.11) |
| workhours | 0.150* | 0.066** | 0.205** | 0.128** | −1.083** | −0.309 |
| (0.08) | (0.03) | (0.09) | (0.05) | (0.46) | (0.23) |
| workhours² | 0.065*** | 0.020* | (0.02) | (0.01) |
| atwork | −2.745** | −1.191*** | −2.236*** | −1.452*** | −0.866¥ | −0.627¥ |
| (1.13) | (0.46) | (0.75) | (0.48) | (0.58) | (0.40) |

(Continued)
| Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 |
|--------|--------|--------|--------|--------|--------|
| Dependent variable | satisfied | satisfied | posfeedback | posfeedback | value | value |
| salary | -0.121 | -0.039 | | | | |
| (0.17) | (0.08) | | | | | |
| context = 2 | -0.029 | -0.018 | -0.052 | -0.068 | -0.378 | -0.206 |
| (0.30) | (0.13) | (0.39) | (0.25) | (0.34) | (0.28) | |
| context = 3 | 0.536 | 0.249 | 0.548*** | 0.331** | 0.238 | 0.149 |
| (0.49) | (0.21) | (0.21) | (0.13) | (0.30) | (0.20) | |
| nature = 2 | -0.205 | -0.050 | 0.084 | 0.076 | -0.256 | 0.019 |
| (0.52) | (0.26) | (0.32) | (0.20) | (0.39) | (0.20) | |
| nature = 3 | -0.866*** | -0.406** | 0.125 | 0.109 | 0.351 | 0.299 |
| (0.31) | (0.16) | (0.26) | (0.16) | (0.50) | (0.37) | |
| constant | 5.280*** | 3.285*** | 5.301*** |
| (1.11) | (0.77) | (0.90) | |

| Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 |
|--------|--------|--------|--------|--------|--------|
| Dependent variable | satisfied | satisfied | posfeedback | posfeedback | value | value |
| salary | -0.121 | -0.039 | | | | |
| (0.17) | (0.08) | | | | | |
| context = 2 | -0.029 | -0.018 | -0.052 | -0.068 | -0.378 | -0.206 |
| (0.30) | (0.13) | (0.39) | (0.25) | (0.34) | (0.28) | |
| context = 3 | 0.536 | 0.249 | 0.548*** | 0.331** | 0.238 | 0.149 |
| (0.49) | (0.21) | (0.21) | (0.13) | (0.30) | (0.20) | |
| nature = 2 | -0.205 | -0.050 | 0.084 | 0.076 | -0.256 | 0.019 |
| (0.52) | (0.26) | (0.32) | (0.20) | (0.39) | (0.20) | |
| nature = 3 | -0.866*** | -0.406** | 0.125 | 0.109 | 0.351 | 0.299 |
| (0.31) | (0.16) | (0.26) | (0.16) | (0.50) | (0.37) | |
| constant | 5.280*** | 3.285*** | 5.301*** |
| (1.11) | (0.77) | (0.90) | |

TABLE A2 (Continued)
| Dependent variable | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 |
|--------------------|---------|---------|---------|---------|---------|---------|
| constant           | -0.193  | -0.191  | -0.016  | -0.034  | -0.006  | -0.049  |
|                    | (0.60)  | (0.59)  | (0.55)  | (0.55)  | (0.68)  | (0.67)  |
| cut_1_1, constant  | -6.019***| -2.472**| -9.231***|         |         |         |
|                    | (2.29)  | (1.27)  | (2.40)  |         |         |         |
| cut_1_2, constant  | -4.234* | -1.247  | -8.034***|         |         |         |
|                    | (2.30)  | (1.16)  | (2.30)  |         |         |         |
| cut_1_3, constant  | -1.651  | 0.333   | -6.600***|         |         |         |
|                    | (2.15)  | (1.23)  | (2.24)  |         |         |         |
| cut_1_4, constant  | 2.315v  | -5.109**|         |         |         |         |
|                    | (1.46)  | (2.20)  |         |         |         |         |
| lnsig_1, constant  | -0.646***| -0.370***|         | -0.318***|         |         |
|                    | (0.07)  | (0.07)  |         | (0.06)  |         |         |
| lnsig_2, constant  | 2.972***| 2.972***| 2.972***| 2.972***| 2.972***| 2.972***|
|                    | (0.04)  | (0.04)  | (0.04)  | (0.04)  | (0.04)  | (0.04)  |
| atanhrho_12, constant | 0.138* | -0.038  | 0.167***| 0.077***| 0.167***| -0.033 |
|                    | (0.08)  | (0.05)  | (0.04)  | (0.03)  | (0.05)  | (0.04)  |
| atanhrho_13, constant | -0.185 | -0.144  | -0.257  | -0.216  | -0.275  | -0.256  |
|                    | (0.34)  | (0.24)  | (0.44)  | (0.42)  | (0.20)  | (0.21)  |
| atanhrho_23, constant | 0.256* | 0.253*  | 0.261** | 0.258** | 0.241** | 0.241** |
|                    | (0.14)  | (0.14)  | (0.15)  | (0.15)  | (0.13)  | (0.13)  |
| pseudo-log-likelihood | -856.335***| -858.494***| -900.844***| -902.540***| -902.840***| -910.610***|
| Number of obs.     | 153     | 153     | 153     | 153     | 153     | 153     |

Notes: Coefficients reported with standard errors below in parentheses; *p < 0.10, **p < 0.05, ***p < 0.01; ¥all within a 85% confidence interval (0.10 < p < 0.15); significance of pseudo-log-likelihoods is based on the Wald’s chi²; ‡education = 3 and nature = 3 categories have only 4 observations making the regression results for these categories irrelevant.
## TABLE A3
Pairwise Linear Correlations

| satisfied feedback | posfeedback | value | flextime | creatime | age | gender | family | education | fhealth | meq | sleep-hours | work-hours | atwork | salary | context | nature |
|--------------------|-------------|-------|----------|----------|-----|--------|--------|-----------|---------|-----|-------------|------------|--------|--------|---------|--------|
| postfeedback       | 0.3833      | 1.0000| 0.0000   | 0.0000   |     |        |        |           |         |     |             |            |        |        |         |        |
| value              | 0.0933      | 0.3531| 1.0000   | 0.0000   |     |        |        |           |         |     |             |            |        |        |         |        |
| flextime           | 0.0386      | 0.1364| 0.0959   | 1.0000   |     |        |        |           |         |     |             |            |        |        |         |        |
| creatime           | 0.1161      | 0.0686| 0.2468   | 0.1120   | 1.0000| 0.0000 |        |           |         |     |             |            |        |        |         |        |
| age                | -0.1017     | -0.0766| 0.0943   | -0.1598  | 0.1292| 1.0000|       |           |         |     |             |            |        |        |         |        |
| gender             | 0.1104      | -0.0268| -0.0194  | 0.1713   | -0.0358| -0.1035| 1.0000|           |         |     |             |            |        |        |         |        |
| family             | 0.1119      | 0.0671 | -0.0323  | 0.0424   | -0.0862| 0.1254| 0.5055| 1.0000    |         |     |             |            |        |        |         |        |
| education          | 0.0534      | 0.0448 | 0.2249   | 0.3365   | 0.2546| -0.3072| -0.0805| 1.0000    |         |     |             |            |        |        |         |        |
| fhealth            | -0.0226     | -0.0838| -0.0421  | -0.0385  | 0.0004| 0.2085| 0.0778| -0.0077   | -0.0053 | 1.0000|             |            |        |        |         |        |
| meq                | 0.0222      | -0.0363| 0.1119   | 0.0239   | 0.0039| 0.0300| 0.0820| 0.1258    | -0.0175  | -0.0154| 1.0000        |            |        |        |         |        |
| sleep-hours        | -0.0024     | 0.0862 | 0.0242   | 0.0730   | 0.0200| -0.0584| 0.0276| -0.0356   | 0.0153   | -0.0519| 0.1350        | 1.0000     |         |        |         |        |
| work-hours         | 0.1742      | 0.2750 | 0.1904   | 0.0717   | -0.0248| 0.2176| -0.0032| 0.0884    | 0.2105   | -0.0542| 0.1184        | -0.1238     | 1.0000   |         |         |        |
| atwork             | -0.2041     | -0.1856| -0.1831  | -0.2104  | -0.0243| -0.2236| -0.1302| -0.1490   | -0.1596  | -0.1033| -0.0696        | 0.0389      | -0.2502| 1.0000   |         |        |
| salary             | 0.0636      | 0.3139 | 0.0717   | 0.1043   | -0.0872| 0.0411| 0.2131| 0.1355    | -0.1389  | 0.0268| 0.1049        | -0.0055     | 0.1613  | 0.0377  | 1.0000   |         |
| 0.4411             | 0.1087      | 0.3847 | 0.2055   | 0.2904   | 0.6186| 0.0091| 0.0934| 0.0911    | 0.7457   | 0.2029| 0.9466        | 0.0517      | 0.6511  |         |         |        |
|                        | context | nature | educationy |
|------------------------|---------|--------|------------|
| context                | -0.0013 | 0.0868 | 0.0190     |
|                        | -0.0392 | -0.0345 | 0.0333     |
|                        | -0.1056 | -0.1239 | 0.2447     |
|                        | -0.1958 | -0.1402 | 0.0292     |
|                        | -0.1195 | -0.0931 | 0.3616     |
|                        | 0.0206  | 0.0264  | 0.2972     |
|                        | 0.0362  | 0.0061  | -0.2671    |
|                        | 0.0287  | -0.1946 | -0.0962    |
|                        | -0.0498 | 0.0522  | 0.9706     |
|                        | 0.0613  | -0.0426 | -0.0002    |
|                        | -0.1516 | 0.1436  | -0.0039    |
|                        | 0.0403  | 0.0882  | 0.0056     |
|                        | -0.0512 | -0.0201 | 0.2137     |
|                        | -0.0241 | 0.2449  | -0.1588    |
|                        | -0.1539 | 0.0098  | -0.1656    |
|                        | 1.0000  | 1.0000  | -0.0655    |
|                        |         |         | -0.2457    |

Notes: Correlation coefficients for each pair of variables with p-values.