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The interplay of workplace satisfaction, activity support, and productivity support in the hybrid work context

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A B S T R A C T

Since the COVID-19 pandemic, more employees started to work (partially) from home. As a consequence, there is a new need to find a balance between working from home and at the office, and to optimize both workplaces to support employees' work activities and perceived productivity. This study aims to gain insights into relationships between satisfaction with physical workplace features, perceived activity support, and productivity support in a hybrid working context. Leesman data (N = 57,286), collected between March 2020 and May 2021, was used to perform a path analysis, which allows to simultaneously analyse multiple relationships. Findings suggest that the experience and the support of the work environment (either the home or the office) to perform a specific task influences employees' location decisions. As both the perceived support of concentrative and collaborative activities at home and at the office relate to higher perceived productivity, organizations are recommended to redesign parts of the office environment to support both types of work activities.

1. Introduction

In the post-pandemic era, some organizations try to push employees to come back to the office [1]. However, perceived shortcomings in the design of the office, such as open-plan and flexible offices without sufficient spaces for concentration and uninterrupted work, may discourage employees from returning [2]. During the COVID-19 pandemic, employees may have become accustomed to a quieter work environment with fewer distractions at home [2]. Nevertheless, employees without a dedicated workroom or with a relatively small desk at home experienced distractions at home as well [3]. Especially the homes of younger-aged workers may not be suitable for homeworking, potentially reducing their productivity. These employees may be more willing to use the office for concentration work [4]. As Walz et al. [5] argue, both the home- and office-work environment can be highly cognitively demanding, resulting in fewer individual behavioural, emotional, and mental resources available. The challenge of hybrid working lies in balancing remote and in-person working while considering and adjusting the spatial configuration of both workplaces [1,6].

Although organizations aim to develop new policies to support this balance, research about individual workplace behaviour in the hybrid work context seems to be lacking [1]. A general tendency of doing concentrative work at home and communicative work at the office has arisen, although both environments should be able to support these work tasks [7]. The allocation of work tasks to specific environments may not guarantee increased productivity. Instead, the hybrid work modality may lead particularly to positive outcomes (e.g., knowledge-sharing, productivity, or innovation) if several ambiguities and constraints are solved, such as unclear policies regarding which tasks to do when and where [2,6]. In addition, hybrid work should be supported with pleasant and supportive physical work environments, both at the office and at home.

This study therefore aims to gain insights into the relationships between the satisfaction with physical workplace characteristics in both these locations, the perceived activity support of both workplaces, and their productivity support in a hybrid working context. The novelty of this study is the use of an extensive sample of office workers (n = 50,000+) who assessed both the home-and office-environment simultaneously within a single survey. This approach facilitates the examination of employees' perception of both work contexts, and whether the perception of one context influences the perception of another context. Another novelty is the use of a wide range of work activities at home and at the office (i.e., 21 activities), instead of the frequently used division in focus work (or concentration work), knowledge sharing (or

communication work), and social interactions [8]. By using a path analysis approach, it is possible to simultaneously analyse both direct and indirect associations between the variables in the model. These insights may help employers and employees to optimize the physical workplace design of the home-and traditional office to support different work activities and productivity, and may also enhance organizational resilience during the hybrid working trend.

In the continuation of this paper a review of the literature has been included, considering hybrid working, workspace types and how they support work activities, as well as a section about physical workplace features and relevant personal characteristics. The literature findings are summarised in a conceptual model, showing the expected relationships between these variables. In section 3, the methodology has been explained, including the data collection process and the analytical method that has been used. Next, the results are described, first showing the sample descriptives, followed by the principal component analysis to distinguish underlying components in employees' satisfaction with the physical workplace features and their experienced support of work activities for both work locations, and last the path model in which all expected relationships between the independent and dependent variables are tested simultaneously. In the last section, the results are discussed, by comparing them to existing studies and indicating several implications, limitations, and opportunities for further research.

2. Literature review

2.1. Hybrid working

Hybrid working can be explained as a work arrangement that offers flexibility in terms of when and where the work is performed, including temporal and geographical flexibility. Employees can conduct their work tasks either independently or in collaboration with others, as mutually determined by the employee and the organization [9]. Some studies show that employees experience increased well-being and productivity because of remote or hybrid work modalities [10]. Nevertheless, Innstrand et al. [11] argue that employees may perceive their productivity at home to be higher due to working more hours. They suggest that extended working hours while working from home might be beneficial for the organization but could have long-term negative mental health outcomes for the individual (e.g., burnout). So, the real positive and negative outcomes of continued hybrid working will still have to become clear in the upcoming years.

2.2. Experienced support of work activities and productivity

In general, office workers perform three types of activities, namely focussed work, knowledge sharing, and social interactions [8]. Since more than half of employees' work tasks are perceived as complex tasks that require concentration, the office should offer sufficient space to perform these tasks [12]. An office workplace that supports both concentrative and communicative work activities may enhance employees' perceived support of productivity [13]. The home-workplace should ideally also facilitate these types of work activities, but research shows that limited social interactions with colleagues is one of the main reasons for reduced productivity (Felstead & Reuschke, 2020). To further investigate how the support of work activities is related to productivity, both at the office and at home, the following hypothesis is drawn.

Hypothesis 1. The experienced support of work activities is associated with the experienced support of productivity.

The current hybrid working strategies implemented by organizations focus mainly on attracting employees back to the office to conduct communicative work activities, while promoting to do concentrative work at home. However, Appel-Meulenbroek et al. [7] indicate that some employees prefer to do their communicative and collaborative

activities from home, which means that the home-workplace should support both these activities. Additionally, experienced hybrid workers have demonstrated the ability to select suitable work tasks to perform in a specifc work environment [14]. When employees perceive adequate support of their work environment for specific tasks (e.g., at home), they may perceive that another location (e.g., the office) supports this task to a lesser extent. This leads to the following hypothesis.

Hypothesis 2. The experienced support of work activities at home is associated with the experienced support of work activities at the office.

Another expectation is that the perceived level of productivity support experienced in one location influences the perceived level of productivity support in another location. A negative association suggests that features contributing to perceived productivity support in one location are lacking or inadequate in another. Conversely, a positive association suggests that individuals who perceive their productivity as supported in one location are likely to extend these perceptions to another workplace setting. As hybrid working is found to have a positive influence on employees' perceived productivity [15], it might be reasonable to expect a positive association, as increased flexibility in choosing the work location might better support employees' productivity overall.

Hypothesis 3. The experienced support of productivity at home is associated with the experienced support of productivity at the office.

2.3. Satisfaction with physical workplace features

Al Horr et al. [16] identified eight main categories of physical office characteristics, namely indoor air quality and ventilation, thermal comfort, light and daylight, noise and acoustics, office layout, biophilia and views, look and feel, and location and amenities. They argued that these could all influence employees' perceived productivity. More recent research shows that employees choose their office workspace mainly based on the perceived sound-, enclosure-, and lighting level [17]. Others indicate that the work area aesthetics and the comfort of furnishing have a significant influence on both people's productivity, health, and overall comfort [18].

Furthermore, Ng [19] indicates that employees prefer to have similar features at their home workplace as they have at their office workplace. Now that hybrid working has become more normalized, organizations may need to increase working from home standards [20]. Tleuken et al. [21] define three main areas of investment that could improve employees' productivity while working from home. These include the creation of comfortable workplaces with ergonomic furniture and sufficient plants, the provision of adequate software and ICT, and the provision of a safe and healthy work environment at home through acceptable air quality- and light-levels. These investments may increase employees' satisfaction with the physical features of their workplace, which might also be associated with increased levels of productivity support. Consequently, hypothesis 4 is.

Hypothesis 4. The satisfaction with physical workplace features is associated with the experienced support of productivity.

The investments suggested by Tleuken et al. [21] may also be beneficial for employees' perceived support of work activities, as higher levels of satisfaction with privacy, daylight, and artificial light may lead to higher levels of satisfaction with the support of online interactions and concentrated work activities while working from home [22]. For confidential and concentrated work activities at the office, dissatisfaction with noise is the most important indoor environmental quality (IEQ) factor, while for informal social interactions and interactive work activities, dissatisfaction with air quality is most important [23]. Nevertheless, even for informal social interactions people do not prefer a work environment that they perceive as noisy [17]. Although some studies indicate that satisfaction with physical workplace features is

associated with the experienced support of work activities, no studies so far seem to address these associations in the context of hybrid working, leading to the following hypothesis.

Hypothesis 5. The satisfaction with physical workplace features is associated with the experienced support of work activities.

Recently, first insights are gained in employees' satisfaction with the workplace within a hybrid working context. For instance, studies have shown that individuals perceive their comfort levels with noise, temperature, and privacy to be higher at home, likely due to having more control over these factors. Conversely, employees generally find the workstation and furniture at the office more comfortable than at home [24]. Overall, the physical features of the home-workplace are perceived more positively than the office-workplace. Further examination of various office types reveals that employees in open-plan offices perceive more auditory and visual distractions, leading to a greater likelihood of working from home. A noisy open-plan office may thus act as a disincentive for office-working, and as a motivator for remote working [25].

While these studies suggest potential differences in employees' satisfaction with physical workplace features at home and the office, to the best of the authors' knowledge, no studies so far have explored whether satisfaction with physical workplace features at one location influences satisfaction at another location. Consequently, the following hypothesis is proposed.

Hypothesis 6. The satisfaction with physical workplace features at home is associated with the satisfaction with physical workplace features at the office.

2.4. Type of work setting

Several office types can be distinguished, including the cell-office, shared-office, open-plan office, and flexible office [26]. Some studies indicate that employees perform best in cell-offices and worst in shared open-plan offices, especially when performing concentrative work activities [27]. Similarly, employees are found to be more satisfied with their productivity support in smaller-sized offices (e.g., private or shared-room offices) than in flexible or activity-based offices [28]. An often-stated disadvantage of the activity based-flexible office is the lack of privacy, potentially impairing people's productivity [29]. Activity based-flexible offices (AFOs) that offer abundant quiet areas for concentrative work activities and that support employees' perceived privacy may be associated with higher productivity levels instead [30].

Recently, the home-work environment has been added as a frequently used place to work from, which, for most employees, provides an assigned enclosed workspace [31]. Nevertheless, for some employees working from home means working in a shared, non-dedicated space, such as the bedroom or kitchen. These employees might experience increased home-workspace distractions, which could significantly reduce their productivity [3]. The type of work setting may thus have a significant influence on employees' experienced support of productivity, leading to the following hypothesis.

Hypothesis 7. The type of work setting is associated with the experienced support of productivity.

Some of these work settings might support specific work activities better than others. For instance, activity based-flexible offices are most appropriate for collaborative and communicative tasks and least suitable for concentrative tasks [30]. The notion that satisfaction with privacy and communication are the most important predictors of satisfaction with activity-based working (ABW) also indicates that the office should ideally facilitate both communicative and collaborative work activities [29]. Furthermore, Forooraghi [32] argues that "healthy activity-based offices are not static solutions but moving projects in which users are provided resources and opportunities to codesign an environment that enables them (i) build meaningful social relationships,

(ii) manage visual and acoustic distractions, (iii) read and comprehend workspaces, and (iv) receive support from management in their daily work". There might thus be a need to redesign the office to better support employees' needs to perform work activities.

Moreover, the home may also become a more permanent work location, as it may offer employees an enclosed workspace that provides a feeling of privacy, the opportunity to concentrate, and to work with fewer distractions [31]. Nonetheless, these positive findings may not be found among employees without a dedicated workroom at home. For instance, Bergefurt et al. [22] show that employees who shared their home-workspace with others were less satisfied with their perceived privacy and with its support to perform concentrated work or online interactions. These studies show that the following association could be expected.

Hypothesis 8. The type of work setting is associated with the experienced support of work activities.

The type of work setting might also be associated with the satisfaction with physical workplace features. It is generally known that employees are least satisfied with the acoustical quality, followed by the thermal comfort, indoor air quality, and lighting quality in an open-plan office environment [33]. Compared to the (open-plan) office, the home-office might stimulate the psychological need for competence more, as employees can tailor their home-workspace to align with their needs. For instance, adequate room size, daylight-, temperature-, and sound levels may contribute to the perceived suitability of the home-workspace [34]. These findings lead to the following hypothesis.

Hypothesis 9. The type of work setting is associated with the satisfaction with physical workplace features.

2.5. Personal characteristics

Personal characteristics, such as age, gender, and time working at the organization, may be associated with the experienced support of productivity. In traditional office settings, older employees may perceive less support of their productivity [35]. Particularly in open-plan offices, older employees may encounter challenges in managing distractions, compared to younger colleagues who are more accustomed to these conditions [36]. Additionally, gender differences are observed in productivity among different office layouts. For instance, females tend to be most productive in shared offices and least productive in middle-sized open-plan offices (i.e., with 6–9 colleagues), whereas males tend to be most productive in middle-sized open-plan offices and least productive in private offices. These differences could be attributable to varying requirements for concentration and stress tolerance levels [37].

Studies during the COVID-19 pandemic suggest that females and older aged employees felt more productive while working from home than males and their younger colleagues [21,38]. Nevertheless, older aged employees might experience more difficulties with remote technologies, potentially decreasing their perceived productivity [38]. Therefore, the following hypothesis is drawn.

Hypothesis 10. Personal characteristics are associated with the experienced support of productivity.

Moreover, research shows that females perceive interactions at the office to have a more positive influence on their productivity than males [39]. While females are more likely to share knowledge via face-to-face interactions at their desk, males more often share their knowledge in documented form [40]. Furthermore, older aged employees are found to be slightly more positive about their social interactions at the office than their younger counterparts, indicating that they value the opportunity to have social interactions more [39]. Although no studies were found about personal differences in the experienced support of work activities, it is expected that.

Hypothesis 11. Personal characteristics are associated with the

experienced support of work activities.

Last, personal characteristics might also influence the satisfaction with physical workplace features. For instance, females are generally less satisfied with the indoor environmental quality of the office than their male counterparts. Kim and de Dear [41] indicate that the largest satisfaction differences were found for temperature, sound privacy, and air quality, with females indicating lower satisfaction. Such differences are not always found for the home-work environment, as employees are able to set the IEQ conditions according to their personal preferences. [42]. Therefore, the following association is expected.

Hypothesis 12. Personal characteristics are associated with the satisfaction with physical workplace features.

2.6. Conceptual model

Fig. 1 shows the conceptual model, in which the expected causal relationships are drawn. Personal characteristics, and workspace types at home and at the office are assumed to be exogenous (i.e., not influenced by variables within the model), while the other variables are expected to be endogenous (i.e., determined by other variables in the model). The literature discussed above and the drawn hypotheses, showed expected relationships between both endogenous variables and the satisfaction and experienced support of activities and productivity in both physical locations.

3. Methods

This section explains how the variables in the conceptual model were measured, and how data was collected. It also shows the analytical procedure, consisting of Principal Component Analyses (PCA) to identify underlying dimensions for several variables. These underlying dimensions were used in the continuation of the analyses, with bivariate analyses followed by a path analysis. A path analysis was performed to simultaneously determine relationships between the dependent and independent variables in the conceptual model.

3.1. Data collection and measures

To study the relationships in the conceptual model, existing data were used that were collected in a cross-sectional survey by an external organization, namely Leesman. This organization sells its surveys to companies to provide insights into different aspects of the work environment. The organizations ask their employees to complete the survey, via a link that Leesman provides. The Leesman sample is much larger, but for these analyses only employees that were asked to jointly fill in their experience of both the office and the home-work environment were selected. Their data were collected between March 2020 and May 2021, right after the start of the COVID-19 pandemic, resulting in a sample of 57,286 respondents. Table I1 summarizes the questions and answer scales that Leesman uses to measure the variables in this study. The experienced support of work activities includes 21 different activities.

Furthermore, 25 items are specified for the satisfaction with physical workplace features at the office, and 11 items for the physical home-workplace features (see Table I2 and I3).

3.2. Analytical approach

First, Principal Component Analyses (PCA) were performed to identify underlying dimensions between items related to satisfaction with physical features and the support of work activities. In line with the assumption that the factors are independent and uncorrelated, Varimax orthogonal rotation was employed. Varimax rotation aims to maximize the variance of the loading within factors and the differences between low and high loadings on a particular factor. The Kaiser-Meyer-Olkin (KMO) test assessed the adequacy of the sample size for factor analysis and should range between 0.80 and 1.00 [43].

The identified dimensions from PCA, along with the original other independent and dependent variables were used in bivariate analyses to gain insights in the significance of direct relationships. Significant relationships were used as input for the path analysis, which is a special case of structural equation modelling (SEM) used to uncover both direct and indirect relationships between dependent and independent variables. Nominal variables (e.g., gender) were recoded to dummy variables (e.g., male = 1 and female = 0). Relationships that were insignificant at the 0.05 ($t < 1.96$) significance level were systematically removed from the path model through a backward stepwise process, repeated until an acceptable model was achieved. The statistical package Lavaan in RStudio was used for conducting the path analysis.

4. Results

4.1. Sample descriptives

Table 1 shows that almost 64% of the respondents were male, and that the largest age category was 35–44 years (32.6%). Of the total sample, 50% consisted of European respondents, followed by 24% Asian, and 23% North-American employees. About 26% of the employees worked 3–8 years at the organization, while almost 32% worked there for more than 12 years. The task profile specified as *concentration* was most occurring (35.5%). Furthermore, at the office, the largest share of employees indicated to work at a flexible open work environment (35%) or an assigned open work environment (39%). At home, many employees (45%) indicated to work at a dedicated enclosed workplace. Employees perceived the support of productivity of the home-work environment to be somewhat higher than the support of the office work environment.

4.2. Principal component analyses

Several principal component analyses (PCA) were run to identify whether underlying dimensions of variable items could be observed (see Appendix I for an overview). First, PCA was performed on the 25 items of the variable satisfaction with the physical features at the office
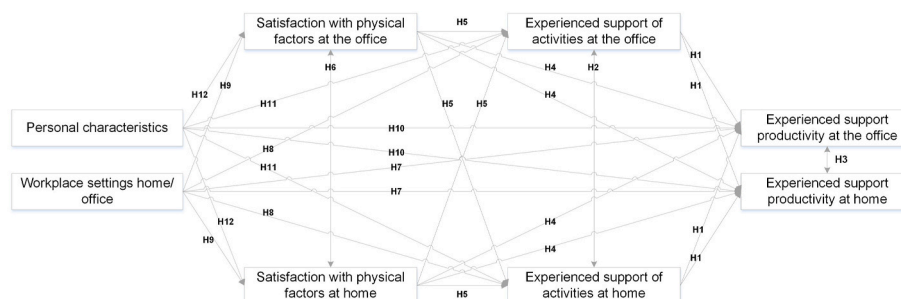

Fig. 1. Conceptual model.

Table 1
Sample descriptives (N = 57,051).

		Sample (N)	Sample (%)
Personal characteristics			
Gender	Male	36372	63.8
	Female	20679	36.2
Age	Under 25	1322	2.3
	25–34 years	13680	24.0
	35–44 years	18612	32.6
	45–54 years	15894	27.9
	55–64 years	7148	12.5
	Over 65 years	325	.6
	Prefer not to say	70	.1
Time with organization	0–6 months	1856	3.3
	6–18 months	6059	10.6
	18 months–3 years	7784	13.6
	3–8 years	15064	26.4
	8–12 years	8122	14.2
	Over 12 years	18166	31.8
Task profiles	Concentration	20256	35.5
	Concentration and meetings	13967	24.5
	Concentration and collaborative work	13073	22.9
	Various activities	9755	17.1
Workspace types			
Workspace types office	Flexible workplace open environment	19924	34.9
	Assigned workplace open environment	22335	39.1
	Assigned workplace enclosed environment	7450	13.1
	Assigned workplace shared room	4411	7.7
	Meeting/project room	893	1.6
	Other office setting	843	1.5
Workspace types home	Dedicated workplace enclosed environment	25381	44.5
	Dedicated workplace in open environment	17292	30.3
	Non-specific home location	13770	24.1
	Other home workspace type	608	1.1
		Mean	**SD**
Experienced support of productivity at the office		1.13	1.50
Experienced support of productivity at home		1.83	1.34

(Table I2). The Kaiser-Meyer-Olkin measurement showed that the sample was suitable to perform a PCA (KMO=.90), as KMO should be higher than 0.5. In total, six components were extracted with an eigenvalue above 1 and a total explained variance of 55%. The items that loaded on the component *availability of supportive spaces* were related to the type of available spaces (e.g. meeting rooms, quiet rooms). Items that loaded on the component *indoor comfort* regarded the environmental quality at the office, and items on *office décor* the more tacit aspects of the office (e.g. art, plants). The items related to space and dividers between workstations loaded on a component labelled *crowdedness*. Furthermore, items as desk and chair loaded on the component *workstation*, and last, the items considering storage possibilities loaded on *storage*.

Another PCA was run on the eleven underlying items of the variable satisfaction with physical features at home (see Table I3). Here, KMO equalled 0.85, which is again satisfactory. Three components arose with an eigenvalue above 1 and a total explained variance of 53%. Items that loaded on the first component, *workstation and office equipment,* regard more basic facilities of the home workplace, such as chairs and monitors. Next, items related to having equipment for online conversations (e.g., WiFi connection) loaded on the *collaborative tools* component. Last, two items about a fixed computer and landline connectivity loaded on the component labelled *fixed computer and landline*.

Third, respondents were asked to indicate their experienced support of work activities at the office and at home. Both at the office and at home the same 21 work activities were judged. The KMO of the PCA on the experienced support of work activities at the office equalled 0.92, which indicates that the sample was suitable to perform this type of analysis. In total, four components arose with an eigenvalue above 1 and a total explained variance of 46%. The items that loaded on the component *meetings* relate to planned meetings, conferences, and conversations. The second component *collaborative and informal work* was loaded by items about group work and cooperation between employees. Third, items that loaded on the component *concentrative work* include individual-focussed tasks but also thinking and reading. Last, several items related to activities that are not performed at the desk loaded on the component *away from desk activities*.

The final PCA was performed on the variable experienced support of work activities at home. Again, four components arose, each with an eigenvalue of 1 and a total explained variance of 45%. The first component, *collaborative and informal work*, was loaded by items on social interactions and meetings. Items regarding individual thinking, reading, and focussing loaded on the component *individual and concentrative work*. The third component, *meetings,* was loaded by items regarding telephone conversations and online meetings. Finally, two items related to spreading out of papers and using technical equipment or materials loaded on *facility dependent activities at home*. The components that arose in these four PCAs were considered as input in the path analysis.

4.3. Path analysis

Paths were specified according to the results of the bivariate analyses. In the path analysis, time with the organization was deleted because this variable did not significantly relate to any other variable when tested simultaneously.

The results of the path analysis revealed a satisfactory fit of the final model data. The Comparative Fit Index (CFI), the Non-Normed Fit index (NNFI), and the Goodness of Fit Index (GFI) were all close to 1. CFI is a measure of fit that examines the difference between the obtained data and the hypothesized model. NNFI indicates the relative position of the current model between the independent and saturated model. GFI indicates the fit between the hypothesized and observed proportion of variance. Furthermore, the Root Mean Square Error of Approximation (RMSEA) is a measure of the square root of population misfit per degree of freedom and should be below 0.05. The Akaike Information Criterion (AIC) and the Bayesian Information Criterion (BIC) estimate the prediction error in the hypothesized model while using different penalties for the number of parameters. These values can be used to compare the competing models and should be as low as possible (see Table 2).

4.4. Direct relationships

Fig. 2 and Table 3 show the significant associations that were found in the path analysis. *Hypothesis 1,* stating that the experienced support of work activities is associated with the experienced support of productivity, could be accepted, as higher perceived support of individual and

Table 2
Goodness of fit statistics.

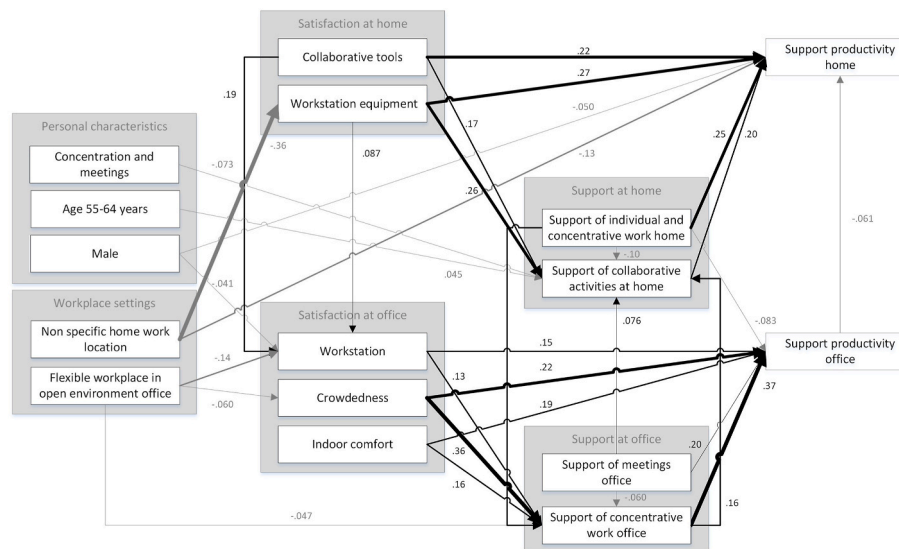| Goodness of fit statistics	
Degrees of Freedom (df)	52.0
Chi Square (χ2)	5597.29
Root Mean Square Error of Approximation (RMSEA)	.043
Akaike Information Criterion (AIC)	1126234.14
Bayesian Information Criterion (BIC)	1126583.26
Comparative Fit Index (CFI)	.94
Non-Normed Fit Index (NNFI)	.90
Goodness of Fit Index (GFI)	.97

Fig. 2. Path model – Significant standardized effects.

concentrative work and collaborative activities positively influenced the perceived support of productivity at home. Similarly, increased support of meetings and concentrative work at the office had a positive association with the experienced support of productivity at the office. Especially the standardized path coefficient of the association between the support of concentrative work activities and the productivity-support at the office was relatively strong (β = -.37). However, a minor negative association was found between the perceived support of individual concentrative work at home and the support of productivity at the office. This means that employees who felt supported in performing collaborative activities at home indicated lower support of their productivity at the office.

Furthermore, findings show that the experienced support of several work activities at home are associated with the experienced support of work activities at the office, which means that *hypothesis 2* could be accepted. Employees who felt supported to do concentrative work and to have meetings at the office felt supported in their collaborative activities at home. Furthermore, employees who indicated that their individual and concentrative work tasks at home were well-supported, also indicated that their concentrative work tasks at the office were well-supported. It could be that these individuals were better capable to concentrate in general, regardless of the work context. Another finding is that the experienced support of productivity at the office is negatively associated with the experienced support of productivity at home, which indicates that employees who feel that their productivity is well-supported at the office indicate lower perceived productivity-support at home. This finding confirms *hypothesis 3*.

According to *hypothesis 4*, the satisfaction with physical workplace features is associated with the experienced support of productivity. This hypothesis can be accepted, as several relatively large associations were found. First, employees who were satisfied with the workstation, crowdedness, and indoor comfort at the office experienced higher support of productivity at the office. Positive associations between satisfaction with collaborative tools and workstation equipment at home and the support of productivity at home were found too.

Moreover, several relatively large-sized associations were found between the satisfaction with physical workplace features and the experienced support of work activities, thereby confirming *hypothesis 5*. Satisfaction with the collaborative tools at home and workstation equipment was positively associated with the experienced support of collaborative activities at home, indicating that having suitable tools and equipment may enhance collaboration while working from home. Regarding the office environment, direct positive associations between

satisfaction with the workstation, with crowdedness, and with indoor comfort and the experienced support of concentrative work activities at the office were found. Thus employees who were satisfied with their workstation, the crowdedness, and the indoor comfort at the office were more likely to feel supported when performing concentrative activities. Particularly the standardized path coefficient of the association between satisfaction with crowdedness and support of concentrative activities at the office was rather large (β=.36).

Additionally, *hypothesis 6*, stating that the satisfaction with physical workplace features at home is associated with the satisfaction with physical workplace features at the office, should be accepted too. Nevertheless, only two relatively small, positive associations were found, between the satisfaction with workstation equipment and collaborative tools at home and the satisfaction with the workstation at the office. These associations may indicate that employees who are satisfied with the workplace features at home might also be more satisfied with their office workstation.

Regarding the type of work setting, the path model shows that a relatively small, negative association is significant between the non-specific home-work location and the support of productivity at home. People who work in such a setting at home might thus feel that their productivity is not well-supported while working from home. *Hypothesis 7*, that the type of work setting is associated with the experienced support of productivity, can thus only be accepted for the home-work environment. Furthermore, no significant associations were found between the type of work setting and the experienced support of work activities. Therefore, *hypothesis 8* should be rejected. Findings do show that the type of work setting is associated with the satisfaction with physical workplace features, indicating that *hypothesis 9* should be accepted. At the office it was found that employees who worked in an open environment felt less satisfied with their workstation and the crowdedness at the office. In the home-workplace context, employees who did not have a specific home-work location felt less satisfied with their workstation equipment at home. Especially the standardized path coefficient for the first association was rather large (β = -.36).

Several minor associations were found between personal characteristics and the experienced support of productivity, work activities, and the satisfaction with physical workplace features. First, it was found that males were less likely to feel supported in working productively at home. *Hypothesis 10*, indicating that personal characteristics are associated with the experienced support of productivity, could only be partially accepted as associations were only found in the home-work context. The same holds for *hypothesis 11*, which states that personal

Table 3
Significant unstandardized direct and indirect effects.

Variables	Support of productivity at the office		Support of productivity at home		Support of concentrative work at the office		Satisfaction with crowdedness at the office	Satisfaction with workstation at the office	Support of collaborative activities at home		Satisfaction with workstation equipment
	Direct	Indirect	Direct	Indirect	Direct	Indirect	Direct	Direct	Direct	Indirect	Direct
Personal variables											
Male			-.14 (-14.71)					-.085 (−10.11)			
Age 55–64 years									-.14 (−11.42)		
Workspace type at home											
Flexible workplace in a shared environment			-.42 (−36.80)	-.15 (−38.67)							-.84 (−91.88)
Workspace type at the office											
Flexible workplace in an open environment					-.099 (−12.34)	.012 (−12.10)	-.13 (−14.43)	-.29 (−34.12)			
Task profiles											
Concentration and meetings									-.17 (−18.13)		
Experienced support of activities at home											
Collaborative and informal work			.26 (56.04)								
Individual and concentrative work	-.12 (−25.11)	-.069 (−23.71)	.33 (70.94)	.086 (42.33)	.11 (29.76)				-.11 (−26.34)		
Experienced support of activities at the office											
Meetings	.29 (58.68)	.007 (13.28)			-.060 (−15.65)				.076 (18.86)	.012 (16.85)	
Concentrative work	.55 (102.31)								.16 (40.32)		
Satisfaction with facilities at home											
Workstation and office equipment			.36 (73.80)	.096 (51.16)				.087 (21.50)	.26 (66.34)		
Collaborative tools			.30 (63.51)	.078 (46.08)				.19 (47.35)	.17 (40.83)		
Satisfaction with facilities at the office											
Indoor comfort	.28 (56.70)	-.035 (−23.06)			.16 (41.62)						
Crowdedness	.33 (63.15)	-.041 (−23.70)			.36 (94.62)	-.036 (−12.33)					
Workstation	.22 (44.00)	-.016 (−19.95)			.13 (32.83)						
Support of productivity at the office			-.054 (−17.85)	-.018 (−17.52)							

characteristics are associated with the experienced support of work activities. Employees who were aged between 55 and 64 years or who frequently performed concentrative tasks and meetings (i.e., concentration and meetings variable) felt less supported in performing collaborative activities at home. Last, findings show that males were less likely to be satisfied with the workstation at the office. Hypothesis 12, stating that personal characteristics are associated with the satisfaction with physical workplace features, could thus only be partially accepted due to the absence of significant associations in the office-workplace context.

4.5. Indirect relationships

For both the home-and office-environment, several indirect associations between endogenous and exogenous variables and the experienced support of productivity could be observed. First, employees who worked at a non-specific home work location were more likely to be satisfied with the home workstation equipment, which increased their experienced support of productivity at home. Employees who worked at a flexible workplace in an open office environment were less likely to be satisfied with their workstation and the crowdedness at the office, which reduced their experienced support of concentrative activities at the office.

Furthermore, the support of collaborative activities at home mediated the association between satisfaction with collaborative tools and workstation equipment at home and support of productivity at home. This indicates that employees who were satisfied with the collaborative tools and workstation equipment at home were also more satisfied with the support of collaborative activities at home, which increased their experienced support of productivity while working from home. Moreover, the association between satisfaction with crowdedness, the workstation, and the indoor comfort at the office and the support of productivity was mediated by the support of concentrative activities at the office.

In addition, the support of concentrated work activities at the office mediated the association between the support of meetings at the office and the support of collaborative activities at home. This association indicates that reduced support of meetings at the office might increase the experience of support for concentrative activities at the office and increase the experienced support of collaborative activities at home.

The support of collaborative activities at home mediated the association between the support of individual and concentrative work at home and the perceived support of productivity at home. The support of concentrative activities at the office also mediated the association between the support of individual concentrative activities at home and the experienced support of productivity at the office. This shows that the feeling of being supported in doing concentrative activities at home increased the experienced support when performing these activities at the office and led to increased support of productivity at the office.

The support of individual and concentrative work tasks at home had an indirect influence on the experienced support of productivity at home, mediated by the experienced support of productivity at the office. Last, it was found that employees who felt supported in having meetings at the office felt less supported in doing concentrative activities at the office, which decreased their experienced support of productivity at the office and the support of collaborative activities at home.

5. Discussion, limitations, and implications

5.1. Discussion

After the COVID-19 pandemic, several organizations aimed to support employees in doing their concentrative activities at home and their collaborative activities at the office [4]. The negative associations between the support of meetings and concentrative work at the office and the support of individual and concentrative work and collaborative activities at home indicates that the workplace usually supports one of the two activities. However, the associations between both the support of concentrative and collaborative activities and the support of productivity at the office and the home-workplace show that the expected tendency to do concentration work at home and communicative work at the office may not fully support productivity. As Appel-Meulenbroek et al. [7] argue, the notion of designing the office for the support of collaborative activities is not optimal, as homeworkers are also found to do communicative activities from home. This means that, ideally, both the home-and office-workplace should stimulate the performance of collaborative and concentrative activities. Organizations may therefore need to put additional effort in optimizing the support of the office workplace for concentrative activities and the home workplace for collaborative activities, as it may optimize perceived productivity too.

Moreover, the satisfaction with physical office- and home-characteristics was directly and indirectly related to the support of productivity, via the support of work activities at both workplaces. This underlines previous findings that the fit between the office type and people's work activities has a significant influence on perceived performance [44]. As Soriano et al. [44, p. 131] argue, *"the happy-productive worker thesis may work fully when workers' offices are adequate for their work patterns"*. This means that there is a need to focus on the workplace conditions that could support employees' work activity patterns. These

conditions may also determine employees' decisions regarding which tasks to do where [45]. As Seddigh [45, p. 15] argues, *"a poorer work environment at home leads to employees wanting to spend more time at the office and a good work environment at the office attracts employees back to the office"*. Employees who work from a non-specific home-work location or a flexible open-plan office might therefore be more likely to change their workspace type to potentially increase their physical workplace satisfaction, and also their perceived activity- and productivity-support. These findings give rise to the expectation that a poorer office design (e.g., a flexible open-plan office) may also cause employees to stay working from home as they perceive higher productivity-support.

Another important contribution of the current study is that strong associations were found between the support of individual and concentrative activities and the support of productivity for both work locations. This implies that employees mainly determine their productivity as dependent on their individual concentrative tasks instead of on their collaborative activities. Generally, knowledge workers value concentrative tasks more than collaborative tasks, and perceive their productivity to be equal or higher when working from home compared to the office [31]. These results are reinforced by the finding that employees who feel supported in doing concentrative tasks at home generally perceive their productivity-support at the office to be lower. Discrepancies between the need for meeting- and concentration-rooms at the office and the actual number of such rooms may further reduce people's perceived office productivity. However, the influence of interactions and knowledge-sharing between colleagues on employees' productivity should not be underestimated [13]. Organizations may therefore need to consider employees' needs in designing the office workplace more thoroughly.

The findings of the current study suggest that employees compare both their home-and office-environment and decide which task to do where based on the perceived support of the work location. It seems that the perception of the workplace (e.g., the home) may even become more positive, when the other workplace (e.g., the office) offers less support to perform a specific task.

5.2. Limitations, implications, and future studies

Although this study showed interesting insights, some limitations remain. First, the sample of the study was slightly dominated by male respondents, which might have affected the sample distribution of several workplace characteristics. For instance, research shows that males are more satisfied with the indoor environmental quality aspects of the office than their female colleagues (Kim et al., 2013). The mean satisfaction with the indoor comfort at the office of the current sample might therefore have been higher than for a more balanced sample distribution. Moreover, the mean perceived support of productivity at home might have been rated lower due to the overrepresentation of male respondents, as females are generally found to feel more productive while working from home [21,38]. Future research could explore whether a more equal gender distribution would lead to different relationships or effect sizes.

Furthermore, the sample of this study was relatively large, which might have influenced the significance and strength of the relationships in the path analysis. For large sample sizes, there is an increased risk of negligible relationships becoming significant. A larger number of independent variables may significantly relate to a dependent variable, while they only account for a small proportion of the total variance [46]. Nevertheless, as only the strongest associations were included in the path analysis, an acceptable proportion of the total variance has been explained. In further research, it could be studied whether the same relationships would be found among a sub-sample of the entire sample.

Another limitation of this study is that contextual information, such as the climate and culture in which employees work, but also the type of buildings and employees' working hours were not considered. This

information may be crucial to fully understand employees' workplace preferences or experiences, and should therefore be included in future studies. Additionally, the study's findings may be constrained by an unequal distribution of responses across continents. A small proportion of respondents were from South America, Africa, and Australia, which might impact the generalizability of the results. The generalizability of current findings to future studies may thus depend on the specific continent, with a higher probability of similar findings within European or North-American contexts.

While data were collected during the COVID-19 pandemic, it might also be hard to generalize the results to the current situation, after the pandemic. For instance, some employees might have been obliged to work several days per week from home. Some employees may not have worked from home voluntarily, which may have impacted their perceived support to perform work activities at home or their satisfaction with the home-workplace characteristics. Therefore, similar future research is needed to explore whether the same relationships would be found in the post-pandemic era, where most employees can choose when and where to work.

Last, using the Leesman dataset provides several benefits, such as having a large dataset to run analyses on. However, using this dataset also comes with limitations. As the survey is designed to serve many different office environments and contexts, so-called two-phase questions were used where employees first rated the importance of activities, after which they indicated the perceived support of only these activities. A similar approach was used for the physical workplace characteristics, where first the importance was indicated, followed by their satisfaction with the selected items. Therefore, not all employees in the sample rated all variable items. Moreover, the Leesman survey lacked comparable items pertaining to physical workplace satisfaction in the home and office environment. Consequently, any comparison between satisfaction levels in these distinct workspace types should be approached with caution and attention to these differences.

This study has provided insights in how both the office- and home-workplace could be optimized to support employees' work activities and their productivity. These insights are relevant for employers, as they help to determine the needs of employees at home and at the office. For instance, employers may need to provide employees with sufficient tools for collaboration at home (e.g., ICT), while they could also aim for improving the indoor comfort at the office (e.g., by more personal control). Furthermore, this study has shown that both workplaces should support collaborative and concentrative work activities. Workplace designers and architects may need to redesign parts of the office to support these activities. At home, employees are advised to reserve a dedicated part of their home to work from, as results have shown that working from a non-specific work location at home reduces the perceived support of productivity. Future research could identify the specific needs of employees at the office and at home in more detail to better support their perceived productivity.

6. Conclusion

This study has provided new insights into the relationships between personal and workplace characteristics, satisfaction with workplace features, the perceived support of work activities, and perceived support of productivity, for both the home-and office-work environment. Findings have shown how much the experience and the support of the workplace (both the home and the office) to perform a work task appears to influence the location decision. Moreover, it seems that employees choose the location of a work task based on the support provided by the location. This study also showed an important recommendation for organizations, namely to design office workplaces that support both concentrative and collaborative work activities instead of solely focussing on collaborative/communicative activities at the office.

CRediT authorship contribution statement

Lisanne Bergefurt: Writing – review & editing, Writing – original draft, Visualization, Methodology, Formal analysis, Conceptualization. **Peter Friso van den Boogert:** Writing – original draft, Methodology, Formal analysis, Conceptualization. **Rianne Appel-Meulenbroek:** Writing – review & editing. **Astrid Kemperman:** Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The authors do not have permission to share data.

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Appendix I

Table I1
Question structure and answer categories – Leesman survey

Variable name	Question structure	Answer categories
Experienced support of productivity at the office	How much do you agree or disagree with the following statement about your main workplace? It enables me to work productively.	**7-point scale:** −3. Disagree strongly – 3. Agree strongly
Experienced support of productivity at home	How much do you agree or disagree with the following statement about working from home? My home environment enables me to work productively.	**7-point scale:** −3. Disagree strongly – 3. Agree strongly
Experienced support of work activities at the office	1. Thinking about the work that you do, which of the following activities are important? From the list below, select only the activities that are important to you in the course of your work. 2. Rate how well your main workplace supports the activities you selected.	**7-point scale:** −3. Not supported at all – 3. Very well supported
Experienced support of work activities at home	1. Thinking about the work that you do, which of the following activities are important? From the list below, select only the activities that are important to you in the course of your work. 2. Rate how well the important activities are supported when you are working from home.	**7-point scale:** −3. Not supported at all – 3. Very well supported

(continued on next page)

Table I1 (*continued*)

Variable name	Question structure	Answer categories
Satisfaction with physical features at the office	1. Thinking about the work that you do, which of the following physical features are important in creating an effective workplace for you? From the list below, select only the features that are important. 2. Rate your satisfaction with those important features in your main workplace, or select the 'not provided' box.	99. Not provided **5-point scale:** −2. Highly dissatisfied – 2. Highly satisfied
Satisfaction with physical features at home	1. Thinking about the work that you do, which of the following features are important to you when working from home? From the list below, select only the features that are important. 2. Rate your satisfaction with those important features in your current home setting, or select the 'not available' box.	99. Not provided **5-point scale:** −2. Highly dissatisfied – 2. Highly satisfied

Table I2
Principal Component Analysis – Satisfaction with physical office characteristics

Satisfaction with physical office characteristics	Components					
	Availability of supportive spaces	Indoor comfort	Office décor	Crowdedness	Workstation	Storage
Meeting room small	**.74**	.15	.022	.065	.12	.023
Meeting room large	**.67**	.12	.050	.007	.065	.076
Quiet rooms for working alone or in pairs	**.59**	.16	.088	.29	.044	-.006
Desk/room booking systems	**.57**	.088	.057	.080	.14	.097
Informal work areas/break-out zones	**.53**	.12	.36	.077	.038	.019
Variety of different types of workspaces	**.46**	.032	.37	.16	-.022	.068
Accessibility of colleagues	**.43**	.13	.13	.042	.21	.086
Air quality	.16	**.75**	.19	.15	.10	.019
Temperature control	.15	**.75**	.13	.17	.053	.006
Office lighting	.19	**.67**	.16	.016	.18	.10
Natural light	.13	**.64**	.17	.061	.15	.091
Noise levels	.20	**.53**	.051	.52	.049	.024
Art/photography	.058	.099	**.76**	.12	.045	.061
Plants/greenery	.073	.21	**.73**	.11	.099	.044
General décor	.16	.21	**.71**	.038	.11	.080
Atriums/communal areas	.17	.099	**.70**	.025	.053	.062
Dividers between desk areas	.085	.061	.11	**.75**	.16	.074
People walking past your workstation	.11	.11	.052	**.74**	.007	.085
Space between work settings	.14	.16	.11	**.69**	.21	.098
Desk	.20	.18	.077	.14	**.81**	.036
Chair	.18	.20	.091	.083	**.80**	.009
Ability to personalize my workstation	.085	.044	.12	.41	**.48**	.12
Shared storage	.11	.056	.091	.077	.044	**.81**
Archive storage	.077	.054	.083	.10	.023	**.81**
Personal storage	.14	.15	-.089	.26	.37	**.41**
Eigenvalue	2.71	2.61	2.58	2.35	1.93	1.58
Percentage of explained variance	10.85	10.45	10.34	9.41	7.72	6.31

Table I3
Principal Component Analysis – Satisfaction with physical home characteristics

Satisfaction with physical home characteristics	Components		
	Availability of supportive spaces	Indoor comfort	Office décor
Chair	**.85**	.17	.039
Desk or table	**.84**	.20	.054
Monitor	**.56**	.17	.34
Printing, copying, scanning equipment	**.40**	.14	.26
Remote access to work files or network	.087	**.76**	.077
Computing equipment mobile/laptop/tablet	.23	**.69**	-.011
WiFi network connectivity	.31	**.62**	.060
Telephone equipment	-.062	**.58**	.38
Audio headset	.28	**.51**	.17
Computing equipment fixed desktop	.21	-.008	**.76**
Wired network connectivity	.091	.20	**.68**
Eigenvalue	2.20	1.18	1.41
Percentage of explained variance	19.96	19.81	12.81

Table I4
Principal Component Analysis – Experienced support of office activities

Experienced support of office activities	Components			
	Meetings	Collaborative and informal work	Concentrative work	Away from desk activities
Audio conferences	**.65**	.11	.28	.006
Video conferences	**.65**	.16	.076	.13
Business confidential discussions	**.59**	.10	.24	.20
Planned meetings	**.58**	.35	.13	-.096
Telephone conversations	**.56**	.027	.48	.058
Private conversations	**.53**	.12	.30	.17
Larger group meetings or audiences	**.51**	.35	-.13	.29
Informal social interaction	.10	**.65**	-.075	.16
Collaborating creative work	.10	**.64**	.20	.073
Learning from others	.041	**.62**	.23	.16
Collaborating on focussed work	.25	**.58**	.31	-.058
Informal unplanned meetings	.34	**.55**	.10	.002
Relaxing, taking a break	.16	**.47**	.18	.19
Individual focussed work, desk based	.22	.090	**.69**	.004
Reading	.15	.13	**.69**	.15
Thinking, creative thinking	.14	.36	**.56**	.16
Individual routine tasks	.12	.20	**.50**	.12
Using technical specialist equipment or materials	.056	.16	.13	**.66**
Spreading-out paper or materials	.081	.025	.29	**.66**
Hosting visitors, clients or customers	.41	.20	-.20	**.51**
Individual focused work, away from your desk	.14	.24	.26	**.29**
Eigenvalue	2.90	2.71	2.46	1.60
Percentage of explained variance	13.79	12.90	11.71	7.62

Table I5
Principal Component Analysis – Experienced support of home activities

Experienced support of home activities	Components			
	Collaborative and informal work	Individual and concentrative work	Meetings	Facility dependent
Informal social interaction	**.66**	.088	-.050	.17
Learning from others	**.65**	.20	.050	.13
Informal unplanned meetings	**.61**	.18	.22	-.048
Collaborating on focussed work	**.61**	.36	.19	-.11
Collaborating on creative work	**.61**	.36	.049	.041
Larger group meetings or audiences	**.54**	-.15	.34	.20
Hosting visitors, clients or customers	**.53**	-.24	-.089	.30
Reading	-.070	**.66**	.19	.10
Thinking, creative thinking	.14	**.62**	.15	.14
Individual focused work, desk based	.17	**.55**	.25	-.12
Individual routine tasks	.16	**.54**	.16	.029
Relaxing/taking a break	.14	**.46**	.16	.13
Individual focused work, away from your desk	.17	**.41**	.12	.29
Audio conferences	.12	.18	**.67**	-.025
Video conferences	.16	.073	**.66**	.064
Telephone conversations	-.055	.34	**.62**	.077
Business confidential discussions	-.007	.24	**.58**	.23
Planned meetings	.37	.20	**.55**	-.21
Private conversations	-.009	.30	**.51**	.27
Spreading out paper or materials	.032	.32	.14	**.64**
Using technical specialist equipment or materials	.32	.051	.093	**.64**
Eigenvalue	2.96	2.66	2.58	1.34
Percentage of explained variance	14.09	12.65	12.29	6.37

References

[1] K.S. Allen, D. Grelle, E.M. Lazarus, E. Popp, S.L. Gutierrez, Hybrid is here to stay: critical behaviors for success in the new world of work, Pers. Indiv. Differ. 217 (Feb. 2024) 112459, https://doi.org/10.1016/j.paid.2023.112459.

[2] M.B. Chafi, A. Hultberg, N.B. Yams, Post-pandemic office work : perceived challenges and opportunities for a sustainable work environment, Sustainability 14 (294) (2022) 1–20.

[3] L. Bergefurt, R. Appel-Meulenbroek, C. Maris, T. Arentze, M. Weijs-Perrée, Y. de Kort, The influence of distractions of the home-work environment on mental health during the COVID-19 pandemic, Ergonomics (Mar. 2022) 1–18, https://doi.org/10.1080/00140139.2022.2053590.

[4] D. Smite, N.B. Moe, J. Hildrum, J. Gonzalez-Huerta, D. Mendez, Work-from-home is here to stay: call for flexibility in post-pandemic work policies, J. Syst. Software 195 (Jan. 2023) 111552, https://doi.org/10.1016/j.jss.2022.111552.

[5] T. Walz, J.M. Kensbock, S.B. de Jong, F. Kunze, Lonely@Work@Home? The impact of work/home demands and support on workplace loneliness during remote work, Eur. Manag. J. (May 2023), https://doi.org/10.1016/j.emj.2023.05.001.

[6] K. Sailer, M. Thomas, R. Pachilova, The challenges of hybrid work: an architectural sociology perspective, Buildings and Cities 4 (1) (Aug. 2023) 650–668, https://doi.org/10.5334/bc.350.

[7] R. Appel-Meulenbroek, A. Kemperman, A. van de Water, M. Weijs-Perrée, J. Verhaegh, How to attract employees back to the office? A stated choice study on hybrid working preferences, J. Environ. Psychol. 81 (Jun. 2022) 101784, https://doi.org/10.1016/j.jenvp.2022.101784.

[8] I. De Been, T. Van der Voordt, B. Haynes, Productivity, in: Facilities Management and Corporate Real Estate Management as Value Drivers, Taylor & Francis, 2016.

[9] Eurofound, The Future of Telework and Hybrid Work, 2023. Luxembourg.

[10] C.B. Gibson, L.L. Gilson, T.L. Griffith, T.A. O'Neill, Should employees be required to return to the office? Organ. Dynam. 52 (2) (Apr. 2023) 100981 https://doi.org/10.1016/j.orgdyn.2023.100981.

[11] S.T. Innstrand, M. Christensen, K. Grødal, C. Banks, Within- and between-person changes in work practice and experiences due to COVID-19: lessons learned from employees working from home, hybrid working, and working at the office, Front. Psychol. 13 (Dec) (2022), https://doi.org/10.3389/fpsyg.2022.948516.

[12] G. Bäcklander, A. Richter, Relationships of task–environment fit with office workers' concentration and team functioning in activity-based working environments, Environ. Behav. 54 (6) (Jul. 2022) 971–1004, https://doi.org/10.1177/00139165221115181.

[13] Z. Zamani, D. Gum, Activity-based flexible office: exploring the fit between physical environment qualities and user needs impacting satisfaction, communication, collaboration and productivity, J. Corp. R. Estate 21 (3) (2019) 234–253, https://doi.org/10.1108/JCRE-08-2018-0028.

[14] C.P. Burmeister, J. Moskaliuk, U. Cress, Office versus leisure environments: effects of surroundings on concentration, J. Environ. Psychol. 58 (February) (2018) 42–51, https://doi.org/10.1016/j.jenvp.2018.07.011.

[15] N. Rupcic, Working and learning in a hybrid workplace: challenges and opportunities, Learn. Organ. 31 (2) (Mar. 2024) 276–283, https://doi.org/10.1108/TLO-02-2024-303.

[16] Y. Al Horr, M. Arif, A. Kaushik, A. Mazroei, M. Katafygiotou, E. Elsarrag, Occupant productivity and office indoor environment quality: a review of the literature, Build. Environ. 105 (2016) 369–389, https://doi.org/10.1016/j.buildenv.2016.06.001 [Online]. Available:.

[17] J. van den Berg, R. Appel-Meulenbroek, A. Kemperman, M. Sotthewes, Knowledge workers' stated preferences for important characteristics of activity-based workspaces, Build. Res. Inf. 48 (7) (2020) 703–718, https://doi.org/10.1080/09613218.2020.1726169.

[18] C. Candido, L. Thomas, S. Haddad, F. Zhang, M. Mackey, W. Ye, Designing activity-based workspaces: satisfaction, productivity and physical activity, Building Research & Information 47 (3) (2019) 275–289, https://doi.org/10.1080/09613218.2018.1476372.

[19] C.F. Ng, Teleworker' s home office : an extension of corporate office, Facilities 28 (3) (2010) 137–155, https://doi.org/10.1108/02632771011023113.

[20] S. Marzban, I. Durakovic, C. Candido, M. Mackey, Learning to work from home: experience of Australian workers and organizational representatives during the first Covid-19 lockdowns, J. Corp. R. Estate 23 (3) (Aug. 2021) 203–222, https://doi.org/10.1108/JCRE-10-2020-0049.

[21] A. Tleuken, et al., Effects of the residential built environment on remote work productivity and satisfaction during COVID-19 lockdowns: an analysis of workers' perceptions, Build. Environ. 219 (Jul. 2022) 109234, https://doi.org/10.1016/j.buildenv.2022.109234.

[22] L. Bergefurt, R. Appel-Meulenbroek, T. Arentze, M. Weijs-Perrée, Y. de Kort, Satisfaction with activity-support and physical home-workspace characteristics in relation to mental health during the COVID-19 pandemic, J. Environ. Psychol. 81 (June 2022) 101826, doi:10.1016/j.jenvp.2022.101826.

[23] J. Radun, V. Hongisto, Perceived fit of different office activities – the contribution of office type and indoor environment, J. Environ. Psychol. 89 (Aug. 2023) 102063, https://doi.org/10.1016/j.jenvp.2023.102063.

[24] C. Srivastava, E. Murnane, S. Billington, H. Samuelson, Impact of workplace design on perceived work performance and well-being: home versus office, J. Environ. Psychol. (Mar. 2024) 102274, https://doi.org/10.1016/j.jenvp.2024.102274.

[25] L. Skountridaki, W.V. Lee, L. Rouhani, Missing voices: office space discontent as a driving force in employee hybrid work preferences, Ind. Relat. J. 55 (1) (Jan. 2024) 54–77, https://doi.org/10.1111/irj.12415.

[26] C. Bodin Danielsson, L. Bodin, B.C. Danielsson, L. Bodin, Office type in relation to health, well-being, and job satisfaction among employees, Environ. Behav. 40 (5) (2008) 636–668, https://doi.org/10.1177/0013916507307459.

[27] H. Jahncke, D.M. Hallman, Objective measures of cognitive performance in activity based workplaces and traditional office types, J. Environ. Psychol. 72 (Dec. 2020), https://doi.org/10.1016/j.jenvp.2020.101503.

[28] C. Bodin Danielsson, The office architecture: a contextual experience with influences at the individual and group level, in: Context, Elsevier, 2019, pp. 431–455, https://doi.org/10.1016/B978-0-12-814495-4.00021-0.

[29] A. Haapakangas, D.M. Hallman, S.E. Mathiassen, H. Jahncke, Self-rated productivity and employee well-being in activity-based offices: the role of environmental perceptions and workspace use, Build. Environ. 145 (2018) 115–124, https://doi.org/10.1016/j.buildenv.2018.09.017.

[30] M. Öhrn, et al., Productivity, satisfaction, work environment and health after relocation to an activity-based flex office—the active office design study, Int. J. Environ. Res. Publ. Health 18 (14) (Jul. 2021) 7640, https://doi.org/10.3390/ijerph18147640.

[31] S. Masoudinejad, J.A. Veitch, The effects of activity-based workplaces on contributors to organizational productivity: a systematic review, J. Environ. Psychol. 86 (Mar. 2023) 101920, https://doi.org/10.1016/j.jenvp.2022.101920.

[32] M. Forooraghi, Healthy Offices - Conceptualizing Healthy Activity-Based Offices, Chalmers University of Technology, Gotenburg, 2022.

[33] Y.K. Kim, Y. Abdou, A. Abdou, H. Altan, Indoor environmental quality assessment and occupant satisfaction: a post-occupancy evaluation of a UAE university office building, Buildings 12 (7) (Jul. 2022) 986, https://doi.org/10.3390/buildings12070986.

[34] T. Cuerdo-Vilches, M.Á. Navas-Martín, S. March, I. Oteiza, Adequacy of telework spaces in homes during the lockdown in Madrid, according to socioeconomic factors and home features, Sustain. Cities Soc. 75 (2021), https://doi.org/10.1016/j.scs.2021.103262.

[35] I. De Been, M. Beijer, The influence of office type on satisfaction and perceived productivity support, J. Facil. Manag. 12 (2) (Apr. 2014) 142–157, https://doi.org/10.1108/JFM-02-2013-0011.

[36] E.N. Yunus, E. Ernawati, Productivity paradox? The impact of office redesign on employee productivity, Int. J. Prod. Perform. Manag. 67 (9) (Nov. 2018) 1918–1939, https://doi.org/10.1108/IJPPM-12-2017-0350.

[37] M. Khoshbakht, G. Baird, E.O. Rasheed, The influence of work group size and space sharing on the perceived productivity, overall comfort and health of occupants in commercial and academic buildings, Indoor Built Environ. 30 (5) (Jun. 2021) 692–710, https://doi.org/10.1177/1420326X20912312.

[38] M. Awada, G. Lucas, B. Becerik-gerber, S. Roll, Working from home during the COVID-19 pandemic : impact on office worker productivity and work experience, Work 69 (2021) 1171–1189, https://doi.org/10.3233/WOR-210301.

[39] B. Haynes, L. Suckley, N. Nunnington, Workplace productivity and office type: an evaluation of office occupier differences based on age and gender, J. Corp. R. Estate 19 (2) (2017) 111–138, https://doi.org/10.1108/JCRE-11-2016-0037.

[40] M. Weijs-Perrée, R. Appel-Meulenbroek, T. Arentze, Analysing knowledge sharing behaviour in business centres: a mixed multinomial logit model, Knowl. Manag. Res. Pract. 18 (3) (Jul. 2020) 323–335, https://doi.org/10.1080/14778238.2019.1664269.

[41] J. Kim, R. de Dear, C. Candido, H. Zhang, E. Arens, Gender differences in office occupant perception of indoor environmental quality (IEQ), Build. Environ. 70 (Dec. 2013) 245–256, https://doi.org/10.1016/j.buildenv.2013.08.022.

[42] M. Awada, B. Becerik-Gerber, G. Lucas, S.C. Roll, Associations among home indoor environmental quality factors and worker health while working from home during COVID-19 pandemic, ASME Journal of Engineering for Sustainable Buildings and Cities 2 (4) (Nov. 2021), https://doi.org/10.1115/1.4052822.

[43] N. Shrestha, Factor analysis as a tool for survey analysis, Am. J. Appl. Math. Stat. 9 (1) (Jan. 2021) 4–11, https://doi.org/10.12691/ajams-9-1-2.

[44] A. Soriano, M.W. Kozusznik, J.M. Peiró, C. Mateo, The role of employees' work patterns and office type fit (and misfit) in the relationships between employee well-being and performance, Environ. Behav. 52 (2) (Feb. 2020) 111–138, https://doi.org/10.1177/0013916518794260.

[45] A. Seddigh, Workplace strategy for the flexible office. Norderstedt, BoD - Books on Demand, 2023.

[46] R.A. Armstrong, Is there a large sample size problem? Ophthalmic Physiol. Opt. 39 (3) (May 2019) 129–130, https://doi.org/10.1111/opo.12618.