# Does working from home work? Experience of working from home and the value of hybrid workplace post-COVID-19

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## Abstract

**Purpose** – This study aims to understand how knowledge workers working from home during COVID-19 changed their views on physical work environments and working-from-home practices.

**Design/methodology/approach** – This study conducted a survey targeting workers in the USA recruited via Amazon Mechanical Turk. A total of 1,651 responses were collected and 648 responses were used for the analysis.

**Findings** – The perceived work-life balance improved during the pandemic compared to before, while the balance of physical boundaries between the workplace and home decreased. Workplace flexibility, environmental conditions of home offices and organizational supports are positively associated with productivity, satisfaction with working from home and work-life balance during the pandemic.

**Research limitations/implications** – While the strict traditional view of "showing" up in the office from Monday through Friday is likely on the decline, the hybrid workplace with flexibility can be introduced as some activities are not significantly affected by the work location, either at home-based or corporate offices. The results of this study also highlight the importance of organizations to support productivity and satisfaction in the corporate office as well as home. With the industry collaboration, future research of relatively large sample sizes and study sites, investigating workers' needs and adapted patterns of use in home-based and corporate offices, will help corporate real estate managers make decisions and provide some level of standardization of spatial efficiency and configurations of corporate offices as well as essential supports for home offices.

**Originality/value** – The pandemic-enforced working-from-home practices awaken the interdependence between corporate and home environments, how works are done and consequently, the role of the physical workplace. This study built a more in-depth understanding of how workers who were able to continue working from home during COVID-19 changed or not changed their views on physical work environments and working-from-home practices.

**Keywords** Home office, Work environment, Hybrid workplace, Working from home, Work-life balance, Workplace flexibility

**Paper type** Research paper

## 1. Introduction

Knowledge workers, who are often defined as individuals whose work is more focused on creating, exchanging and managing intellectual subjects, have had some degree of teleworking, whether from their homes or corporate satellite offices. Teleworking was only allowed for limited work and positions such as managers and white-collar professionals, accounting for 7% of private industry workers in the USA before COVID-19 (Desilver, 2020). However, regardless of occupations, COVID-19 forced the change of the work locations from

a centralized office to a home office and many workers had or have experienced working-from-home arrangements because of COVID-19 since March 11, 2020, when the World Health Organization declared the pandemic. The percentage of people exclusively working from home in the USA increased from 8.2% in February 2020 to 35.2% in May 2020 (Bick *et al.*, 2020).

Even though various factors have affected the workers' workplace perceptions during the pandemic, working from home is one of the most significant considerations. Since mid-March 2020, when most US states enacted a lockdown, individuals have used their homes as their primary offices and only 11% of individuals who used to work from home exclusively went back to their corporate offices between April and September 2020 (Brenan, 2020). The extended period of working from home possibly changes individuals' perception of new ways of work and the workplace (Waizenegger *et al.*, 2020). Recent survey results reported that employees did not want to go back to full-time work in the office and preferred working from home on a regular basis (Colley and Williamson, 2020; Slack, 2020). As the home offices can be used more frequently, it is important to examine which environmental conditions can effectively support the workers working from home. Studies on working from home focused on workplace flexibility (Singer-Velush *et al.*, 2020) and work-life balance (Bellmann and Hübler, 2021; Maruyama *et al.*, 2009) while research about home-based work environments is less explored.

In addition, the pandemic-enforced working-from-home practices awakened the role of corporate offices. As many workers used home offices as a primary workplace, they had to do all types of work, including focus work, meetings, training and socializing with colleagues, at home. However, not all jobs are appropriate for working from home. In fact, studies estimated that between 37% (Dingel and Neiman, 2020) and 38.8% (Su, 2020) of jobs in the USA could be performed entirely from home. Working from home during the pandemic allowed workers to explore, which activities were supported well by different work locations; individuals could have different supports between home-based and corporate offices, pursuing a hybrid workplace arrangement.

The objective of this study is to build an in-depth understanding of how the changes due to the pandemic were related to workers' perceptions of workplaces and how workers who were able to work from home during COVID-19 changed or did not change their views on physical work environments, including home-based and corporate offices. This study aims to answer the following two primary research questions:

*RQ1.* Are the work- and workplace-related changes during the pandemic associated with workers' outcomes (i.e. productivity, satisfaction with working from home and work-life balance)?

*RQ2.* Which types of activities are supported better at home-based offices than at corporate offices?

Based on these two research questions and the literature review, this research will examine if workplace flexibility under the pandemic worked as it did before the pandemic, focusing on workers' outcomes, including work productivity, satisfaction and work-life balance. To achieve these research objectives, this study proposes hypotheses in the following sections.

## 2. Literature review
### 2.1 Work productivity, satisfaction with working from home and work-life balance during the pandemic
During the pandemic, many changes in work environments may influence workers' productivity. In a study by Felstead and Reuschke (2020) in the UK, 29% of the survey

respondents reported an increase in productivity during the pandemic, while 30% experienced a decrease in their productivity. The respondents provided the reasons for low productivity: childcare/homeschooling, lack of motivation/focus, limited access to workplace resources, limited software and Internet connection and limited interaction with other coworkers. Felstead and Reuschke (2020) argued that one of the most important considerations to explore the worker outcomes during the pandemic was the change in the main work locations from corporate offices to home offices.

In an office setting, it is known that workers' satisfaction with the workplace is positively associated with work productivity (Haapakangas *et al.*, 2018). Likewise, the work environment is also important for individuals' work productivity when working from home. During the pandemic, people hesitated to go to indoor spaces where had a greater possibility of infection of the disease. Working from home could decrease their anxiety of infection and consequently, increase their satisfaction. On the other hand, there was concern about decreased work-life balance as the separation between work and life became blurred while working from home (Bellmann and Hübler, 2021). According to Singer-Velush *et al.* (2020), Microsoft workers measured the collaboration patterns of their 350-person team and reported that their temporal work-life boundaries became blurry: 10% of the employees had meetings for collaboration on weekends and work-related interactions on weekday evenings. There is still a lack of understanding of how worker outcomes changed during the pandemic and further research is needed:

*H1a-1c.* Worker outcomes, including (a) perceived productivity, (b) satisfaction with working from home and (c) the work-life balance, have changed during the pandemic.

### 2.2 Workplace flexibility

Workplace flexibility is defined as "the ability of workers to make choices influencing when, where and for how long they engage in work-related tasks" (Hill *et al.*, 2008, p. 166). Hill *et al.* (2010) found that flexibility in the work schedule, work hours and the choice of work locations all contributed to positive outcomes for employees and the companies they work for. Teleworking provided workplace flexibility in choosing their best period to concentrate on work and reduced commuting time and fatigue from commuting (Basile and Beauregard, 2016; Becker and Steele, 1995). Maruyama *et al.* (2009) also claimed that teleworking improved a sense of work-life balance with the flexibility of working hours such that the autonomy of when they work was positively associated with the satisfaction with work-life balance. The COVID-19 pandemic gave workers more flexibility in terms of work schedule and hours. The workplace flexibility allowed the employees to spend more time with family and care for their children; 82.6% of the survey respondents reported "having more time for themselves and families" (Colley and Williamson, 2020, p. 12). However, it limited the choice of where to work, locking them in their houses and reducing their workplace flexibility. In spite of the limited flexibility in work locations, this study expects to find that higher workplace flexibility would be positively associated with workers' outcomes, such as work productivity, satisfaction with working from home and work-life balance, during the pandemic:

*H2a–2c.* Higher workplace flexibility is positively associated with (a) perceived productivity, (b) satisfaction with working from home and (c) the work-life balance during the pandemic.

*2.3 Environmental condition for work*
Whereas physical work environments of traditional corporate offices have been studied in various settings, such as closed, open-plan and activity-based offices (Davis *et al.*, 2011; Haapakangas *et al.*, 2018), few studies have dealt with the physical features of a home office environment in relation to satisfaction and productivity (Ng, 2010). Employees want to maintain similar workstations in home offices as traditional offices (Ng, 2010) and the home environment for work would include various factors, such as indoor environmental quality (Cuerdo-Vilches *et al.*, 2021; Ng, 2010), ergonomic furniture (Montreuil and Lippel, 2003), technology (Morgan, 2004) and a separate room for work (Cuerdo-Vilches *et al.*, 2021; Ng, 2010). Home offices became workers' main workplace for most work-related activities during the pandemic. Thus, the environmental settings in home-based offices should fully support various work-related activities and ergonomic functions associated with workers' satisfaction and productivity:

*H3a–3c.* Satisfaction with indoor environmental conditions of home offices and having appropriate home environments for work are positively associated with (a) perceived productivity, (b) satisfaction with working from home and (c) the work-life balance during the pandemic.

*2.4 Supports from companies*
During the COVID-19 pandemic, knowledge workers had to find ways to work as usual by using existing or new technologies at home due to their constrained working conditions. The office space's environmental affordances were substituted by technological affordances (Lupton and Haynes, 2000; Waizenegger *et al.*, 2020). Workers in corporate offices can communicate and collaborate with their colleagues within both physical and virtual dimensions; however, the enforced working-from-home situation made physical office-based interactions unavailable and the need for communications in physical space was shifted into a virtual environment through technology (Negulescu and Doval, 2021). Although technical support was not significantly associated with teleworkers' performance before COVID-19 (Aboelmaged and El Subbaugh, 2012), technical support is now expected to be associated with the performance under the enforced teleworking circumstances. In addition, Montreuil and Lippel (2003) emphasize the importance of employers' financial, technical and training support for ergonomic furniture and technology when workers adopt teleworking. As costs for space and utilities are shifted from employers to employees when employees work from home, the reduced costs in the traditional offices can be offered to improve home-based workstations for work-from-home outcomes (Baker *et al.*, 2007). Supports from organizations to furnish and equip individuals' home-based workstations were appreciated by employees, while employers' oversight of the supports negatively influenced employees' experiences when setting up home-based workstations (Janneck *et al.*, 2018; Montreuil and Lippel, 2003). This study investigates how support from companies is associated with the productivity and satisfaction with working from home during the pandemic:

*H4a–4b.* Organizational supports for working from home are positively associated with (a) perceived productivity and (b) satisfaction with working from home during the pandemic.

*2.5 Family situation*
Family–work balance at home is more required for employees who are working from home. Many employees used to send their children to daycare centers or hire baby and childcare

professionals during working hours before the pandemic, so demographics did not influence teleworkers' performance, such as having children (Aboelmaged and El Subbaugh, 2012; Maruyama *et al.*, 2009). However, during the pandemic, childcare services were limited; for instance, school-aged children were required to learn remotely while their parents worked from home, which added to their parents' workload while working from home (Felstead and Reuschke, 2020; Fox and Anderson, 2020). Consequently, 28.6% of the respondents self-reported lower productivity due to childcare/homeschooling and care for others during the COVID-19 pandemic (Felstead and Reuschke, 2020). This result aligns with another study conducted by Fox and Anderson (2020); higher education workers (faculty, librarians and staff) who lived with children reported greater difficulty finishing work while working from home during the pandemic than those who lived without children. This context infers that the work side in work-life (family) balance can be interfered with by such a family situation. Therefore, it is expected that the family situation could be negatively related to the work-related outcomes in this study:

*H5a–5c.* Living with children and having more interruptions are negatively associated with (a) perceived productivity, (b) satisfaction with working from home and (c) the work-life balance during the pandemic.

### 2.6 Activity

To investigate how the physical work environment supports activities in the office, Chacon Vega *et al.* (2020) conducted a study of three commercial offices that identify occupants' perceived environmental supports for 11 key activities, such as formal meetings, quiet working, socializing, training and eating, in open-plan layouts including workstations, training, rooms and meetings rooms. Individuals who worked in the open-plan workplace setting reported a lack of environmental support for their quiet working. The results also indicated the different needs of office environments depending on activities: for instance, the R&D department spending much time on individual, focused work required the highest needs of quiet working spaces compared to other departments (Chacon Vega *et al.*, 2020). Dutcher (2012) experimented with individual dull and concentration tasks, such as typing provided letters and a tic-tac-toe game, respectively, to investigate the productivity in corporate offices and teleworking environments. The productivity was evaluated by the achievements of assigned tasks. It was shown that the out-of-lab environment – the telecommuting environment – reduced productivity of the dull task by 6–10%. Conversely, the out-of-lab environment increased productivity of the concentration task by 11–20%. The results imply that individuals are more likely to be productive with concentration tasks in telecommuting environments than with simple tasks.

In the aspects of knowledge workers' performance, individual concentration and interactions between colleagues are important. Organizational knowledge creation is developed through the spiral of explicit and tacit knowledge (Nonaka, 1994). Tacit knowledge is delivered in a context through communication as "an analog process that aims to share tacit knowledge to build mutual understanding" (Nonaka, 1994, p. 17). In this context, interactions with colleagues, including formal meetings and casual conversations, are crucial activities. The survey carried out by Felstead and Reuschke (2020) also reported that lower work performance while working from home was attributed to limited interactions with others. In this context, the role of a home office that supports interactions with colleagues should be investigated:

*H6.* Certain activities are supported better at home-based offices than corporate offices.

## 3. Methods

### 3.1 Procedure

This study conducted a survey targeting workers in the USA and survey participants were recruited via Amazon Mechanical Turk (MTurk), an online crowdsourcing platform. MTurk allows a researcher to collect data in a diverse population than college samples in social sciences and the reliability of data is the same or higher than the data collected through traditional methods (Buhrmester *et al.*, 2011). To collect reliable and appropriate data for this study, the participants of this study had read the recruiting description before answering the survey, that this survey was about the experience of working from home during COVID-19 and were asked to participate in the survey only if they were or had experienced working from home during the pandemic. The researchers also excluded the responses from those who had not worked from home at all.

The work request was posted on the MTurk website for data collection, asking to participate in a 15-minute survey. The system qualification for location limited the participants to US residents only. The participants from MTurk were provided the link to the survey created using Qualtrics. As compensation, all respondents received US$0.50 after completing the survey. Before administering the survey, the researchers had the survey validated through random probes. Through the random probe process, minor word changes occurred to enhance readability. For example, "commute on average a day" was changed to "average daily commute."

The data were collected in three different periods. The first data collection was on September 14, 2020 and the second was on October 1, 2020. For the first two periods, the survey was open to the public in MTurk, so anyone who has an MTurk account could see and access the survey. From the 2nd collection, 'Captcha' was added at the beginning of the survey to distinguish a human from an answering machine. The last data collection was from October 4, 2020, to October 9, 2020 and was open to only those who were qualified. It raised the qualifications of respondents through 'Masters Qualification' in MTurk.

The first, second and third survey participants numbered 218, 124 and 1,309, respectively. Thus, a total of 1,651 responses were collected. As there has been a consideration for invalid responses on MTurk, screening questions are required to demonstrate the right respondent and prevent fraudulent answers (Chmielewski and Kucker, 2020). The survey questions in this study included screening questions and the researchers comprehensively examined and conservatively used the data in the analysis.

First, 137 incomplete responses were excluded from the analysis. Second, the respondent's location was reviewed to filter out fraudulent responses. This type of question is used in academic research when collecting data from MTurk to check the consistency of answers (Teitcher *et al.*, 2015). Qualtrics provided the latitude and longitude information showing where the participants were while filling out the survey and the respondents were asked to provide their zip codes and states of work offices at the end of the survey. Three location indicators were compared to one another and the responses were excluded if they did not match. For instance, the state where they worked at that time in a survey response was considered a criterion to clean data. There were mainly three cases to exclude the longitude and latitude information from Qualtrics was out of the state in the response, the Qualtrics information did not match the same state of the zip code and the zip code was out of state from where they worked at the time. Additionally, traveling out of state was not identifiable, so they might be excluded from the analysis. In this process, 600 responses were excluded. Lastly, the researchers reviewed open-ended questions and removed 261 responses with noncomplying answers; for instance, participants answered a number higher than 7 for the question "On how many days a week do you walk for exercise?" After that,

five respondents who had never worked from home were excluded from the analysis. As a result, a total of 648 responses were used for the analysis.

### 3.2 Participants

Among a total of 648 respondents, 51% were male and 49% were female. The age was distributed into 25–34 years old (39.04%), 35–44 years old (29.47%), 45–54 years old (16.36%), 55–64 years old (10.80%), 18–24 years old (2.62%) and 65 years old or older (1.69%). Most of the respondents (95.83%) were full-time workers. Management levels accounted for over 50% of positions, while the other positions were less than 10%, except trained professionals (16.05%). For company size, the largest number of participants were in a company with 100–499 employees (31.64%), followed by 25–99 (17.90%), 500–999 (16.51%), 5,000 or more (13.42%), 1,000–4,999 (8.18%), 10–24 (7.41%) and fewer than 10 (4.94%). Table 1 shows a summary of the demographic distribution.

| Variable | $N$ (%) |
| --- | --- |
| *Gender* | |
| Male | 331 (51.08%) |
| Female | 317 (48.92%) |
| *Age* | |
| 18–24 years old | 17 (2.62%) |
| 25–34 years old | 253 (39.04%) |
| 35–44 years old | 191 (29.47%) |
| 45–54 years old | 106 (16.36%) |
| 55–64 years old | 70 (10.80%) |
| 65 years old or older | 11 (1.69%) |
| *Current employee status* | |
| Full-time | 621 (95.83%) |
| Part-time | 20 (3.09%) |
| Self-employed | 6 (0.09%) |
| Unemployed | 1 (0.15%) |
| *Position* | |
| Upper management | 53 (8.18%) |
| Middle management | 237 (36.57%) |
| Junior management | 82 (12.65%) |
| Administrative staff | 95 (14.66%) |
| Support staff | 49 (7.56%) |
| Trained professional | 104 (16.05%) |
| Skilled laborer | 11 (1.70%) |
| Consultant | 9 (1.39%) |
| Researcher | 6 (0.93%) |
| Other | 2 (0.31%) |
| *Company employee* | |
| Fewer than 10 | 32 (4.94%) |
| 10–24 | 48 (7.41%) |
| 25–99 | 116 (17.90%) |
| 100–499 | 205 (31.64%) |
| 500–999 | 107 (16.51%) |
| 1,000–4,999 | 53 (8.18%) |
| 5,000 or more | 87 (13.42%) |

**Table 1.**
Demographic information ($n$ = 648)

*3.3 Survey*

The survey addressed flexibility, the work environment at home, support from the company, family situation and outcomes of working from home.

*Flexibility* was asked using Hill *et al.'s* (2008) four aspects in five questions: work schedule, work hours, personal and family responsibility and work locations. Each flexibility was evaluated before and during COVID-19. They were measured using a five-point Likert scale (1: Not at all, 5: Completely).

*The work environment at home* was measured in seven questions. Firstly, work environment conditions at home were evaluated using a five-point Likert scale (1: Very dissatisfied, 5: Very satisfied). There were seven items measuring work environment conditions at home: an opportunity to concentrate at work, freedom from distraction, visual privacy, acoustic privacy, overall noise level, ergonomic quality of furniture and telecommunication/Internet quality. The work location at home was also asked using a multiple choice of a basement, study room or separate home office, bedroom, living room, kitchen/dining area and others. The last two questions asked if the participants:

*Q1.* Had a separate room specifically for working from home?

*Q2.* Shared the work area at home with others on a binary scale (yes, no).

*Support from the company* was asked with a multiple-choice question, asking to choose all applicable choices. The options were technology (providing devices, application utilization and technical support), financial support in addition to paychecks, instruction for setting up the workplace at home, instruction for work patterns, mental health management (Baker *et al.*, 2007), ergonomic chair and equipment, sit-to-stand (height-adjustable) desk (Janneck *et al.*, 2018), none and others.

For *family and living situations*, the question asked if the participants lived by themselves, with other adults/spouse/domestic partners, or with children. The participants were asked to choose all applicable choices and fill out the number of children and their ages.

*Perceived productivity* was assessed with six questions on a five-point Likert scale (1: Very low, 5: Very high). The questions included:

(1) overall productivity;
(2) productivity of focused individual work;
(3) productivity of routine work (i.e. checking and replying to emails);
(4) productivity of a two-person online meeting;
(5) productivity of an online meeting with 3–8 people; and
(6) productivity of an online meeting with nine or more people.

These six questions asked the participants to report their perceived productivity before and during COVID-19.

*Satisfaction* was evaluated with one question, "Please evaluate the outcomes of your work before and after the COVID-19 outbreak - Satisfaction with working-from-home," on a five-point Likert scale (1: Very low, 5: Very high). A single-item measure is commonly used for assessing overall satisfaction because multiple-item measures sometimes may ignore some important aspects or include unimportant aspects, leading to misconclusion (Scarpello and Campbell, 1983). In addition, many studies verified that a single-item measure is appropriate to measure satisfaction (Cheung and Lucas, 2014; Nagy, 2002). Therefore, this

study used a single-item measure for satisfaction and satisfaction with working from home was measured both before and during the COVID-19 situation.

*Work-life balance* was measured before and during the COVID-19 pandemic with two questions:

(1) balance of physical boundaries between workplace and home; and

(2) work-life balance.

A five-point Likert scale (1: Very low, 5: Very high) was used for these questions.

*Environmental supports for activities* included 12 types of activity:

(1) having a sensitive/confidential discussion with one other person;

(2) having formal or planned meetings;

(3) work meetings with several colleagues;

(4) socializing with colleagues;

(5) teleconferencing (audio only);

(6) teleconferencing (both audio and video);

(7) making and receiving phone calls;

(8) highly focused work;

(9) routine work (i.e. checking and replying to emails);

(10) getting trained;

(11) training others; and

(12) refreshment, eating and drinking.

The types were adopted from Chacon Vega *et al.'s* (2020) Workplace Activity Questionnaire (WAQ) and revised corresponding to a working-from-home situation: this study excluded "greeting visitors" and "storing belongings and filing," separated "teleconferencing and videoconferencing" into "teleconferencing (audio only)" and "teleconferencing (both audio and video)," changed "training in the workplace" to "getting trained" and "training others" and added "routine work." The questions asked the satisfaction level with the company and home office for each activity using a five-point Likert scale (1: Very low, 5: Very high).

*3.4 Statistical analysis*
Statistical analyses were performed using R studio. Before running analyses, some categorical variables were merged to avoid possible loss of statistical power if the cell size was fewer than 10% of the total sample size. For instance, employment status categories other than full-time (i.e. part-time, self-employed and unemployed) were merged. Also, the small company size (i.e. less than 10 and 10–24) and the large size (i.e. 1,000–4,999 and 5,000 or more) were combined, respectively. The positions were recategorized into managerial positions (upper, middle and junior management) and others.

The comparisons of flexibility and the outcomes (productivity, satisfaction with working from home and work-life balance) between before and during the COVID-19 pandemic were conducted using a paired *t*-test, including *H1*. As this study aims to draw a general understanding of the impacts of working from home during COVID-19 on perceived productivity and satisfaction with working from home, *H2–H5* were tested with a hierarchical regression method. The dependent variables were perceived productivity, satisfaction and work-life balance during the pandemic. For the dependent variables, internal consistency was examined by Cronbach's alpha, where the value was higher than

0.70. The assumptions of linearity, homoscedasticity, independence and normality were checked and not violated. The categorical variables were converted into dummy codes. In the base model (Model 1), this study controlled several variables of gender, age, current employment status, position and company size to control possible influences. In the next model (Model 2), independent variables of flexibility, work environments and family situation (living with children and interruption by other members in the house) were entered to determine the effect of each variable in the model. Model 2 tested one independent variable at a time to examine its unique contribution to the amount of variance of the dependent variables explained. The change in adjusted $R^2$ was provided to explain the amount of variance changed by the variables and increments to $R^2$ ($\Delta R^2$ F) were tested using ANOVA to examine the significance of adding an independent variable compared to the base model (Model 1).

## 4. Results

### 4.1 Descriptive analysis: overall experience of working from home

Over 70% of the respondents had either partially or entirely worked from home *before* COVID-19. Since the COVID-19 outbreak, all respondents included in the analyses have ever worked from home and 90.59% of the respondents were working from home because of COVID-19 when they responded to this survey. Workplace flexibility significantly increased after the COVID-19 outbreak; change in work schedule flexibility was the biggest (d = −0.403, t = −9.042, $p < 0.05$), followed by flexible work hours (d = −0.397, t = −8.584, $p < 0.05$), worksite locations (d = −0.395, t = −7.587, $p < 0.05$) and personal and family responsibility (d = −0.284, t = −6.760, $p < 0.05$) (Table 2).

In their home, 70.22% of workers had a separate space specifically for working from home. About 43% of workers shared their work area at home with others. Workers used a study room or home office (38.73%), bedroom (25.46%), living room (20.99%), kitchen and dining area (7.72%), basement (6.33%) or others (0.77%) as their regular work location in their home. Others (0.77%) included a backyard, a den, an extra bedroom, a garage, a kids' playroom and a loft. In terms of devices, the respondents used laptops the most (82.41%), followed by a desktop (64.51%), smartphone (29.94%) and tablet (10.19%) for work in a total of 1,035 multiple responses. Other respondents (1.70%) used other technologies, such as an additional monitor, headset and webcam, office phone, printer and mini-PC. For the family situation, over a quarter of the respondents (26.85%) lived with children. The results of the descriptive analysis are shown in Table 3.

### 4.2 Productivity, satisfaction with working from home and work-life balance before and during the pandemic

Work outcomes were measured in terms of productivity, satisfaction and work-life balance, showing enough internal consistency by the range of Cronbach's alpha between 0.71 and 0.78 (Table 4). Overall productivity (d = 0.147, t = 3.664, $p < 0.05$), productivity of focused individual work (d = 0.099, t = 2.457, $p < 0.05$) and productivity of routine work (d = 0.088,

| Flexibility | Before | During | Difference | t value |
|---|---|---|---|---|
| Work schedule | 2.998 (1.236) | 3.401 (1.150) | −0.403 | −9.042* |
| Work hours | 2.912 (1.290) | 3.309 (1.216) | −0.397 | −8.584* |
| Personal responsibility | 3.332 (1.122) | 3.616 (1.065) | −0.284 | −6.760* |
| Worksite locations | 2.705 (1.429) | 3.100 (1.407) | −0.395 | −7.587* |

Table 2.
Result of changes in
flexibility

| Variable | N (%) | Mean (sd) |
|---|---|---|
| *Home environment for work* | | |
| *Ability to concentrate at work* | | 3.745 (0.977) |
| *Freedom from distraction* | | 3.657 (1.075) |
| *Visual privacy* | | 3.986 (0.967) |
| *Acoustic privacy* | | 3.816 (1.060) |
| *Overall noise level* | | 3.818 (1.042) |
| *Ergonomic quality of furniture* | | 3.571 (1.066) |
| *Telecommunication/Internet quality* | | 3.906 (0.966) |
| Having a separate room for work [a] | 455 (70.22%) | |
| Sharing a workspace[a] | 277 (42.75%) | |
| *Supports from the company*[a] | | |
| Technology | 362 (55.86%) | |
| Financial support | 135 (20.83%) | |
| Instruction for workplace setups | 223 (34.41%) | |
| Instruction for work patterns | 184 (28.40%) | |
| Mental health management | 126 (19.44%) | |
| Ergonomic chair and equipment | 60 (9.26%) | |
| Sit-to-stand desk | 30 (4.63%) | |
| None | 70 (10.80%) | |
| *Family situation* | | |
| Living with children[a] | 174 (26.85%) | |
| Interruption by other members in the house | | 2.941 (1.338) |

**Note:** [a]Binary variable (1: yes, 0: no)

**Table 3.**
Descriptive analysis
($n = 648$)

t = 2.255, $p < 0.05$) decreased significantly during the pandemic. On the contrary, workers were more satisfied with working from home during the pandemic than before COVID-19 (d = −0.500, $t = −8.320$, $p < 0.05$). At the same time, the balance of physical boundaries between workplace and home decreased during the pandemic (d = 0.130, t = 2.223, $p < 0.05$), but the perceived work-life balance increased (d = −0.128, $t = −2.270$, $p < 0.05$). The results supported *H1a–1c*.

The regression results on the productivity during the pandemic with temporal and spatial flexibility, work environments and family situations are shown in Table 5. The control variables, including gender, age, employment status, company size, the number of working hours and position, explained only 1.0% of the variance of productivity. The productivity during the pandemic (range between 6 and 30) was positively associated with flexibility in the work schedule (B = 1.022, $\Delta R^2 = 6.0\%$), work hours (B = 0.971, $\Delta R^2 = 5.9\%$), personal responsibility (B = 1.044, $\Delta R^2 = 5.5\%$) and worksite locations (B = 0.636, $\Delta R^2 = 3.3\%$), supporting *H2a*. Next, the quality of work environment conditions at home showed a significant association with perceived productivity. The models with environmental conditions explain from 1.7% to 28.9% of variances of the perceived productivity, supporting *H3a*. Having a separate room for work was positively related to productivity (B = 1.718, $\Delta R^2 = 2.6\%$), while sharing a workplace with others had a negative relationship with productivity (B = −0.865, $\Delta R^2 = 0.7\%$). For the company's supports, instruction for work patterns (B = 0.832, $\Delta R^2 = 0.6\%$) and an ergonomic chair and equipment (B = 1.496, $\Delta R^2 = 0.8\%$) were associated with productivity, partially supporting *H4a*. Lastly, the family situation was not associated with productivity during the pandemic. Therefore, *H5a* was rejected.

| Outcomes | Items | Before (mean (sd)) | During (mean (sd)) | Mean difference | t value | Note* |
|---|---|---|---|---|---|---|
| Productivity | Overall productivity | 3.858 (0.860) | 3.711 (1.005) | 0.147 | 3.664* | Min = 6 |
| | Productivity of focused individual work | 3.846 (0.894) | 3.749 (0.981) | 0.099 | 2.457* | Max = 30 |
| | Productivity of routine work (i.e. checking and replying to email) | 3.897 (0.883) | 3.809 (1.004) | 0.088 | 2.255* | Mean = 21.847 |
| | Productivity of a two-person online meeting | 3.685 (0.988) | 3.634 (1.013) | 0.051 | 1.172 | Sd = 4.723 |
| | Productivity of an online meeting with 3–8 people | 3.509 (1.055) | 3.506 (1.072) | 0.003 | 0.067 | Cronbach's alpha = 0.71 |
| | Productivity of an online meeting with 9 or more people | 3.427 (1.110) | 3.440 (1.157) | −0.012 | −0.267 | |
| Satisfaction | Satisfaction with working from home | 3.302 (1.318) | 3.802 (1.124) | −0.500 | −8.320* | Min = 1 Max = 5 |
| Work–life balance | Balance of physical boundaries between workplace and home | 3.656 (1.075) | 3.526 (1.199) | 0.130 | 2.223* | Min = 2 |
| | Work–life balance | 3.611 (1.013) | 3.739 (1.136) | −0.128 | −2.270* | Max = 10 Mean = 7.265 Sd = 2.119 Cronbach's alpha = 0.78 |

**Notes:** *For analyses, the outcomes after COVID-19 were used. The information under the note is based on the responses after COVID-19

Table 4.
Mean difference of
work outcomes
between before and
during the pandemic
($n$ = 648)

| Independent variable | B | Adjusted $R^2$ | Changed $R^2$ | Model F | $\Delta R^2$ F |
|---|---|---|---|---|---|
| Model 1: Baseline | | 0.010 | – | 1.514 | – |
| Model 2 | | | | | |
| *Flexibility* | | | | | |
| Work schedule** | 1.022* | 0.071 | 0.060 | 4.273* | 41.528* |
| Work hours** | 0.971* | 0.070 | 0.059 | 4.262* | 41.380* |
| Personal responsibility** | 1.044* | 0.065 | 0.055 | 4.014* | 37.777* |
| Worksite locations** | 0.636* | 0.043 | 0.033 | 2.932* | 22.067* |
| *Home environmental condition* | | | | | |
| Ability to concentrate at work** | 2.581* | 0.289 | 0.272 | 18.490* | 247.881* |
| Freedom from distraction** | 2.103* | 0.236 | 0.221 | 14.320* | 187.411* |
| Visual privacy** | 2.040* | 0.182 | 0.169 | 10.610* | 133.477* |
| Overall noise level** | 1.857* | 0.181 | 0.167 | 10.510* | 131.994* |
| Ergonomic quality of furniture** | 1.928* | 0.183 | 0.169 | 10.660* | 134.179* |
| Telecommunication/Internet quality** | 1.717* | 0.158 | 0.144 | 9.062* | 111.033* |
| Having a separate room for work** | 1.718* | 0.036 | 0.026 | 2.593* | 17.151* |
| Sharing a workspace** | −0.865* | 0.017 | 0.007 | 1.749* | 4.9075* |
| *Supports from company* | | | | | |
| Technology | 0.338 | 0.011 | 0.001 | 1.464 | 0.761 |
| Financial support | 0.124 | 0.010 | 0.000 | 1.416 | 0.067 |
| Instruction for workplace setups | 0.671 | 0.014 | 0.005 | 1.609 | 2.870 |
| Instruction for work patterns** | 0.832* | 0.016 | 0.006 | 1.691* | 4.068* |
| Mental health management | 0.625 | 0.012 | 0.003 | 1.528 | 1.693 |
| Ergonomic chair and equipment** | 1.496* | 0.018 | 0.008 | 1.774* | 5.265* |
| Sit-to-stand desk | −0.425 | 0.010 | 0.000 | 1.427 | 0.230 |
| *Family situation* | | | | | |
| Living with children | −0.354 | 0.011 | 0.001 | 1.458 | 0.685 |
| Interruption by others in the house | −0.184 | 0.012 | 0.002 | 1.516 | 1.519 |

**Notes:** *$p < 0.05$. **Significant model

**Table 5.**
Hierarchical regression analysis results on perceived productivity (n = 648)

Second, the respondents reported higher satisfaction with working from home when there was high flexibility, satisfaction with the home environmental condition, as well as supports of an ergonomic chair and equipment (Table 6). The model with control variables explained only 1.6% of the variances. For temporal and spatial flexibility, all independent variables were positively related to the satisfaction: the flexibility in work hours explained the largest variance (B = 0.174, $\Delta R^2$ =3.4%), followed by personal responsibility (B = 0.177, $\Delta R^2$ = 2.8%), work schedule (B = 0.166, $\Delta R^2$ = 2.8%) and work locations (B = 0.130, $\Delta R^2$ = 2.4%). Thus, *H2*b was supported. Additionally, all work environment variables showed a significant relationship with satisfaction. Specifically, the model with freedom from distraction explained 21.6% of the variances (B = 0.472, $\Delta R^2$ = 19.6%). Besides, the ability to concentrate at work had a stronger positive relationship with satisfaction (B = 0.502, $\Delta R^2$ = 18.2%) than visual privacy (B = 0.478, $\Delta R^2$ = 16.4%), ergonomic furniture quality (B = 0.422, $\Delta R^2$ = 14.3%), telecommunication/Internet quality (B = 0.369, $\Delta R^2$ = 11.8%) and overall noise level (B = 0.365, $\Delta R^2$ = 11.4%). Having a separate room for work increased satisfaction (B = 0.395, $\Delta R^2$ = 2.4%) while sharing a workspace decreased the satisfaction (B = −0.263, $\Delta R^2$ = 1.2%). Therefore, *H3*b was supported. The ergonomic chair and equipment provided by the company also showed significant, positive associations with satisfaction, explaining 0.7% of the increased variance. However, other supports had no relationship with satisfaction with working from home, partially supporting *H4*b. Living

| Independent variable | B | Adjusted $R^2$ | Changed $R^2$ | Model F | $\Delta R^2$ F |
|---|---|---|---|---|---|
| Model 1: Baseline | | 0.016 | – | 1.74* | – |
| Model 2 | | | | | |
| *Flexibility* | | | | | |
| Work schedule** | 0.166* | 0.043 | 0.028 | 2.919* | 18.736* |
| Work hours** | 0.174* | 0.049 | 0.034 | 3.215* | 23.012* |
| Personal responsibility** | 0.177* | 0.043 | 0.028 | 2.926* | 18.838* |
| Worksite locations** | 0.130* | 0.039 | 0.024 | 2.748* | 16.272* |
| *Home environmental condition* | | | | | |
| Ability to concentrate at work** | 0.502* | 0.201 | 0.182 | 11.870* | 148.013* |
| Freedom from distraction** | 0.472* | 0.216 | 0.196 | 12.880* | 162.593* |
| Visual privacy** | 0.478* | 0.182 | 0.164 | 10.610* | 129.797* |
| Overall noise level** | 0.365* | 0.132 | 0.114 | 7.530* | 85.343* |
| Ergonomic quality of furniture** | 0.422* | 0.162 | 0.143 | 9.296* | 110.842* |
| Telecommunication/Internet quality** | 0.369* | 0.135 | 0.118 | 7.746* | 88.459* |
| Having a separate room for work** | 0.395* | 0.039 | 0.024 | 2.739* | 16.132* |
| Sharing a workspace** | −0.263* | 0.027 | 0.012 | 2.184* | 8.128* |
| *Supports from company* | | | | | |
| Technology | 0.061 | 0.015 | 0.001 | 1.652 | 0.433 |
| Financial support | 0.091 | 0.015 | 0.001 | 1.667 | 0.651 |
| Instruction for workplace setups | 0.054 | 0.015 | 0.000 | 1.644 | 0.329 |
| Instruction for work patterns | 0.173 | 0.019 | 0.005 | 1.837* | 3.1094 |
| Mental health management | 0.298 | 0.025 | 0.010 | 2.099* | 6.902* |
| Ergonomic chair and equipment** | 0.340* | 0.022 | 0.007 | 1.956* | 4.832* |
| Sit-to-stand desk | −0.044 | 0.014 | 0.000 | 1.625 | 0.044 |
| *Family situation* | | | | | |
| Living with children | −0.135 | 0.017 | 0.003 | 1.745* | 1.778 |
| Interruption by others in the house** | −0.121* | 0.032 | 0.018 | 2.446* | 11.909* |

**Notes:** *$p < 0.05$. **Significant model

with children presented no association with satisfaction, but an interruption by others in the house was negatively associated with satisfaction with working from home (B = −0.121, $\Delta R^2$=1.8%), partially supporting *H5*b.

Lastly, the model on work-life balance with control variables explained only 0.4% of the variance and the work-life balance was positively associated with flexibility (Table 7); therefore, *H2c* was supported. Flexibility in worksite locations explained the largest variance of work-life balance (B = 0.456, $\Delta R^2$ =8.3%), followed by work hours (B = 0.483, $\Delta R^2$=7.3%), work schedule (B = 0.483, $\Delta R^2$ =6.6%) and personal responsibility (B = 0.394, $\Delta R^2$ =3.8%). The other factors were also related to the perceived work-life balance, such as Having a separate room for work (B = 0.953, $\Delta R^2$ =3.9%), Sharing a workspace (B = −0.357, $\Delta R^2$ =0.06%) and Living with children (B = −0.357, $\Delta R^2$ =0.8%). These results partly supported *H3d* and *H5d*.

### 4.3 Corporate office vs. home office: supporting work-related activities
The respondents reported different perceived supports for activities between the company and home offices (Table 8); therefore, *H6* was supported. They were more satisfied with home offices for teleconferencing for audio-only ($t = −3.715$, $p < 0.05$), teleconferencing for both audio and video ($t = −5.784$, $p < 0.05$) and refreshment, eating and drinking

| Independent variable | B | Adjusted $R^2$ | Changed $R^2$ | Model F | $\Delta R^2$ F |
|---|---|---|---|---|---|
| Model 1: Baseline | | 0.004 | – | 1.168 | – |
| Model 2 | | | | | |
| *Flexibility* | | | | | |
| Work schedule** | 0.483* | 0.070 | 0.066 | 4.262* | 46.407* |
| Work hours** | 0.483* | 0.077 | 0.073 | 4.617* | 51.605* |
| Personal responsibility** | 0.394* | 0.041 | 0.038 | 2.880* | 26.198* |
| Worksite locations** | 0.456* | 0.088 | 0.083 | 5.159* | 59.533* |
| Having a separate room for work** | 0.953* | 0.042 | 0.039 | 2.910* | 26.635* |
| Sharing a workspace | −0.357* | 0.009 | 0.006 | 1.372 | 4.146* |
| *Family situation* | | | | | |
| Living with children | −0.453* | 0.011 | 0.008 | 1.471 | 5.600* |
| Interruption by others in the house | −0.122 | 0.007 | 0.005 | 1.318 | 3.367 |

**Notes:** *$p < 0.05$. **Significant model

**Table 7.**
Hierarchical regression analysis results on work–life balance (n = 648)

| Activities | Company office | Home office | Difference | $t$ value |
|---|---|---|---|---|
| Having a sensitive/confidential discussion with one other person | 3.533 (1.093) | 3.502 (1.065) | 0.031 | 0.635 |
| Having formal or planned meetings | 3.789 (0.982) | 3.470 (1.076) | 0.318 | 7.349* |
| Work meetings with several colleagues | 3.804 (0.976) | 3.482 (1.090) | 0.324 | 6.995* |
| Socializing with colleagues | 3.689 (1.045) | 2.983 (1.273) | 0.713 | 12.771* |
| Teleconferencing (audio only) | 3.371 (1.205) | 3.542 (1.071) | −0.177 | −3.715* |
| Teleconferencing (both audio and video) | 3.349 (1.231) | 3.642 (1.073) | −0.295 | −5.784* |
| Making and receiving phone calls | 3.681 (1.054) | 3.672 (1.038) | 0.006 | 0.140 |
| Highly focused work | 3.746 (0.984) | 3.674 (1.007) | 0.073 | 1.531 |
| Routine work (i.e. checking and replying to emails) | 3.833 (0.942) | 3.799 (0.993) | 0.035 | 0.908 |
| Getting trained | 3.590 (1.070) | 3.113 (1.213) | 0.477 | 10.041* |
| Training others | 3.542 (1.132) | 3.018 (1.293) | 0.526 | 10.508* |
| Refreshment, eating and drinking | 3.430 (1.063) | 3.752 (1.031) | −0.324 | −6.259* |

**Note:** *$p < 0.05$

**Table 8.**
Paired t-test results of activity support between company offices and home offices

($t = -6.259$, $p < 0.05$). On the other hand, the respondents showed significantly higher satisfaction with their company offices than home offices for having formal or planned meetings (t = 7.349, $p < 0.05$), work meetings with several colleagues (t = 6.995, $p < 0.05$), socializing with colleagues (t = 12.771, $p < 0.05$), getting trained (t = 10.041, $p < 0.05$) and training others (t = 10.508, $p < 0.05$). However, there was no difference in supporting other activities, such as having a sensitive/confidential discussion, making and receiving phone calls, doing highly focused work and doing routine work, between home offices and corporate offices.

## 5. Discussion
Working from home was mostly partial and optional before the COVID-19 pandemic. However, this study was performed during the COVID-19 situation, which forced workers to work from home. As the purpose of home use is originally not for work (Ilona Kojo and Nenonen, 2015; Waizenegger *et al.*, 2020), it is difficult to change or adjust the home

environment for work in an unexpected and abrupt situation. Even though not all survey respondents entirely worked from home when they participated in this study, the results of this study are still valuable in that all of them worked from home to a certain degree during the pandemic. It enabled this study to explore the workers' perceptions of work environments during the pandemic. Considering this condition, this study found changes in productivity, satisfaction with working from home and work-life balance. The overall productivity, focused individual work productivity and routine work productivity decreased during the pandemic, supporting *H1*. This result is possibly related to the enforced situation during the pandemic without preparation for working from home for both employees and employers. Before the COVID-19 outbreak, workers who worked from home could avoid distractions in the office, including unnecessary meetings and noisy workspaces and control their work environments at home. They chose to do and maybe selectively worked from home based on their preferred schedule and housing situation, bringing more autonomy and a sense of control over their time and environments. However, the pandemic forced people to work from home and restricted their home-based work environments as all family members were at home 24/7, sharing spaces. As a result, all family members stayed together within unprepared home office environments, leading to a decrease in productivity, especially individual focused and routine work. It might have led to the loss of controllability to the home-based work environments. As a result, the ability to concentrate could be one of the most important factors for productivity during working from home. The results of this study also support the idea that the environmental comforts were associated with productivity, such as visual privacy, overall noise and freedom from distraction. Sharing the limited home space with other members could decrease productivity. Therefore, the changes in home-based office environments during the pandemic, compared to pre-COVID-19, may undermine the benefits of working from home in focused individual tasks, known as one of the benefits of working from home before the pandemic.

In contrast to productivity, satisfaction with working from home significantly increased, consistent with a previous study (Almarzooqi and Alaamer, 2020). People felt anxious being with other people during the COVID-19 pandemic (Burtscher *et al.*, 2020; Usher *et al.*, 2020; Zhang *et al.*, 2020); hence, they might be more satisfied that they did not need to be with others in their offices. The work-life balance of workers also increased. This is plausible because they had a more flexible arrangement of work time and hours (Maruyama *et al.*, 2009). Unlike the satisfaction with working from home and work-life balance, the perceived balance of physical boundaries between workplace and home significantly decreased during the pandemic because people spent most of their time in the same place and the physical boundaries of where professional, job-related activities and personal, family-related activities happen became blurry. As workers' productivity and balance of physical boundaries have decreased, it is especially important to provide proper home environments supporting workers' outcomes.

Workplace flexibility was positively associated with perceived productivity, satisfaction with working from home and the work-life balance during the pandemic, supporting *H2a–H2c*. When they worked from home, even though they partially worked from home, workers had to spend most of their time with their family or needed to do housework (Collins *et al.*, 2020). However, employees became able to freely schedule their working hours throughout the day under the lockdown situation. In this situation, workplace flexibility during the COVID-19 enabled workers to easily deal with their family situation or emergency and consequently influenced satisfaction and work-life balance during the pandemic. It was previously explained that the flexibility of time to work positively influences work-life balance by allowing employees to cope with their family needs and

other work smoothly (Illegems *et al.*, 2001). Furthermore, having the autonomy to choose when to work allows individuals to work when they are most productive, ultimately increasing productivity (Illegems *et al.*, 2001; Lim and Teo, 2000).

Overall, most of the home environments for work were positively correlated with productivity, satisfaction with working from home and work-life balance during the pandemic, partially supporting *H3*. First, all environmental conditions were positively associated with productivity and satisfaction. The result was predicted, as many studies suggested that work environments affect productivity (Arundell *et al.*, 2018; De Been and Beijer, 2014; Haapakangas *et al.*, 2018) and satisfaction (Arundell *et al.*, 2018; Bangwal and Tiwari, 2019; Kim and de Dear, 2013). Even though previous studies investigated corporate office environments, the results of this study show that the work environment at home is also important for teleworking when homes become offices.

Importantly, there were different relationships of the outcomes with having a separate room and sharing a workplace. Having a separate room for work at home was positively associated with perceived productivity during the pandemic, which might allow workers to physically and mentally separate work and personal lives and effectively get involved in their work. A separate room plays a similar role as a private office in the traditional workplace. To effectively support working from home, the home environment should be similar to workers' office environment settings (Ng, 2010). Workers who work from home by choice may decide to move to a larger house or renovate the house because extra space for work is a critical consideration for working from home (Moos and Skaburskis, 2008). A survey conducted by realtor.com found that people showed a strong interest in suburban areas and wanted specific features of larger space, quiet living areas, home offices and outdoor access (Taylor, 2020) and the need for additional space for work contributed to the pandemic-fueled housing boom.

Workers who have abruptly started working from home needed to adapt to and settle down in the changed working environments from office to home. To effectively support working from home, providing supports for building workers' own workplace is important (Ilona Kojo and Nenonen, 2015). In this study, approximately 89% of respondents received at least one type of support from the company: technology, instruction for workplace setups and work patterns, financial support, mental health management, an ergonomic chair and equipment and a sit-to-stand desk. In addition, this study found that some supports from the company were positively related to productivity and satisfaction. Likewise, office workers reported that time spent using a cellphone, laptop/desktop and television significantly increased during the COVID-19 lockdown and there was an increase in discomfort in the neck, shoulders, elbows, wrists, upper back and hips of workers during this period (Majumdar *et al.*, 2020). This study also found that receiving ergonomic furniture resulted in higher perceived productivity; however, sit-to-stand desks provided by companies were not related to workers' outcomes. A similar outcome was found in another study; sit-to-stand desks for work were not associated with call center employees' productivity (Chau *et al.*, 2016).

Unlike ergonomic furniture, none of the outcomes, such as productivity and satisfaction, were associated with technical support from the company, notwithstanding that many studies have emphasized the importance of technical support for working from home for improving employee satisfaction (Baker *et al.*, 2007; Baruch, 2001; Clear and Dickson, 2005; Sánchez *et al.*, 2007). Nevertheless, more than half of the respondents in this study received technical support from the company. A possible reason for this is that the home environments of workers were already equipped enough to perform work because they partially or entirely worked from home before the COVID-19 pandemic, given that about

70% of the respondents of this study had a working-from-home experience before the pandemic. In addition, studies pointing out the importance of technical support were published in the 2000s, so the technical infrastructure for working from home at that time might have been worse or more expensive than now.

A study by Fox and Anderson (2020) indicated the difficulty to finish work because of increased childcare responsibilities simultaneously coping with work-related tasks. However, in this study, children did not show a significant impact on workers' productivity, rejecting 5a and 5c. There is reason to believe that the different results were due to the different survey periods. The survey by Fox and Anderson (2020) was conducted during spring 2020 when the outbreak was announced and the pandemic enforced working from home was in its initial stage, whereas the survey of this study was conducted during fall 2020. Some states in the USA started to reopen daycare centers and preschools in April and May 2020 (The Hunt Institute, 2021) and 47% of children returned to childcare centers in June 2020 compared with early March (Procare, 2020). Although the productivity was not related to the family situation, satisfaction with working from home was negatively associated with 'Interruption by others in the house.' The pandemic enforced working from home situation put all family members together, caused vague physical boundaries between work and home and consequently, decreased satisfaction with working from home experience.

Another interesting finding of this study was that workers reported different satisfaction with home offices vs. corporate offices depending on the types of work-related activities. For example, a significant difference in satisfaction was found in teleconferencing, showing the lowest satisfaction in corporate offices. This is possibly because workers sometimes had difficulty finding an adequately equipped space with technology for teleconferencing in their office buildings (Chacon Vega et al., 2020). Evidently, there was also a preference for home offices for refreshment. However, in contrast to previous studies suggesting that home environments effectively support tasks requiring high concentration without distraction (Basile and Beauregard, 2016; Bloom et al., 2015), the respondents in this study reported similar satisfaction with high-concentration tasks in both home and corporate offices. A plausible reason for this result is that family members are together all the time at home and noise control is more difficult than when working from home is optional (Fox and Anderson, 2020). Corporate offices were significantly preferred for formal meetings, work meetings with several colleagues, socializing, getting trained and training others. These results align with concerns discussed in previous studies; professional and social isolation was a critical concern when implementing teleworking because of reduced interactions between coworkers (Baker et al., 2007; Illegems et al., 2001). Waizenegger et al. (2020) found, in interviews with knowledge workers, that virtual communication channels sometimes hindered quick and instant communication among workers and made knowledge sharing difficult. The study carried out by Bao et al. (2020) also reported the difficulty of working from home on large projects requiring more collaboration and communication than small projects. Therefore, the results of this study infer the need for corporate offices to interact with colleagues for knowledge sharing, especially from tacit knowledge to explicit knowledge for organizational knowledge creation.

There are limitations of this research to be pointed out. First, the representativity of MTurk users has been actively discussed in the literature and it is argued that the population of MTurk is not identical to the distribution of the US population (Huff and Tingley, 2015; Ross et al., 2010). Furthermore, opinions from non-MTurk users were not considered in this study. Therefore, further examination using other US population groups is required to generalize the results of this study. Another limitation is that the survey

questions about working before the COVID-19 pandemic asked respondents to recall their memory of work experience, so there is a possibility of biased responses. Finally, this study did not consider how long the workers worked from home, which might influence workers' perceptions differently.

## 6. Conclusion

The pandemic-enforced working-from-home arrangements since March 2020 have been an unprecedented challenge for workers, whether they had fully or partially worked from home before. This also highlights the strong interdependence between home and work environments. Activities that usually take place outside the home now occur mostly at home and home environments need to be shared by other household members for a wide range of activities. At the same time, corporate physical workplaces, support for working from home and workplace policies related to workplace flexibility have to respond to the changes in work arrangements.

To summarize, the key findings of this study are that:

- overall productivity, the productivity of focused individual work, the productivity of routine work and the balance of physical boundaries between work and home have decreased during the COVID-19, whereas the work-life balance has increased;
- workplace flexibility, indoor environmental conditions of home offices and organizational supports for working from home are positively associated with perceived productivity and satisfaction and work-life balance;
- living with children was not associated with any work outcomes; and
- work activities involving collaboration, socialization and training are better supported at corporate offices.

The results of this study highlight the importance of home-based work environments (i.e. having a separate room) and organizational supports (i.e. ergonomic chairs and equipment, mental health management) for working-from-home arrangements. The results also reveal which activities are supported better at corporate offices vs home-based offices, which implies that the future of corporate offices should focus on collaboration, socializing and training for space design and planning. While the strict traditional view of "showing up" at the office from Monday through Friday is likely on the decline, the results of this study highlight the importance of the workplace in the ecosystem of our lives, showing the strong interdependence of home and work environments; the workplace flexibility and related policies affect more than just work and home environments affect more than just living.

At the same time, the hybrid workplace with flexibility can be introduced post-COVID, as some activities are not significantly affected by the work location, either at home-based offices or corporate offices and some activities are better supported at corporate offices than home-based offices and vice versa. One of the suggested future research directions is the hybrid workplace; finding the optimal composition of the number of days working at home offices vs corporate offices and the types of tasks to be more effectively done at home offices vs corporate offices, team dynamics and knowledge sharing, the level of employees' autonomy at work to determine their own workplace flexibility yet giving some level of predictability to corporate real estate directors. Based on the positives and negatives of teleworking, finding a balance between organizational management and workplace flexibility is important to maximize the benefits for both employees and employers (Morgan, 2004). Employers' over-control of work activities is not sustainable to maintain employees'

high productivity and job satisfaction. On the other hand, poor management that fails to provide appropriate directions and leadership may negatively affect productivity among employees.

It is expected that corporate real estate directors may face the difficulty of predicting the average number of people showing up in the physical offices and peak space use when employees have more freedom to work anywhere, anytime and at varying durations, even post-COVID. Especially, many workers tend to choose to work from home on Mondays and Fridays, which may result in over-crowding in mid-week (Bloom, 2021). With the industry collaboration, future research of relatively large sample sizes and study sites, investigating workers' needs and adapted patterns of use of corporate and home-based offices, will help corporate real estate managers make decisions and provide some level of standardization of spatial efficiency and configurations of corporate offices as well as essential supports for home offices.

Lastly, it should be noted that undesirable home-based office environments, such as not having a separate room for work at home, are negatively related to work outcomes. This gives another stream for future research. As the interdependence between the workplace and home becomes stronger, future research should address whether the impact of social equity in the workplace on individual and family vitality becomes more significant. This future research can help individuals find their optimal integration of work and life. In this sense, the proper mixture of the hybrid workplace and flexible and supportive workplace policies would benefit individuals with varying work environments at home as well as organizations with increased workplace agility, flexibility and resiliency, corresponding to the changes in workplace demands.

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**Appendix. Survey**
Employee experience of working-from-home and the new role of the workplace in post-COVID-19
*Section 1. General questions about your work*

(1) Have you worked at home at all because of COVID-19? Y/N
(2) Are you currently working from home because of COVID-19? Y/N
(3) Before the COVID-19 (before March 2020), how many hours did you work from home a week?
(4) After the outbreak of COVID-19, did your company provide any support for working from home? Please select all applicable choices:
   • Technology (providing devices, application utilization, technical support, etc.)
   • Financial support in addition to paychecks
   • Instruction for setting up the workplace at home
   • Instruction for work patterns
   • Mental health management
   • Ergonomic chair and equipment
   • Sit-to-stand (height-adjustable) desk
   • None
   • Others (Please specify)

*Section 2. Your work environment at home*

(1) Do you have a separate room specifically for working from home? (Y/N)
(2) Do you share your work area at home with others? (Y/N)
(3) Where is your regular work location in your house?
   • Basement
   • Study room or separate home office
   • Bedroom
   • Livingroom
   • Kitchen, dining area
   • Others (Please specify)

*Section 3. Perceived work environment at home*
Please evaluate your work environment conditions at home.

| Work environment | Very dissatisfied | Dissatisfied | Moderate | Satisfied | Very satisfied |
|---|---|---|---|---|---|
| Ability to concentrate at work | | | | | |
| Freedom from distraction | | | | | |
| Visual privacy | | | | | |
| Acoustic privacy | | | | | |
| Overall noise level | | | | | |
| Ergonomic quality of furniture | | | | | |
| Telecommunication/ internet quality | | | | | |

Please evaluate the level of workplace flexibility with the following statements before and after the COVID-19 outbreak.

| Activity | | Not at all | A little | Moderate | Mostly | Completely |
|---|---|---|---|---|---|---|
| Options in work schedules (the beginning and ending times, either occasionally or frequently) | Before After | | | | | |
| Options in work hours (e.g. reduced work hours, flexible work hours) | Before After | | | | | |
| Options for managing unexpected personal and family responsibilities | Before After | | | | | |
| Options for selecting worksite locations (if your employer has more than a single worksite) | Before After | | | | | |

*Section 4. Satisfaction and performance of your work*
Please evaluate the outcomes of your work before and after the COVID-19 outbreak.

| Outcomes | | Very low | Fairly low | Moderate | Fairly high | Very high |
|---|---|---|---|---|---|---|
| Overall productivity | Before After | | | | | |
| Productivity of focused individual work | Before After | | | | | |
| Productivity of routine work (i.e. checking and replying to email) | Before After | | | | | |
| Productivity of a two-person online meeting, including yourself | Before After | | | | | |
| Productivity of an online meeting with 3–8 people, including yourself | Before After | | | | | |
| Productivity of an online meeting with 9 or more people, including yourself | Before After | | | | | |
| Satisfaction with working-from-home | Before After | | | | | |
| Balance of physical boundaries between workplace and home | Before After | | | | | |
| Work-life balance | Before After | | | | | |

*Section 5. Key work activities at home vs at work*
Please evaluate your perceived support when you work from home vs work in your company office
for each activity.

| Activity | | Very low | Fairly low | Moderate | Fairly high | Very high |
|---|---|---|---|---|---|---|
| Having a sensitive/ confidential discussion with one other person | Home office | | | | | |
| | Company office | | | | | |
| Having formal or planned meetings | Home office | | | | | |
| | Company office | | | | | |
| Work meetings with several colleagues | Home office | | | | | |
| | Company office | | | | | |
| Socializing with colleagues | Home office | | | | | |
| | Company office | | | | | |
| Teleconferencing (audio only) | Home office | | | | | |
| | Company office | | | | | |
| Teleconferencing (both audio and video) | Home office | | | | | |
| | Company office | | | | | |
| Making and receiving phone calls | Home office | | | | | |
| | Company office | | | | | |
| Highly focused work | Home office | | | | | |
| | Company office | | | | | |
| Routine work (i.e. checking and replying emails) | Home office | | | | | |
| | Company office | | | | | |
| Getting trained | Home office | | | | | |
| | Company office | | | | | |
| Training others | Home office | | | | | |
| | Company office | | | | | |
| Refreshment, eating and drinking | Home office | | | | | |
| | Company office | | | | | |

*Section 6. Personal information*
(1) What is your gender?
   a. Male; b. Female; c. Prefer not to answer; d. Other (please specify)

(2) What is your age?
   a. 18–24 years old; b. 25–34 years old; c. 35–44 years old; d. 45–54 years old; e. 55–64 years old; f. 65–74 years old; g. 75 years or older

(3) Do you live with other people? If yes, please choose all applicable choices.
   a. No, live alone; b. Spouse/domestic partner; c. Parent(s); d. Children (the number of children and their ages); e. Other family members (the number of other family members); f. Roommates (the number of roommates)

(4) What is your current employment status?
   a. Full-time; b. Part-time; c. Self-employed; d. Unemployed

(5) What is your job position?
   a. Upper Management; b. Middle management; c. Junior management; d. Administrative staff; e. Support staff; f. Trained professional; g. Skilled laborer; h. Consultant; i. Researcher; j. Other (please specify)

(6) What is the total number of employees in your company?

a. Less than 10; b. 10 – 24; c. 25 – 99; d. 100 – 499; e. 500 – 999 l; f. 1,000 – 4,999; g. 5,000 or more; h. Don't know

(7) In what state or the US territory do you currently work? (Select from the dropdown of the US states and provide zip codes)

(8) Where is your home located?

a. Urban area; b. Suburban; c. Commuter towns; d. Rural

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