

PLEASE, DO NOT DISTURB. TELEWORK, DISTRACTIONS, AND THE PRODUCTIVITY OF THE KNOWLEDGE WORKER

Research-in-Progress

Nick van der Meulen

Rotterdam School of Management
Erasmus University, The Netherlands
dmeulen@rsm.nl

Peter van Baalen

Rotterdam School of Management
Erasmus University, The Netherlands
pbaalen@rsm.nl

Eric van Heck

Rotterdam School of Management
Erasmus University, The Netherlands
evanheck@rsm.nl

Abstract

An unanswered question regarding telework is how differences in workplace distraction levels influence the effect of the extent of telework on productivity. Drawing from research and theory on cognitive overload and distraction conflict, we developed a quasi-field experiment to test the influence of so-called 'distraction gains' (indicating lower distraction levels at home compared to the office work environment) on the telework-productivity relationship. The results of our study (N=141) show that distraction gains will increase the positive effect of telework on productivity for knowledge workers (i.e. those with high levels of task complexity, novelty and non-routineness). A subgroup characterized by low knowledge work did not show any relationship between telework and productivity. This study provides much needed longitudinal research findings on the relationship between telework and productivity, and may serve as a basis for future studies on the importance of situational factors regarding telework.

Keywords: Field experiment, Information worker, Moderating effect, Remote work, Work performance

Introduction

The ubiquitous presence of powerful portable computers, a high penetration rate of cheap and reliable broadband communications, unified communication and collaboration software, as well as cloud computing and software as a service solutions have changed the way we work and live. One of these changes is that in the past two decades, full-time teleworking has become a viable alternative to regular office-based work for most job types and functions, including knowledge work. Estimations indicate that in the United States and the European Union around twelve percent of all employees telework to some extent (James 2004; WorldatWork 2009), and this number is expected to grow to nearly twenty percent by 2016 (Forrester Research 2009). Telework, which we define as a work practice that enables employees to work at home with the help of IT, offers many potential benefits for individuals, organizations, and society at large. Of these benefits, the most alluring to organizations remains the potential for higher employee productivity (Hartman et al. 1991; Jensen 2007). In principle, organizations will only consider telework a viable work practice if teleworkers prove to be at least as productive as their 'traditional office' colleagues. Ideally, telework should even lead to higher employee productivity. Yet despite positive results coming from telework survey reports (James 2004), there seems to be little clear scientific evidence that these productivity gains actually occur (Bailey and Kurland 2002; Johanson 2007). We propose that this lack of scientific evidence is due to the fact that existing research has failed to take two important factors into account: 1) the *extent* of telework, and 2) differences in workplace distraction levels. Therefore, the research question addressed in this paper is:

"How do differences in workplace distraction levels influence the effect of the extent of telework on knowledge worker productivity?"

Theory and Hypotheses

As is the case with most research on telework, research on the relationship between telework and productivity is plagued by a lack of theory (Bailey and Kurland 2002). Notwithstanding, some empirical research has been conducted on the topic, with most studies reporting generally positive differences between groups of teleworkers and non-teleworkers (e.g. Bailyn 1988; Bélanger 1999; Dubrin 1991; Hill et al. 1998; Johanson 2007; Poissonnet 2002) or between pre-and post-telework recollections on the teleworker's part (e.g. Baruch 2000; Frolick et al. 1993; Kemerling 2002). Only a few studies indicate that there might be a negative effect (e.g. Hartman et al. 1991) or no effect at all (e.g. Olson 1989). While such investigations give valuable primary insights, they are hard to compare due to vast differences in defining who 'classifies' as a teleworker. Most existing research tends to label those who work away from the main office for at least one day as 'teleworker' (e.g. Bélanger 1999), while yet other researchers make no distinction or rather depend on the undefined classification made by the organizations under study (e.g. Hill et al. 1998). By not examining the actual *extent* of telework, existing research is unable to adequately distinguish between those whose primary identity is likely to be 'office worker' versus those who are likely to identify themselves as 'teleworker'. We define the extent of telework as the percentage of working time (a week) spent working at home. For instance, an individual who works at home 20 percent of his/her working time will most likely identify oneself as an 'office worker', whereas someone who works at home 80 percent of his/her working time will likely identify oneself as a 'teleworker'. To date, relatively little research has addressed this extent of telework (Raghuram et al. 2003). Subsequently, no research has examined the expected relationship between the extent of telework and teleworker productivity, even though it was deemed important in previous investigations (Golden and Veiga 2005; Hill et al. 1998).

Telework and Productivity

The traditional definition of productivity stems from the industrial era and bases productivity on a comparison between outputs (typically number of units) and inputs (typically hours of labor). This is a problem in an era where knowledge workers dominate, as it is no longer just the quantity of work, but rather the quality and timeliness of work that lies at the core of output (Drucker 1999). A knowledge worker is typically someone whose work requires high levels of autonomy, as the work is characterized as complex, novel, and non-routine (Davenport 2005). We therefore define productivity as an individual's

effectiveness with which he or she applies talents and skills and uses resources to perform work within a specific timeframe (Ruch 1994). A lack of research regarding the extent of telework means that we do not know exactly the reasons for change in teleworker productivity levels, as the impact of possible influencing factors is likely to be very much related to the extent of telework. The possible influencing factors are multiple, but can generally be divided into three categories, namely those pertaining to 1) individual factors, 2) social factors, and 3) situational factors (Neufeld and Fang 2005).

While originally the *individual factors* category is described only in terms of demographics such as family status or gender (Neufeld and Fang 2005), we propose that it could also include physiological and psychological factors. For instance, telework is said to lead to greater productivity by virtue of greater control over working time (Bailyn 1988; Bélanger 1999). This is beneficial, as it allows teleworkers to benefit from the moments during the day during which energy levels, creativity, and productivity are at its highest. Another factor is the avoidance of the daily commute, which is typically 20 kilometers (one-way worldwide average) (Silva et al. 2009). This avoidance is said to improve productivity due to stress reductions and an increase in working time (as commuting time is transformed into working time) (Baruch 2000; Frolick et al. 1993).

The *social factors* category primarily relates to social interactions with clients, colleagues, and managers. The main premise is that social interaction is positively associated with productivity (Neufeld and Fang 2005), as it allows individuals to obtain social support and exchange information essential in performing their tasks. In addition, it helps to spread corporate culture and organizational norms (Kraut 1989; Shamir and Salomon 1985). As the central office is the place where most (informal) information is shared, social networks develop, and friendships emerge (Salomon and Salomon 1984; Sias and Cahill 1998), one could posit that teleworking —due to long-term reduced physical proximity— increases (professional) isolation and thereby reduces productivity. However, research has shown that teleworkers' proactive use of (modern) communication media may mitigate this negative effect (Hartman et al. 1991; Katz 1987; Poisonnet 2002).

Last, the *situational factors* category relates to the actual working location. In some cases, the comfort of the (private / informal) work environment is mentioned as beneficial to productivity (e.g. Hill et al. 1998), where in other cases conflict due to negative spillovers between work and home domains were mentioned as a potential drawback to productivity (Hartman et al. 1991; Shamir and Salomon 1985). In addition, the lack of certain facilities (e.g. a laser printer or intranet connectivity) at a location was also mentioned as a limitation to productivity (Hill et al. 1998; Staples et al. 1999). Yet these are all minor aspects compared to one of the most oft-mentioned (but never truly investigated) reasons for telework productivity increases: the elimination of possible work distractions (Apgar 1998; Baruch 2000; Bélanger 1999; Dubrin 1991; Frolick et al. 1993; Hill et al. 1998; Mokhtarian and Salomon 1997; Poisonnet 2002).

Ideally, we would like to examine how the various aforementioned factors relate to the extent of telework and employee productivity levels. Yet it is also important to get a thorough understanding of all these factors, which is hard to achieve in a single study. Therefore, we shall initially examine the combined effect of these factors by directly testing the effect of the extent of telework on knowledge worker productivity. As most of the existing research claims that teleworking benefits outweigh the drawbacks (implied by positive effects of telework on productivity), we can formulate the following hypothesis:

H1: *“The extent of telework will positively influence the productivity of a teleworker”*

Additionally, we shall focus on the one factor that is tied most directly to the teleworker's work location and is mentioned most in the existing literature: the level of distraction. To our knowledge, this factor has not been quantitatively examined in the context of teleworker productivity, making it a worthwhile area of investigation.

Distractions and Productivity

The work environment of the modern-day knowledge worker is filled with various sources of distraction (Jett and George 2003). Distractions can typically be characterized in two ways. First, the source of distraction may be internally generated (e.g. anxiety, stress, or a tendency for instant gratification) or externally generated (caused by the work environment or organizational policies). Second, distractions may be voluntary, such as a short walk to clear one's head (a 'break' according to the framework of Jett

and George(2003)), or involuntary, such as when a colleague drops by with a question (a 'distraction' or an 'intrusion' according to the framework of Jett and George (2003)) (Roper and Juneja 2008). As the work location of a teleworker is mainly expected to have an impact on externally generated involuntary distractions, we shall focus on these.

Distractions are psychological reactions triggered by competing activities or environmental stimuli that do not pertain to the primary task and frustrate focused concentration and attention that would have been directed at the task (Jett and George 2003). Research on this topic generally finds that cognitive (working memory) overload occurs when new information cues (e.g. background noise or visual stimuli) draw on the same type of sensory channel that is being used for the primary task (Gillie and Broadbent 1989; Hirst and Kalmar 1987; Kahneman 1973; Klingberg, 2009). For instance, nearby conversations from colleagues are likely to lead to cognitive overload when doing a task that involves writing a report, as both are phonological (i.e. deal with the storage of linguistic information). The overload will cause an individual to take cognitive shortcuts (e.g. by using heuristics) to save already limited cognitive capacity. This phenomenon—which is known as cognitive economy—severely limits the cognitive exploration that knowledge workers need when performing highly complex and novel tasks, thus reducing their performance and productivity.

The importance of task complexity and novelty is further established by distraction conflict theory (Baron 1986), which states that distractions cause stress, which in turn causes narrowed attention to information cues. As complex and novel tasks typically involve the processing of many (combined) information cues (Wood 1986), one can infer that distractions reduce complex task performance. Conversely, one could also state that distractions are beneficial to tasks with lower complexity, in which case the narrowing of one's attention helps to focus on only the most important cues (Speier et al. 1999).

Interruptions (or intrusions) are generally considered to be a more invasive type of distraction. Both are linked in the sense that both direct attention away from an ongoing activity, thus impeding progress related to this activity. Yet both are different in the sense that interruptions tend to require one's immediate attention, whereas distractions do not (Speier et al. 2003). Most often an interruption is caused by an unexpected encounter with another individual, be it face-to-face or via electronic media, and it generally takes up time that could be spent on the primary task at hand. Furthermore, interruptions tend to frustrate opportunities for extended periods of concentration and reflection (Jett and George 2003) that are beneficial to productivity. In addition, interruptions may prevent certain individuals from reaching a state of 'flow': a condition "in which people are so involved in an activity that nothing else seems to matter at the time" (Csikszentmihalyi 1990: p.4) that has been linked to high productivity and performance (Demerouti 2006; Eisenberger et al. 2005). However, one should note that the actual influence of interruptions on work performance or productivity is expected to depend on the frequency, unexpectedness, and duration of the interruptions (Jett and George 2003).

As we have pointed out, distractions (including interruptions) might have a different impact on those with low levels of task complexity and novelty than on those with high levels of task complexity and novelty. Considering the fact that high levels of work complexity, novelty and non-routineness are characteristics of knowledge work (Davenport 2005), we could state that distractions might lead to reduced productivity for those who are *high on knowledge work*, and improved productivity for those who are *low on knowledge work*. In the context of telework it is thus not surprising that individuals who are high on knowledge work indicate that they telework in order to escape the distractions that are so prevalent at the office (Peters et al. 2004). Such behavior signals a fundamental aspect to research on distraction in the context of telework: each work environment (home & the office) has its own level of distraction, and the differences between both environments need to be taken into account if we are to truly understand the phenomenon under study. After all, 'escaping the office' will only make sense if the home environment provides less distraction than the office. In other words: there needs to be something to 'gain' in terms of a distraction-free environment. If we define the aforementioned difference between the level of distraction at the office minus the level of distraction at home the '*distraction gain*' and combine this notion with what we expect from 1) the relation between the extent of telework and productivity (hypothesis 1), and 2) distraction in relation to high and low levels of knowledge work, we can formulate the following hypotheses:

H2: "*The positive influence of the extent of telework on the productivity level of a teleworker with a low degree of knowledge work will decrease in the case of higher distraction gains*"

H3: “The positive influence of the extent of telework on the productivity level of a teleworker with a high degree of knowledge work will increase in the case of higher distraction gains”

Method

Sample and Procedures

To test our hypotheses we sought out organizations that fit the following criteria:

- The decision to telework should rest with the employees (in order to avoid selection bias);
- Employees should have absolute freedom regarding their extent of telework, as productivity benefits are most likely to occur when employees telework to suit both their personal and work needs;
- The organizations are planning to implement official teleworking programs in the near future, so we can perform comparisons on pre- and post-measurements;
- The teleworking programs that the organizations are about to implement should be active and comprehensive with regards to organizational and technological support, in order to exclude factors that might limit teleworker productivity.

Three organizations agreed to participate in our study: a car lease organization, a medicines evaluation agency, and a utilities company. To date, pre-measurements have been carried out at all three organizations, whereas only one post-measurement has been conducted thus far. The remaining post-measurements are planned for fall 2012 and spring 2013.

The preliminary analysis in this paper will be based on the one case for which we currently have pre- and post-measurement data available. It involves a European utilities company that, at the time of measurement, employed over 10,000 FTE and had an annual turnover of approximately 9 billion Euro. Before launching an organization-wide teleworking program, management first wanted to conduct a pilot project with 206 participants. To examine the potential impact of telework on those with a high and a low degree of knowledge work, the pilot participants were pre-selected based on their functional profile. Participants with a high degree of knowledge work performed a wide array of job functions in operations, sales, HR, and IT. Participants with a low degree of knowledge work were predominantly call center employees. Regardless of job function, all participants were given a support package, which included a mobile phone, laptop, router, printer, company token, and a monthly fee for a high speed Internet connection. In addition, several software and cloud-based solutions for (unified) communication and collaboration as well as desktop virtualization supported the pilot. All pilot participants received training on how to best work at home with the provided tools and software.

An online survey was employed as the preferred data collection method. The (translated) research instrument was pre-tested in the final stage of development in order to test the user friendliness of the survey and to check if acceptable levels of measurement reliability could be achieved. An independent agency provided a panel consisting of 100 unique respondents, whose responses and feedback led to minor changes in question wording, the addition of fill-in instructions, and the inclusion of definitions when deemed necessary. The online survey environment allowed for automatic randomization and recoding of questions (when appropriate), which minimized the risk of anchored and adjusted responses. In addition, the tool allowed for automatic coding and provided the opportunity to export the answers directly to a format that was ready for statistical analysis, eliminating the risk of data entry errors.

Two surveys were administered: one pre-measurement approximately three months before the start of the pilot, and one post-measurement six months after the start of the pilot. Due to the use of personalized invitation links (necessary to match responses), data confidentiality was assured in the introduction text of the survey, and participants were told that no individual results would be communicated to any of the parties involved. Hosting the survey on the researchers' university servers meant that the latter could be ensured, as the participating organization did not have any access to survey information. This allowed us to match the responses across both measurements and yet maintain the necessary research protocol. Response rates for the pre- and post-measurement were 86 percent and 80 percent, respectively. After screening for any irregularities and errors, a workable sample of 141 respondents remained, representing approximately 68 percent of the pilot participants.

Measures

For all measures in this section we used a 5-point Likert scale from ‘strongly disagree’ to ‘strongly agree.’ To prevent forced answers or guessing, the scales also contained a “no opinion” option to give the respondents the opportunity to avoid questions that they cannot (or would not like to) answer. No respondents used this option, meaning there were no missing variables in the paired sample dataset.

Extent of telework. The extent of telework was assessed by asking respondents the proportion of the average workweek that they spent working at home (in percentages). Prior research has shown that this measure is no different from asking the average number of hours per week spent working at home (Golden and Veiga 2005).

Distraction (at the office/at home). For both the office location as well as the home location, the level of distraction was assessed using a general measure by Lee and Brand (2005). The general measure contains five items, which were slightly adjusted to represent the work environments in both measures yet stay as identical as possible otherwise. An example of one such statement is “I experience visual distractions at my office workplace” and “I experience visual distractions at my home workplace.” The items were averaged for each environment to create two distraction scores. These measures were only included in the post-measurement survey, as 1) we expected identical distraction scores for both measurements and 2) a substantial amount of participants did not work at home at the time of the pre-measurement, making it too difficult to adequately assess the distractions at home. Post-measurement Cronbach alpha scores were .87 and .88 for the office and home location, respectively. The level of distraction gain was subsequently calculated by subtracting the score for ‘distraction at home’ from the score for ‘distraction at the office.’

Productivity. Productivity was assessed using five items from an ‘overall productivity’ measure by Staples et al. (1999). The measure includes various aspects of productivity, such as effectiveness, efficiency, quality of work, and top performance. Examples of statements are “I believe I am an effective employee” and “I am happy with the quality of my work output”. The items were averaged to create a productivity score. Cronbach alpha scores were .82 and .84 for the pre- and post-measurement, respectively.

Results

In this particular case we were able to do a quasi-field experiment, consisting of a pre-measurement, intervention, and post-measurement. Unfortunately, we could not survey a control group in addition to the pilot project participants. As comparisons between treatment and non-treatment groups are not possible, we opted instead to investigate the effect of changes in the extent of telework on the changes in productivity levels. We shall do this by means of hierarchical regression analysis based on residual change scores (see Blomqvist 1977) to remove any structural elements. In addition, we shall also take into account the moderating effect of distraction gains by means of interaction terms. As hypothesis 2 and 3 require groups of respondents with high and low degrees of knowledge work (KW), we split our sample into two groups (refer to the ‘sample and procedures’ section for more information on the functional split). Table 1 presents for both groups the means and standard deviations of the variables upon which the analysis is based. These two groups do not differ significantly on most variables, with the sole exception of the extent of telework for both the pre ($F=5.07$, $p<.05$) and post ($F=8.246$, $p<.01$) measurements.

Table 1. Descriptive Statistics

	Low KW - Pre	High KW - Pre	Low KW - Post	High KW - Post
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Extent of telework	6.67 (17.43)	13.28 (17.43)	42.87 (26.68)	31.28 (20.94)
Productivity	3.89 (0.52)	3.93 (0.46)	3.95 (0.52)	4.02 (0.45)
Distraction at the office	n/a	n/a	2.91 (0.82)	2.89 (0.91)
Distraction at home	n/a	n/a	1.80 (0.59)	1.65 (0.67)

N (Low KW)=70, N (High KW)=71

Before the regression analysis can be conducted, the residual change scores for extent of telework and productivity must be computed. This is done in two subsequent steps. First, the post-measurement value of variable Y is used as an outcome variable in a linear regression analysis, with the pre-measurement value of Y as the predictor variable, as such: $Y_{it2} = \beta_0 + \beta_1 Y_{it1} + \varepsilon_i$. Second, the difference (ΔY) between the observed value of Y_{t2} and the predicted value of Y_{t2} (based upon the equation above) is calculated and used for the regression analysis.

Table 2. Hierarchical Regression Analysis (Δ Productivity) for the low KW subgroup

	Model 1	Model 2	Model 3
Step 1: Hypothesis 1			
Δ Extent of Telework	-.07	-.06	-.06
Step 2			
Distraction Gain		-.02	-.06
Step 3: Hypothesis 2			
Δ Extent of Telework * Distraction Gain			.07
Change in R ²	.00	.00	.00
R ² (Adjusted)	.00 (.00)	.00 (.00)	.00 (.00)
F	.29	.15	.17

N=70, **p*<.05, ***p*<.01, ****p*<.001

Table 3. Hierarchical Regression Analysis (Δ Productivity) for the high KW subgroup

	Model 1	Model 2	Model 3
Step 1: Hypothesis 1			
Δ Extent of Telework	.34**	.34**	.27*
Step 2			
Distraction Gain		.00	.08
Step 3: Hypothesis 3			
Δ Extent of Telework * Distraction Gain			.45***
Change in R ²	.12**	.00	.19***
R ² (Adjusted)	.12 (.11)	.12 (.09)	.31 (.28)
F	8.62**	4.24*	9.33***

N=71, **p*<.05, ***p*<.01, ****p*<.001

Hypothesis 1 predicted that the extent of telework would positively influence productivity. As shown in Table 3 (Model 1), a positive linear effect exists for those with a high degree of knowledge work (β =.34, *p*<.01), whereas Table 2 (Model 1) shows no significant effect for those with a low degree of knowledge work (β =-.07, n.s.). This means that hypothesis 1 is supported only for the high knowledge work subgroup. Hypothesis 2 predicted that the positive influence of the extent of telework on the productivity level of teleworkers who are low on knowledge work would be decreased by distraction gains. Table 2 (Model 3) shows no effect (β =.07, n.s.) or increase in model fit (ΔR^2 =.00, n.s.), meaning that there is no substantive support for this hypothesis. Hypothesis 3 predicted that the positive influence of the extent of telework on the productivity level of teleworkers who are high on knowledge work would be increased by their distraction gains. In Table 3 (Model 3), the significant effect of the interaction term Δ extent of telework and distraction on Δ productivity (β =.45, *p*<.001) and the significant increase in model fit (ΔR^2 =.19, *p*<.001) support this hypothesis.

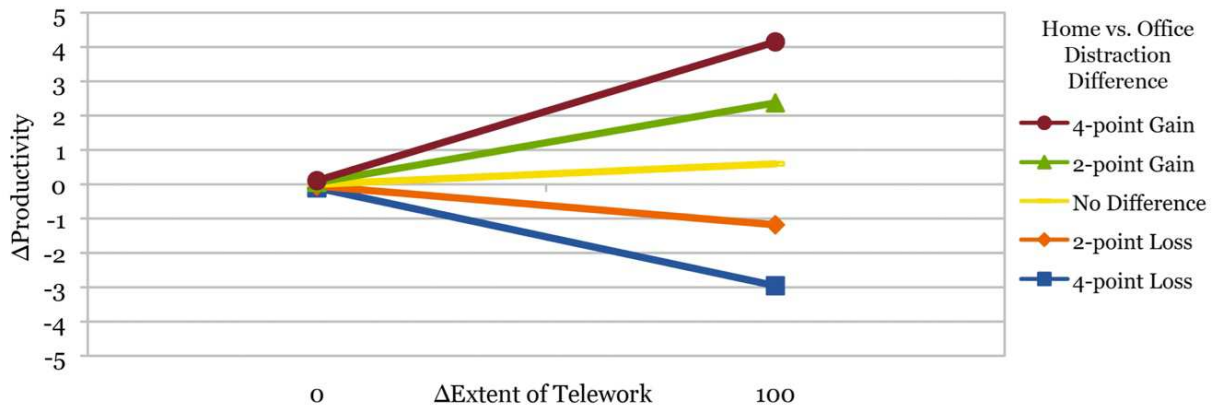


Figure 1. Distraction Gain Moderation Effect for the High KW subgroup (n=71)

Preliminary Conclusions and Limitations

Our study shows that differences in workplace distraction levels can have a significant impact on the positive effect of the extent of telework on knowledge worker productivity. More specifically, if a knowledge worker obtains distraction gains by teleworking, the positive effect of telework on productivity will be increased. In the case of distraction losses, telework will have a negative effect on productivity. However, these results only hold true for individuals whose work is characterized as highly complex, novel, and non-routine. The subgroup characterized by low knowledge work (comprised primarily of call center employees) did not show any relationship between telework and productivity. To gain solid evidence for this difference, we are currently examining ways to create a more elaborate knowledge worker taxonomy to incorporate in our second study, the results of which we hope to share during the 33rd International Conference on Information Systems.

Our current study is potentially limited in several ways. For instance, as our results are based on self-reported data from two subsequent surveys, there is a risk of common source bias. We shall address this issue in our second study, where we will incorporate manager-rated as well as objective measures concerning productivity. As is, our study answers the call for longitudinal empirical research on how the extent of telework affects productivity (Golden et al. 2005; Hill et al. 1998), as well as the role of so-called 'distraction gains' therein (Jensen 2007). Naturally, this sole focus on distraction gains limits a full understanding of what happens when people use information technology to work at home. As shown in Figure 1, productivity gains are minimal if the teleworker does not experience any difference in distraction levels. This could indicate that telework does not offer any additional benefits besides possible distraction reductions, or that other benefits do exist but that they are offset by certain drawbacks of telework. Part of our upcoming study will therefore be the inclusion of additional situational factors that might affect (or control for) the relationship between the extent of telework and productivity. Another interesting area for future research involves an investigation of the particular tradeoffs between physical and electronic distractions (see for instance Wajcman and Rose (2011)) and possible shifts among these as individuals change their work location - a distinction which we have not made thus far. Also, our study is limited to work at home; it would be interesting to examine individuals who choose to work 'on the go' or at so-called 'third locations' (such as a library or coffee shop), where distraction levels are different still.

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