

# The influence of the physical home work environment on perceived productivity during the COVID-19 pandemic

Monique H. Arkesteijn<sup>1</sup>, Sylvia J.T. Jansen<sup>1</sup>, Bernice B.T. Kieft<sup>1</sup>, Rianne A.J.A. Appel-Meulenbroek<sup>2</sup>, Bartele S. Hoekstra<sup>3</sup>, and Pity Jongens-van der Schaaf<sup>4</sup>

## ABSTRACT

**Background and aim** – Due to the COVID-19 crisis, Dutch employees were told to work from home as much as possible. Homeworking can have benefits both for employees and employers, as some experience a productivity increase and a better work-life balance. However, it is also harder for employers to measure and monitor employees' performance and for the employee it can cause social and professional isolation. Previous research studied homeworking from a voluntarily perspective assuming that the home work environment was suitable to conduct homeworking. Little is known about the experience of 'obliged' home working. In this research, the suitability of the home work environment is examined by looking at the relationship of physical aspects of the home work environment with perceived individual productivity.

### Citation:

Arkesteijn, M.H., Jansen, S.J.T., Kieft, B.T., Appel-Meulenbroek, R.A.J.A., Hoekstra, B.S. and Jongens-van der Schaaf, P. (2021) The influence of the physical home work environment on perceived productivity during the COVID-19 pandemic. *The proceedings of the 20<sup>th</sup> EuroFM Research Symposium 2021*, European Facility Management Network, 16-17 June 2021, online conference.

**Methods / Methodology** – For this research the data at from an existing dataset (N = 36,102) was used, gathered by the research project "We Work from Home (WWH)". Data was collected, on a weekly basis, from Dutch office workers in (mainly) public organizations from April till December 2020. The following aspects were examined with regard to the room people used for their working activities: (1) the original function, (2) private vs shared use, (3) size, (4) ambient factors, and (5) outside view. Perceived individual productivity was measured on a ten-point scale. In this research descriptive and bivariate analyses (independent samples t-test or one-way anova) were conducted.

**Results** – Results showed that respondents who worked in a work room at home reported higher productivity (mean = 7.84, std. = 1.18) than respondents that worked in different types of rooms, especially those in the bedroom (mean = 7.45, std. = 1.38). In addition, respondents that did not have to share their workspace (mean = 7.83, std. = 1.19) reported higher productivity than those that (partly) did (mean shared = 7.57, std. = 1.34; mean both shared and private use = 7.52, std. = 1.34). Also, a higher productivity was found for respondents that indicated having ambient factors in their home work environment, like plants, art, and colour, and to have an outside view from their workplace.

**Originality (if applicable)** – The mass experiment of obliged homeworking provided a unique opportunity to study the relationship between physical aspects of the home work environment and perceived individual productivity.

**Practical or social implications** – It is expected that after the pandemic, employees will work from home more often than before. The ultimate goal of this study was to provide organisations and homeworkers with guidelines that can help them to enhance a suitable home work environment.

**Type of paper** – Research paper

**KEYWORDS:** Teleworking; Homeworking; Productivity; Home work environment; COVID-19

## INTRODUCTION

Homeworking, also known as teleworking, is a phenomenon that has been studied since the 1980s.

<sup>1</sup> Delft University of Technology, Faculty of Architecture and the Built Environment, Department of Management in the Built Environment, m.h.arkesteijn@tudelft.nl

<sup>2</sup> Eindhoven, University of Technology, Department of the Built Environment, Real Estate Management & Development

<sup>3</sup> Center for People and Building

<sup>4</sup> Aestate / Ontrafelexperts

It was predicted that, partly due to the rise of information and communication technologies (ICTs), homeworking arrangements for employees would be implemented by many organizations. Especially so, because such research showed an expected increase in productivity of their employees; an essential benefit from an organizational perspective (Bloom et al., 2015). However, throughout the years homeworking arrangements were adopted less than predicted (Martin & MacDonnell, 2012), probably because it is harder for managers to monitor and measure the performance of their employees (Martin & MacDonnell, 2012; Steward, 2000). Furthermore, teleworking was also shown to potentially cause social or professional isolation because of less informal interaction with colleagues, and lower the career prospects of homeworkers as they are not seen (as often) at the office (Nakrošienė et al., 2019).

During the COVID-19 crisis, (Dutch) employees were suddenly told to work from home as much as possible, providing a unique opportunity to study the experiences of employees during this mass homeworking period. While homeworking influenced productivity of employees positively before COVID-19 (Bloom et al., 2015), recent research during COVID-19 showed various results (Mihai et al., 2020; Moretti et al., 2020; Toscano & Zappalà, 2020). In addition, not every home work environment is equally suitable for working from home. Employees do not always have a separate working room available and/or lack proper ICT facilities. Hence, the aim of this research was to determine what aspects of the physical home work environment influenced employees' productivity during this period.

## LITERATURE STUDY

The emphasis in this study was on the productivity of knowledge workers in relation to their personal and home workplace characteristics. Because actual productivity is difficult to quantify (there are multiple ways of executing knowledge work and the outcomes of knowledge workers are mostly not comparable (Frankema, 2003)), we followed others in measuring perceived individual productivity instead (e.g. Bosch-Sijtsema et al., 2009). Throughout the years, research has shown that homeworking increases perceived productivity (Bloom et al., 2015; Giovanis, 2018; Martin & MacDonnell, 2012). However, homeworking is mostly studied as a phenomenon in itself, which means that no specific elements of homeworking were studied more in detail. An exception is Hoornweg et al. (2016), who discuss the impact that telework intensity (the number of hours working from home compared to total work hours) can have on productivity. When telework intensity is high (more than 8 hours per week), it was found that productivity decreased (Hoornweg et al., 2016). As the homemaker during COVID-19 is likely to work at home all the time, the telework intensity is very high. This implies that the productivity of the homemaker during COVID-19 might have decreased instead of increased. However, recent research on homeworking and productivity during COVID-19 showed various results. According to Moretti et al. (2020) respondents were less productive, although less stressed. On the contrary, Toscano and Zappalà (2020) record a high level of strain and, because of that, low productivity, whereas Mihai et al. (2020) showed higher productivity during COVID-19.

So far, studies on office employees' productivity focused on the office environment, such as the literature study by de Croon et al. (2005), instead of the home work environment. An exception is Ng (2010) who adjusted the conceptual framework of de Croon et al. (2005) to fit into the context of the home work environment. However, Ng (2010) did not study the effect that specific aspects of the home work environment have on productivity. A recent study by Nakrošienė et al. (2019) showed that the overall suitability of the working place at home has a positive effect on productivity, but the effect of specific aspects of the home are not addressed yet either.

So, a selection of relevant workplace design aspects must be drawn from office literature. According to de Croon et al. (2005), aspects of the office work environment that influence employee performance can be categorized by (1) office location, (2) office lay-out, and (3) office use. For the office location, a distinction is made between the conventional office and the telework office (this includes remote offices as well as the homework office) (de Croon et al., 2005). In the case of the COVID-19 situation, the office location is (mostly) the homework office, here referred to as home. The lay-out and use means whether the office uses an open plan or cellular offices, and if the workplaces are fixed or shared (de

Croon et al., 2005). The office lay-out in the home work environment can be interpreted as whether the room is used as a separate office or whether the employee works in a room with a different function (Ng, 2010), such as a living room or a bedroom, and should also include the size of this room. The office use means whether the room is shared or not. Usually, homeworkers prefer a private office, especially because of distraction issues (Ng, 2010). The current study looks at the function of the room (office layout) and whether the workplace is shared or used privately (office use).

Haynes (2008) found that besides a layout and use component (called behaviour by Haynes), there is also a component comfort of the physical environment that influences employees' productivity. He distinguished the indoor climate, such as temperature and ventilation, the lighting, both natural and artificial, décor, cleanliness, physical security, and the overall comfort. In addition to these attributes, the spatial requirements found by Ng (2010) are other ambient factors, such as the view from a workplace.

## RESEARCH METHODOLOGY

This study is part of a Dutch research project called 'We Work from home' (WWH). WWH is a collaboration between the knowledge center 'Center for People and Buildings' (CfPB), consulting firm Aestate/Ontrafelexperts, Eindhoven University of Technology, and Delft University of Technology. The aim of the WWH project is to collect experiences with and insights in mass and obliged homeworking, to firstly offer organizations and employees practical tools on how to work from home, now and in the future, and secondly provide insights into starting points for policy and management after COVID-19. To gather the necessary data, weekly surveys were conducted over a period of nine weeks. For this short paper the data from the second week, with questions on the physical home work environment and productivity, was used (N = 36,102). Respondents with missing answers on at least one of the socio-demographic variables or with regard to productivity were omitted from the analyses, resulting in a sample 31,301 respondents. Most participating organisations belonged to the public sector.

The following aspects of the room in which the respondent worked most frequently (often to always) were available from this survey: for layout (1) the original function and (2) size, for use (3) private vs shared use and for comfort, (4) ambient factors, and (5) view. Table 1 shows the answer categories that respondents could pick from. Individual perceived productivity was measured on a 10-point scale. Descriptive and bivariate analyses (independent samples t-test and one-way anova) have been used to examine the relationship between the various physical aspects of the room and productivity.

## RESULTS

The results of the analyses are provided in Table 1. Forty percent of respondents (mostly) worked in a work room (40%) and another 31% in the living room. Only 8% of respondents reported working often in multiple rooms in the home. Half of all respondents used the room they worked in privately and their workplace generally measured between 11 – 25 m<sup>2</sup> (42%). A little less than half of the respondents reported to have ambient factors in their home work environment, like plants, art, and colours (other than neutral, light colours). The majority (89%) had an outside view from their workplace.

**Table 1.** Aspects of the physical home work environment and mean individual productivity

	n	%	Mean productivity (std)
Original function of the room (n = 31,301)**			
Work room	12,425	40%	7.84 (1.18)
Kitchen	1,763	6%	7.68 (1.32)
Living room	9,783	31%	7.68 (1.33)
Bedroom	1,973	6%	7.45 (1.38)
Other room	2,096	7%	7.57 (1.32)
Multiple rooms	2,518	8%	7.62 (1.34)
No type of room assigned / No response	743	2%	7.44 (1.60)

Size of the workplace (n = 31,301)**			
Small size workplace (1 – 10 m <sup>2</sup> )	8,059	26%	7.62 (1.32)
Medium size workplace (11 – 25 m <sup>2</sup> )	13,217	42%	7.70 (1.28)
Large size workplace (> 25 m <sup>2</sup> )	8,832	28%	7.80 (1.25)
No response	1,193	4%	7.78 (1.36)
Use of the room (n = 31,301)**			
Private use	16,091	51%	7.83 (1.19)
Shared use	7,391	24%	7.57 (1.34)
Both private and shared use	761	2%	7.52 (1.34)
No type of use assigned / No response	7,058	23%	7.60 (1.41)
Ambient factors			
Plants (n = 31,297)**			
Yes	14,610	47%	7.77 (1.27)
No / No response	16,687	53%	7.66 (1.30)
Art (n = 31,297)**			
Yes	12,686	41%	7.80 (1.25)
No / No response	18,611	59%	7.65 (1.31)
Colour (n = 31,297)**			
Yes	13,446	43%	7.82 (1.24)
No / No response	17,851	57%	7.63 (1.32)
View from workplace (n = 31,266)**			
Yes	27,690	89%	7.75 (1.26)
No / No response	3,576	11%	7.44 (1.45)

\*\* = mean individual productivity differs, with  $p < 0.001$

The last column of Table 1 shows the mean productivity. A Welch test<sup>5</sup> showed that perceived productivity differed significantly (Welch's  $F(6, 5146.87) = 45.56, p < .001$ ) between the various home work places. Post hoc comparisons using the Games-Howell test indicated that the mean productivity for respondents mainly working in a work room (7.84) was significantly higher than the productivity reported for all other rooms (7.44-7.68). Furthermore, the mean productivity reported by respondents working in the bedroom (7.45) was significantly lower than most other rooms, except 'Other room' (7.57) and 'No type of room assigned / No response' (7.44). These results show that productivity seems to be dependent upon the original function of the room in which respondents work; a dedicated work room seems to induce higher productivity whereas working in the bedroom appears to decrease productivity.

The mean productivity also differed significantly (Welch's  $F(3, 5348.97) = 29.465, p < .001$ ) depending on the size of the workplace. The Games-Howell test showed that a small size workplace (7.62) scored significantly lower than all other size categories (7.70-7.80). And also the mean productivity reported for the medium-size workplace (7.70) again was also significantly lower than those in the large workplace (7.80), so, the larger the workplace, the higher the perceived productivity.

With regard to the use of the room, the results show that the mean productivity differs depending on whether the room is used privately, shared or both (Welch's  $F(3, 3451.99) = 100.97, p < .001$ ). The post hoc Games-Howell test showed that only the mean productivity reported for private use (7.83) is significantly different (higher) than for all the other types of use (7.52-7.60). Respondents that worked both in private and shared environments were not more productive than respondents that only worked in a shared home work environment.

All ambient characteristics also showed higher productivity levels among the respondents. Those with plants in their home work environment reported a significantly higher mean productivity (7.77) than respondents without plants (7.66;  $t(31295) = 7.5, p < 0.001$ .) Respondents who indicated that they had

art or colour in their home work environment significantly differed with regard to mean productivity from respondents without art or colour in their room (for art  $t(31295) = 10.4$ ,  $p < 0.001$ ; for colour  $t(31295) = 12.8$ ,  $p < 0.001$ ). Lastly, respondents who reported to have a view from their workspace (7.75) significantly differed from respondents without (7.44)  $t(31299) = 13.6$ ,  $p < 0.001$ ). So, ambient factors in the home work environment and a view from the workspace seem to be favourable for productivity too.

## DISCUSSION AND/OR CONCLUSIONS

The current study aimed to analyse the relationship between various physical aspects of the home work environment and perceived individual productivity. The results showed that those respondents with a dedicated work room at home, a place that does not have to be shared, which was relatively large ( $>25\text{m}^2$ ), decorated with plants, art, and colour, and provided an outside view perceived higher productivity than those with inferior home workplace qualities. A future longer paper will also present data on the satisfaction with the physical home work environment and the socio-demographic characteristics of the respondents, and how all these subjects are related to each other in a more integrated analysis.

## REFERENCES

- Bloom, Nicholas & Liang, James & Roberts, John & Ying, Zhichun. (2013). Does Working from Home Work? Evidence from a Chinese Experiment. *The Quarterly Journal of Economics*. 130. 10.1093/qje/qju032.
- Bosch-Sijtsema, P. M., Ruohomäki, V., & Vartiainen, M. (2009). Knowledge work productivity in distributed teams. *Journal of Knowledge Management*, 13(6), 533–546. <https://doi.org/10.1108/13673270910997178>
- de Croon, E. M., Sluiter, J. K., Kuijter, P. P. F. M., & Frings-Dresen, M. H. W. (2005). The effect of office concepts on worker health and performance: A systematic review of the literature. In *Ergonomics* (Vol. 48, Issue 2, pp. 119–134). <https://doi.org/10.1080/00140130512331319409>
- Frankema, E. H. P. (2003). *Kantoorinnovatie in economisch perspectief*. Delft: Center for People and Buildings.
- Giovanis, E. (2018). The relationship between flexible employment arrangements and workplace performance in Great Britain. *International Journal of Manpower*, 39(1), 51–70. <https://doi.org/10.1108/IJM-04-2016-0083>
- Haynes, B.P. (2008), "The impact of office layout on productivity", *Journal of Facilities Management*, Vol. 6 No. 3, pp. 189-201. <https://doi.org/10.1108/14725960810885961>
- Hoorweg, N., Peters, P., & van der Heijden, B. (2016). Finding the optimal mix between telework and office hours to enhance employee productivity: A study into the relationship between telework intensity and individual productivity, with mediation of intrinsic motivation and moderation of office hours. In *Advanced Series in Management* (Vol. 16, pp. 1–28). <https://doi.org/10.1108/S1877-636120160000016002>
- Martin, B. H., & MacDonnell, R. (2012). Is telework effective for organizations?: A meta-analysis of empirical research on perceptions of telework and organizational outcomes. *Management Research Review*, 35(7), 602–616. <https://doi.org/10.1108/01409171211238820>
- Mihai, F., Stan, M., Radu, G., & Dumitru, V. F. (2020). Heavy Work Investment for the Accounting Profession in Romania at Time of Coronavirus Pandemic. *Amfiteatru Economic*, 22(14), 1121–1139. <https://doi.org/10.24818/EA/2020/S14/1121>
- Moretti, A., Menna, F., Aulicino, M., Paoletta, M., Liguori, S., & Iolascon, G. (2020). Characterization of home working population during covid-19 emergency: A cross-sectional analysis. *International Journal of Environmental Research and Public Health*, 17(17), 1–13. <https://doi.org/10.3390/ijerph17176284>
- Nakrošienė, A., Bučiūnienė, I., & Goštautaitė, B. (2019). Working from home: characteristics and outcomes of telework. *International Journal of Manpower*, 40(1), 87–101. <https://doi.org/10.1108/IJM-07-2017-0172>
- Ng, C. F. (2010). Teleworker's home office: An extension of corporate office? In *Facilities* (Vol. 28, Issues 3–4, pp. 137–155). <https://doi.org/10.1108/02632771011023113>

- Steward, B. (2000). Changing times: The meaning, measurement and use of time in teleworking. *Time and Society*, 9(1), 57–73. <https://doi.org/10.1177/0961463X00009001004>
- Toscano, F., & Zappalà, S. (2020). Social isolation and stress as predictors of productivity perception and remote work satisfaction during the COVID-19 pandemic: The role of concern about the virus in a moderated double mediation. *Sustainability (Switzerland)*, 12(23), 1–14. <https://doi.org/10.3390/su12239804>