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On workers' fit with activity-based work environments

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**On Workers' Fit with
Activity-Based Work Environments**

Jan Gerard Hoendervanger

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Summary

Due to the rise of knowledge work since the 1980s, high job autonomy and high task variety have become common job characteristics. Knowledge workers increasingly work across multiple locations, using advanced information and communication technologies; a trend that is expected to accelerate in the post-COVID-19 world of work. As these developments fundamentally change the use of office work environments, organizations and workplace professionals have been searching for new ways to facilitate the workforce more effectively and efficiently. In the past two decades, more and more of them seem to have found the ultimate solution in activity-based working (ABW). According to this concept, workers share a variety of non-assigned work settings, enabling them to use different work settings in accordance with their varying tasks. Yet, outcomes of ABW environments generally fall short of expectations. Remarkably, while sharing the same ABW environment, some workers seem to experience fit while others do not.

Optimization of perceived fit with ABW environments is important for organizations, since it is linked to various work outcomes. Currently, this is particularly relevant in the context of expected post-COVID-19 changes in work practices. To find clues for optimization of ABW practice, the current PhD research project was designed to examine how workers' jobs, tasks, behaviors, psychological needs, and demographic characteristics may be related to their perceived fit. Two survey-based studies revealed relevant workers' attributes, which were further examined in experience-sampling field studies and a virtual reality experiment. From the findings, a clear profile arises of workers who best fit with ABW environments, i.e.: high task variety, job autonomy, external and internal mobility, social interaction, and need for relatedness; low need for privacy; few high-complexity tasks, many non-individual tasks; appropriately using open and closed work settings; frequently switching between work settings; relatively young age.

The findings demonstrate that perceived fit, resulting from the alignment of workers' needs and abilities with the environment's supplies and demands, plays a central role in the origin of mixed outcomes of ABW environments. Hence, Person-Environment (P-E) fit theory provides a useful framework for expanding our understanding of underlying factors. At the same time, adopting a P-E fit approach

in ABW research helps filling a gap in P-E fit literature, in which, as yet, the physical aspects of the work environment seem underexposed.

With regard to the ABW concept, this research shows that it may indeed make sense to provide a variety of non-assigned work settings, as it generally fits with job characteristics that are typical of knowledge work (i.e. high autonomy, high task variety, high social interaction, high external mobility, and high internal mobility). However, this also implies suboptimal fit for workers who not match this profile, some of whom may be better off with an assigned work setting that is tailored to their needs. Furthermore, the ABW concept should be extended to acknowledge that, in addition to work activities (i.e., tasks), workers' jobs, behaviors, psychological needs, and demographic characteristics influence their perceived fit as well. The findings from this research indicate that ABW is not a one-size-fits-all solution, which should be implemented carefully to ensure that: (1) the supply of different types of work settings actually matches the needs of the workforce, (2) workers switch between these work settings in accordance with their activity patterns.

In current ABW practice, both requirements seem to be widely compromised, particularly with respect to individual high-concentration work. Lack of privacy for high-concentration work appeared to be the single-most important issue in current ABW practice, due to the highly prevalent use of open work settings for this type of work. This particularly affects workers in jobs in which this type of work is central, especially when they are high in need for privacy. A two-fold approach is recommended to resolve this issue: (1) facilitate high-concentration work by providing sufficient (single- and multi-person) closed work settings for individual work, (2) stimulate the use of such work settings by removing ergonomical, psycho-social, and practical barriers. This approach should be integrated in a comprehensive design and change process that is informed by a thorough pre-project analysis of the workers' needs and abilities and the organizational context.

Are ABW environments future proof, in the light of expected post COVID-19 changes? According to current insights, these changes may particularly include an increased, structural adoption of working from home, blended working practices and time-spatial job crafting. As a consequence, a general increase in workers' fit with ABW environments is expected due higher job autonomy, higher external mobility, less office time spent on individual high-concentration work (i.e., more

focus on non-individual work), and more setting-switching. Furthermore, increased external mobility may strengthen the cost-saving argument for ABW. Hence, ABW environments are probably here to stay and the already growing adoption might even accelerate in the post-COVID-19 world of work. This calls for further research to enable evidence-based optimization of workers' fit with ABW environments.

Based on the current research project and expected changes in knowledge work practices, effective future ABW environments may be envisioned which integrate: (1) extensive supply of attractive, inspiring settings for formal and informal face-to-face interactions, (2) sufficient supply of closed work settings to support individual high-concentration work and video calls, (3) state-of-the-art ICT and adequate closed work settings for virtual teamwork, (4) a work culture that fosters time-spatial job crafting and optimal use of various work settings at the office.

Samenvatting

Dankzij de groei van kenniswerk sinds de jaren '80, worden tegenwoordig veel banen gekenmerkt door een hoge mate van autonomie en afwisseling tussen verschillende typen werkzaamheden. Geavanceerde informatie- en communicatie-technologie (ICT) stelt kenniswerkers steeds beter in staat om afwisselend gebruik te maken van verschillende werklocaties; een trend die naar verwachting versterkt zal doorzetten na de COVID-19 periode. Al deze ontwikkelingen veranderen het gebruik van kantooromgevingen ingrijpend. Daarom vragen veel organisaties, adviseurs en ontwerpers zich af hoe de werkomgeving hedendaagse kenniswerkers effectiever en efficiënter kan ondersteunen. In de afgelopen twintig jaar lijken steeds meer van hen het ultieme antwoord te hebben gevonden: activiteitgerelateerd werken (activity-based working; ABW). Volgens dit concept beschikt een groep medewerkers over een gevarieerd aanbod van niet-persoonsgebonden werkplekken, waardoor zij afwisselend verschillende typen plekken kunnen gebruiken voor hun uiteenlopende werkzaamheden. Tot op heden vallen de praktijkervaringen met ABW omgevingen over het algemeen echter tegen. Daarbij valt op dat sommige mensen fit¹ lijken te ervaren en anderen juist niet, terwijl zij dezelfde werkomgeving gebruiken.

Optimalisatie van de fit die medewerkers ervaren met de ABW omgeving is belangrijk voor organisaties met het oog op daaraan gerelateerde werkprestaties en andere uitkomsten van het werk. De urgentie van het vraagstuk wordt vergroot door verwachte veranderingen in manieren van werken na de COVID-19 periode. Dit promotieonderzoek is gericht op het vinden van aanknopingspunten voor optimalisatie van ABW omgevingen. In dat kader is onderzocht op welke manier verschillen tussen medewerkers – in termen van functiekenmerken, taakkenmerken, gedragspatronen, psychologische behoeften en demografische kenmerken – kunnen samenhangen met de fit die zij ervaren in een ABW omgeving. Uit twee vragenlijstonderzoeken kwamen relevante factoren naar voren, die vervolgens nader werden bestudeerd aan de hand van data uit veldstudies waarbij experience sampling werd toegepast en een lab experiment in een virtual reality studio. Op basis van de uitkomsten kan een duidelijk profiel worden geschetst van mensen die fit ervaren met ABW omgevingen, namelijk: veel verschillende taken;

¹ De term 'fit' laat zich moeilijk vertalen; in de context van dit onderzoek wordt ermee bedoeld dat de werkomgeving past bij de persoon met zijn behoeften en mogelijkheden.

hoge mate van autonomie, externe mobiliteit, interne mobiliteit en sociale interactie; sterke behoefte aan sociale verbondenheid; weinig behoefte aan privacy; weinig hoog-complexe taken; veel niet-individuele taken; op het juiste moment gebruikmakend van open c.q. gesloten werkplekken; frequent wisselend tussen verschillende werkplekken; relatief jong.

De bevindingen laten zien dat de ervaren fit, als gevolg van de interactie tussen kenmerken van de persoon en kenmerken van de werkomgeving, een centrale rol speelt in het ontstaan van wisselende ervaringen met ABW omgevingen. Dit betekent dat de Person-Environment (P-E) fit theorie een goede basis biedt om meer inzicht te krijgen in onderliggende factoren. Tegelijkertijd wordt, door een P-E fit benadering te hanteren in onderzoek naar ABW omgevingen, een witte vlek in de P-E fit literatuur verkleind. In die literatuur zijn fysieke aspecten van de werkomgeving namelijk nog nauwelijks belicht.

Dit onderzoek laat zien dat het aanbieden van een variëteit aan flexibel te gebruiken werkplekken in beginsel goed past bij hedendaags kenniswerk (met veel verschillende taken en een hoge mate van autonomie, sociale interactie en externe en interne mobiliteit). Dit impliceert echter ook dat het concept minder geschikt is voor functies met een ander profiel; een deel van de betreffende medewerkers functioneert mogelijk beter op een vaste werkplek die is toegesneden op hun behoeften. Verder geven de onderzoeksresultaten aan dat het ABW concept zou moeten worden uitgebreid met de notie dat, naast werk activiteiten, ook functiekenmerken, gedragspatronen, psychologische behoeften en demografische kenmerken bepalend zijn voor de ervaren fit. Tot slot onderstrepen de onderzoeksresultaten het belang van een zorgvuldige implementatie, die ervoor zorgt dat: (1) het aanbod van verschillende typen werkplekken (de 'werkplekmix') daadwerkelijk aansluit bij de behoeften en mogelijkheden van de gebruikers, (2) gebruikers van de ABW omgeving daadwerkelijk gebruik maken van verschillende werkplekken (door van plek te wisselen) voor hun uiteenlopende werkzaamheden.

Het lijkt erop dat beide aspecten van een zorgvuldige implementatie in de huidige praktijk vaak niet goed worden ingevuld, vooral waar het gaat om individueel concentratiewerk. Gebrek aan privacy, ten gevolge van het gebruik van open werkplekken voor dit type werk, kwam naar voren als het grootste knelpunt in de huidige ABW praktijk. Dit raakt vooral mensen wiens baan in belangrijke mate bestaat uit concentratiewerk, in het bijzonder degenen die, als persoon, een sterke

behoefte hebben aan privacy. Het probleem kan worden opgelost met een tweeledige aanpak: (1) concentratiewerk goed faciliteren door hiervoor voldoende (eenpersoons en meerpersoons) gesloten werkplekken te creëren, (2) het gebruik van deze werkplekken stimuleren door ergonomische, psychosociale en praktische barrières weg te nemen. Deze aanpak zou onderdeel moeten zijn van een integraal ontwerp- en veranderproces, dat start met een gedegen analyse van de behoeften en mogelijkheden van de gebruikerspopulatie en de organisatiespecifieke context.

In hoeverre zijn ABW omgevingen toekomstbestendig, in het licht van verwachte veranderingen na de COVID-19 periode? Op basis van de huidige inzichten wordt met name een versnelling verwacht in de adoptie van thuiswerken en blended working (ook wel: 'Het Nieuwe Werken' of 'hybride werken'), waarbij mensen meer bewuste, individuele keuzes maken met betrekking tot het werken op bepaalde plekken en tijdstippen (time-spatial job crafting). Naar verwachting draagt deze ontwikkeling, in het algemeen, bij aan een betere fit met ABW omgevingen, dankzij een toename van autonomie en externe mobiliteit, gekoppeld aan een afname van de tijd die op kantoor wordt besteed aan concentratiewerk, waarbij er meer van plek wordt gewisseld. Daarnaast kan een toename van thuiswerken ervoor zorgen dat de belangstelling voor het ABW concept verder groeit vanuit het oogpunt van kostenbesparing. Al met al kunnen we er vanuit gaan dat organisaties zullen doorgaan met het implementeren van ABW omgevingen en dat deze trend zich mogelijk zelfs versterkt voortzet. Tegen deze achtergrond is verder onderzoek naar ABW omgevingen gewenst, gericht op gefundeerde optimalisatie van de fit die mensen met deze omgevingen ervaren.

Op basis van dit promotieonderzoek en de verwachte veranderingen in de manier waarop kenniswerkers hun werk uitvoeren, kunnen we het volgende toekomstbeeld van effectieve ABW omgevingen schetsen: (1) een uitgebreid aanbod van aantrekkelijke, inspirerende plekken voor formele en informele sociale interactie (face-to-face), (2) voldoende aanbod van gesloten werkplekken om concentratiewerk en videobellen te ondersteunen, (3) geavanceerde ICT voorzieningen en adequate, gesloten plekken voor samenwerken en ('hybride') overleg op afstand, (4) een werkcultuur die bewust gebruik van verschillende werklocaties en werkplekken, afgestemd op persoonlijke behoeften en mogelijkheden, ondersteunt.

CHAPTER 1

General introduction

Workers' fit with activity-based work environments

Since the 1980s, the world has seen a spectacularly growth of knowledge work (Van Yperen et al., 2014; Zumbun, 2016), currently accounting for around 40% of the total workforce in advanced economies like the EU and the US (Davenport, 2005; Greene & Myerson, 2011; Seddigh, 2015). As a consequence, high job autonomy and high task variety (including both collaborative and individual high-concentration tasks) have become common job characteristics (Davenport, 2005; Duffy & Powell, 1997; Newport, 2016). Furthermore, blended working practices, involving high external mobility, are increasingly adopted (Greene & Myerson, 2011; Van Yperen et al., 2014) – a trend that is expected to accelerate in the post-COVID-19 world of work (Kniffin et al., 2020; Rudolph et al., 2020). These developments have driven innovation in workplace concepts over the past decades (Becker et al., 1994; Van der Voordt & Van Meel, 2000; Van Meel, 2011), followed by a growing, worldwide adoption of activity-based working (ABW) in recent years (Cushman & Wakefield, 2013; Leesman, 2017; Van Meel, 2019).

ABW requires a work environment that provides a range of choice of non-assigned work settings, designed to support different work activities (Becker, 1999; Van Meel, 2019, Veldhoen, 2005). The concept is supposed to fit well with the aforementioned key characteristics of contemporary knowledge work i.e., high job autonomy, high task variety, and high external mobility (Duffy & Powell, 1997). The growing popularity of the ABW concept among organizations is understandable, as it is expected to combine effective support of the workforce with improved cost-efficiency (Cushman & Wakefield, 2013; Van Meel, 2019). Since fewer workstations than workers are needed, expected savings on real estate and facilities costs are usually realized (Oseland & Webber, 2012; Van Meel, 2019). When it comes to effective support of the workforce however, previous research has shown mixed outcomes. Typical findings include user dissatisfaction due to lack of privacy, and the loss of an assigned workstation (Babapour, 2019; Bodin Danielsson & Bodin, 2009; De Been & Beijer, 2014; Engelen et al., 2019; Van der Voordt, 2004) and a

widespread reluctance to switch among work settings (Blok et al., 2009; Qu et al., 2010; Appel-Meulenbroek et al., 2011). In terms of Person-Environment (P-E) fit theory (Edwards et al., 1998), workers often do not seem to experience fit between their needs and the ABW environment.

Optimizing perceived fit with ABW environments is important for organizations, as it has been found to be linked to satisfaction with the work environment and collaboration (Gerdenitsch et al., 2018; Haapakangas et al., 2018b; Zamani & Gum, 2019), communication and perceived productivity (Zamani & Gum, 2019), and job attitudes and vitality (Wohlers et al., 2019). Furthermore, through its link with satisfaction with the work environment, perceived fit may indirectly impact job satisfaction (Carlopio, 1996; Veitch et al., 2007) and employee engagement (Ipsos, 2016). This implies that experienced misfits can be regarded as clear indicators that the workforce is *not* effectively supported. In economic terms, the costs associated with negative labour-related outcomes may easily exceed the cost-savings associated with real estate and facilities (Brill & Weidemann, 2001; Kampschroer & Heerwagen, 2005). Given its impact on labour-related outcomes, optimizing perceived fit with ABW environments is not only in the interest of organizations, it may also contribute to the personal well-being of workers, and to the prosperity of the society as a whole.

The purpose of the current research was to identify and analyze antecedents of perceived fit with ABW environments, as these may provide clues for optimization. To do so, the differences within organizations, that were observed in previous ABW research (e.g., Göçer et al., 2018; Leesman, 2017), were taken as a starting point. Such differences indicate that some (groups of) workers experience fit in an ABW environment, while others do not. In line with Wohlers and Hertel (2017), it was assumed that the underlying factors would be both person-related (i.e., demographic characteristics, psychological needs, and behavioral patterns) and job-related (i.e., job and task characteristics). Hence, the current research project was designed to examine how workers' jobs, tasks, behaviors, psychological needs, and demographic characteristics may be related to their perceived fit with ABW environments.

Activity-based working and the work environment

ABW is part of wider changes that affect the work that is carried out in office work environments². These work environments are used mostly by knowledge workers, a category that was defined by Davenport (2005, p. 10) as workers who “have high degrees of expertise, education, or experience, and the primary purpose of their jobs involves the creation, distribution, or application of knowledge”. Due to information and communication technology (ICT) taking over other types of office work, more and more office workers belong to this category and their work has become central to the organizations they work for (Davenport, 2005; Duffy & Powell, 1997; Newport, 2016). Knowledge work typically involves a high degree of job autonomy (Davenport, 2005), meaning that knowledge workers have freedom, independence, and discretion in when and how to carry out their tasks (Morgeson & Humphrey, 2006). These tasks generally include both collaborative work, which involves social interaction, and individual work (Duffy & Powell, 1997). Within the latter category, the importance of high-complexity work, which requires concentration, is increasing (Newport, 2016). The combination of different types of work implies that knowledge workers’ jobs are typically characterized by a high degree of task variety (Morgeson and Humphrey, 2006).

Along with the rise of knowledge work, the way it is carried out has changed, again due to the advancement of ICT, which provides flexibility in where and when people work (Van Yperen & Wörtler, 2017; Wessels et al., 2019). The term ‘blended working’ was introduced for the way of working that is based on this flexibility, using different locations (e.g., employer’s office, home office, co-working office, on the move), both during and outside office hours (Van Yperen et al., 2014). Such a location-independent and time-independent way of working is typical for knowledge workers, allowing them to work at the most appropriate times and places to meet both personal and organizational needs. According to Greene and Myerson (2011), knowledge workers may use their employer’s office more or less frequently – as their ‘home base’ or rather as one of the nodes in a network of different work locations – depending on their external mobility (i.e., to what extent they are working at different locations). Recently, Wessels et al., (2019) introduced ‘time-spatial job crafting’, arguing that, in the context of blended working, workers

² In addition to office buildings, such work environments are also found in parts of buildings for in e.g. healthcare, education, and manufacturing.

are required to actively reflect on, and make changes to their work, relating to choices with regard to working hours, places, and locations of work.

Building on many earlier publications (e.g., Becker, 1999; Duffy & Powell, 1997; Stone & Luchetti, 1985) the term ABW was introduced by Veldhoen (2005) to describe a flexible way of working *within* an office building. Van Meel (2019, p. 10) defines ABW as “a way of working in which employees make shared use of a diversity of work settings that have been designed to support different kinds of activities”. In line with blended working, ABW enables workers to make their own choices with regard to where and with whom they work across the work environment (Van Meel, 2019). An integrated approach, including the design of the physical work environment, introduction of ICT solutions, and behavioral/organizational change (sometimes referred to as ‘bricks, bytes, and behavior’), has proven to be key to successful implementation of ABW (De Kok, 2018; Van Meel, 2019; Veldhoen, 2005).

With regard to the physical work environment, the defining characteristic of an ABW environment is a variety of different types of (i.e., activity-based) non-assigned work settings (Becker, 1999; Van Meel, 2019, Veldhoen, 2005). The term ‘work setting’ covers different types of workstations, rooms, and areas within the work environment, each designed to support a specific type of work activity, e.g. places for collaboration, concentration, communication, creativity, confidentiality, and contemplation (Harris, 2015). The basic rationale underlying the ABW concept is that it enables workers to use the most appropriate work setting at all times, by switching between different types of work settings when switching among different kinds of activities (Van Koetsveld & Kamperman, 2011).

The origins of the ABW concept date back to the 1970s (Van Meel, 2011). A famous early experiment with non-assigned workstations in a so-called ‘non-territorial office’, in which workers could “locate themselves anywhere that they wish on any given day, or at different times during a day” was conducted at IBM (Allen & Gerstberger, 1973, p. 487). In 1985, Stone and Luchetti (1985, p. 106). launched the idea that workers should “move to various specialized activity settings as [their] tasks change”, because this would “resolve the dilemma of providing both privacy and participation”. This dilemma results from the fact that social interaction (as part of collaborative work) may easily distract co-workers focusing on individual work, while both are vital parts of the work that needs to be supported (Brill &

Weideman, 2001; Haynes, 2007). To date, the provision of separate work settings for collaborative and individual work, to avoid distractions, is a key feature of ABW environments (Van Meel, 2019).

During the 1990s, more and more ABW (pilot) projects were undertaken by corporate and public organizations, which received increasing attention of media, workplace professionals, and researchers (Becker et al., 1994; Van der Voordt & Van Meel, 2000). In this phase, ABW was not yet considered a proven concept, and many of the early adopters struggled with resistance to change and disappointing ICT solutions (Van Meel, 2019). During the first decades of the 21st century, when the ABW concept was further adopted worldwide, it seemed to be coming of age and even becoming mainstream (Cushman & Wakefield, 2013; Leesman, 2017; Wohlers & Hertel, 2017; Van Meel, 2019). At first sight, this development seems to be grounded in a good fit of the ABW environment with important characteristics of contemporary knowledge work. That is, a range of choice of different work settings, to be used on an as-needed basis, might be expected to enhance job autonomy and support task variety. Still, the dispute between those in favor of and those against ABW solutions continues, fueled by recent mixed research findings (e.g., Babapour, 2019; Engelen et al., 2019; Göçer et al., 2018; Leesman, 2017). These mixed findings seem to indicate that ABW is not a one-size-fits-all solution, and that there is a series of contingency factors that may explain why workers may, or may not, fit with ABW environments.

Perceived Person-Environment fit in the context of ABW

The current research project draws on P-E fit theory to analyze potential antecedents of workers' perceived fit with ABW environments. This theory postulates that a misfit between personal and environmental characteristics causes various psychological strains, which negatively affect organizational outcomes (Edwards et al., 1998). Empirical studies have shown that P-E fit is indeed related to various outcomes such as job satisfaction, performance, organizational commitment, turnover, and psychological and physical well-being (Edwards et al., 2006).

Although many different aspects of 'environment' have been studied (e.g., vocation/job, organization/group, manager), P-E fit literature, as yet, generally

seems to have overlooked the *physical* work environment (Kristof-Brown & Guay, 2011). Yet, Appel-Meulenbroek et al. (2020a) argued that the physical work environment can play a pivotal role in achieving P-E fit. Recently, some scholars have adopted a P-E fit approach in empirical studies on ABW environments, showing its potential for further research in this field by linking it to outcomes such as satisfaction with the work environment and collaboration (Gerdenitsch et al., 2018; Haapakangas et al., 2018b; Zamani & Gum, 2019), communication and perceived productivity (Zamani & Gum, 2019), and job attitudes and vitality (Wohlers et al., 2019). These findings suggest that adopting a P-E fit approach may advance our understanding of ABW environments, and at the same time contribute to filling a gap in P-E fit literature (i.e., workers' fit with the physical work environment).

P-E fit may be broadly defined as the compatibility between a person and the environment; however, this compatibility can be conceptualized in different ways: supplementary fit derives from similarity between personal and environmental characteristics (e.g., personal values match with organizational values), whereas complementary fit derives either from a match between a person's needs and environmental supplies (i.e., needs-supplies fit), or from a match between environmental demands and a person's abilities (i.e., demands-abilities fit) (Kristof-Brown & Guay, 2011). While some studies assess P-E fit indirectly by comparing separately (i.e., objectively or subjectively) measured commensurate characteristics of Person and Environment, there is agreement in P-E fit literature that direct measures of subjectively experienced fit (i.e., perceived fit) are more powerful predictors of outcomes (Edwards et al., 1998; Kristof-Brown et al., 2005). Hence, in the current research project, perceived fit with ABW environments was used as the central variable.

The (perceived) alignment of personal and environmental characteristics is central to P-E fit theory. This implies that, like in other organizational theories (e.g., Hackman & Lawler, 1971; McClelland & Burnham, 1976), individual differences are explicitly taken into account. In the context of ABW, relevant individual differences concern both personal characteristics and job or task characteristics (Appel-Meulenbroek et al., 2020a; Wohlers & Hertel, 2017). The current thesis focuses on workers' job characteristics (Chapter 2, 3, and 5), task characteristics (Chapter 4), behaviors (Chapter 2 and 5), psychological needs (Chapter 3 and 4), and demographic characteristics (Chapter 3).

A specific feature of the ABW environment is that, in the course of a working day, workers may use different work settings for different work activities, which may yield different P-E fit experiences. Hence, to enable the analysis of perceived fit in relation to specific setting-activity combinations, we³ used experience sampling (Larson & Csikszentmihalyi, 1983) to collect perceived fit scores at random moments during the working day (Chapter 4 and 5). Furthermore, in a lab experiment, we measured perceived fit related to specific simulated setting-activity combinations (Chapter 4). In line with affective events theory (Weiss & Cropanzano, 1996; Ashkanasy et al., 2014), we considered the use of specific work settings for specific activities as a 'work events', which yield momentary experiences of (mis)fit that, over time, create workers' general perception of fit with the ABW environment (Chapter 4 and 5).

Satisfaction with activity-based work environments

According to P-E fit theory, perceived fit is a predictor of workers' satisfaction (Edwards et al., 1998). Indeed, previous ABW research linked perceived fit to satisfaction with the work environment (Gerdenitsch et al., 2018; Haapakangas et al., 2018b; Zamani & Gum, 2019). Given this direct relationship, we used satisfaction with the work environment as a proxy for perceived fit with the ABW environment in our surveys (Chapter 2 and 3)⁴. Furthermore, in Chapter 4, we replicated the link between satisfaction with the work environment and perceived fit.

Including satisfaction with the work environment as an outcome variable helps embedding this research in broader work environment research, as it is traditionally focused on measuring user satisfaction (Vischer, 2007). Optimizing satisfaction with the physical work environment is important for organizations, since this has been found to be related directly to job satisfaction and indirectly to other organizational outcomes such as commitment, intention to leave, engagement,

³ 'We' and 'our' are used when referring to the contents of Chapter 2 – 5, to acknowledge the contributions of the co-authors.

⁴ To enhance the readability of this thesis, findings based on measuring satisfaction (i.e., from Chapter 2 and 3) are sometimes referred to as findings regarding perceived fit.

and absenteeism (Carlopio, 1996; Ipsos, 2016; Rashid & Zimring, 2008; Veitch et al., 2007; Wohlers et al., 2019).

With regard to ABW environments, previous research has shown that satisfaction is usually below expectations, with concentration, privacy, and the loss of an assigned workstation as major self-reported issues (Babapour, 2019; Bodin Danielsson & Bodin, 2009; De Been & Beijer, 2014; Engelen et al., 2019; Van der Voordt, 2004). These studies also show large differences among workers who share the same ABW environment, which supports the relevance of examining P-E fit as an underlying variable.

Design and overview of the research project

The current research project was designed to examine between-person differences in perceived fit with ABW environments. The overall research model (see Figure 1.1) includes workers' jobs, tasks, behaviors, psychological needs, and demographic characteristics as potential antecedents of perceived fit. Satisfaction with the work environment was included, both as an outcome variable and as a proxy for perceived fit. Furthermore, task performance was included as an outcome variable.

Figure 1.1 Overall research model.

The research project comprises a series of five related empirical studies, each covering a specific part of the overall research model (see Table 1.1). The validity of the integrated findings was enhanced by using multiple methods and data sources across the five studies (Mathison, 1988). The first studies were focused on identifying workers' attributes that are related to perceived fit (Chapter 2 and 3). These attributes were examined more closely in the follow-up studies (Chapter 4 and 5).

Table 1.1 *Overview of the chapters and studies, with methods and variables, that are included in this dissertation.*

<i>Chapter</i>	<i>Study</i>	<i>Method</i>	<i>Variables</i>
2	1	Survey	Switching behavior, activity pattern, satisfaction with work environment
3	2	Survey	Job characteristics, psychological needs, age, gender, satisfaction with work environment
4	3	Experience sampling	Activity, work setting, need for privacy, perceived fit, satisfaction with work environment
	4	Virtual reality lab experiment	Activity, work setting, need for privacy, perceived fit, satisfaction with work environment, task performance
5	5	Experience sampling	Use of work settings, setting-switching, activity-switching, perceived fit

Chapter 2. To establish a solid starting point for our perceived fit studies, we analyzed a large existing dataset that was built by the Dutch Center for People and Buildings, using a standardized survey for post-occupancy evaluation of ABW environments (Maarleveld et al., 2009). This study was focused on explaining individual differences in satisfaction with ABW environments, as a proxy for perceived fit, from (job-related) differences in switching behavior. Hence, the two

main questions were: (1) Is switching behavior related to satisfaction with ABW environments? (2) Which factors may explain switching behavior? Questionnaire data provided by users of ABW environments were used to carry out ANOVA and logistic regression analyses. Findings from this study indicated the relevance of switching behavior for perceived fit with ABW environments and revealed several related job characteristics, which we further examined in Chapter 5.

Chapter 3. To further identify workers' attributes that may explain perceived fit, we developed a survey including a range of psychological needs (i.e., need for autonomy, relatedness, structure, and privacy), job characteristics (i.e., job autonomy, social interaction, and internal mobility), and demographic variables (i.e., gender and age). Survey data collected at seven organizations in the Netherlands were examined using correlation and regression analyses. The findings showed that need for privacy was a particularly powerful predictor of individual differences in satisfaction with ABW environments, which indicated its relevance to perceived fit.

Chapter 4. Given the importance of need for privacy that we found in Chapter 3, and the fact that complaints about lack of concentration and privacy were frequently reported in previous ABW research (Babapour, 2019; Bodin Danielsson & Bodin, 2009; De Been & Beijer, 2014; Engelen et al., 2019; Van der Voordt, 2004), we narrowed our scope for Chapter 4 to the interplay of task complexity (which is directly linked to required level of concentration⁵; Bedny et al., 2012), architectural privacy (i.e., closed vs. open work setting), and need for privacy, in the creation of perceived fit and associated outcomes. In two complementary studies, we tested the same P-E fit centered model, first using experience sampling field data, and next testing causal relationships in a virtual reality lab. The results from both studies consistently showed that perceived fit is a function of activity, work setting, and personal need for privacy, with indirect effects on satisfaction with the work environment and task performance.

Chapter 5. Based on our findings regarding the relevance of switching behavior (Chapter 2) and the relevance of using specific work settings for specific activities (Chapter 4), we took a closer look at how perceived fit in ABW environments is

⁵ Given this direct link, throughout this thesis, the terms 'high/low-complexity tasks' and 'high/low-concentration tasks' are used as synonyms.

related to user behavior. Experience sampling data, collected across seven organizations, were used to analyze perceived fit in relation to (1) the use of closed vs. open work settings for high- vs. low-concentration individual work vs. non-individual work, and (2) switching between different work settings and work activities.

CHAPTER 2

Flexibility in use: Switching behavior and satisfaction in activity-based work environments⁶

Abstract

Despite their growing popularity among organizations, satisfaction with Activity-Based Work (ABW) environments is found to be below expectations. Research also suggests that workers typically do not switch frequently, or not at all, between different activity settings. Hence, in the present research, the two main questions were: (1) Is switching behavior related to satisfaction with ABW environments? (2) Which factors may explain switching behavior? Questionnaire data provided by users of ABW environments (n = 3,189) were used to carry out ANOVA and logistic regression analyses. Satisfaction ratings of the 4% of the respondents who switched several times a day appeared to be significantly above average. Switching frequency was found to be positively related to heterogeneity of the activity profile, share of communication work, and external mobility. Our findings suggest that satisfaction with ABW environments might be enhanced by stimulating workers to switch more frequently. However, as strong objections against switching were observed and switching frequently does not seem to be compatible with all work patterns, this will presumably not work for everyone. Many workers are likely to be more satisfied if provided with an assigned (multifunctional) workstation. In a large sample, clear evidence was found for relationships between behavioral aspects and appreciation of ABW environments that had not been studied previously.

⁶ This chapter is based on Hoendervanger, J. G., De Been, I., Van Yperen, N. W., Mobach, M. P., & Albers, C. J. (2016). Flexibility in use: Switching behaviour and satisfaction in activity-based work environments. *Journal of Corporate Real Estate*, 18(1), 48-62. <https://doi.org/10.1108/JCRE-10-2015-0033>

Introduction

Knowledge work in general is becoming more autonomous and interactive (Duffy & Powell, 1997; Davenport, 2012), with workers switching more frequently between different activities, co-workers, tools and locations (Mark et al., 2005; Van Yperen et al., 2014). This development is reflected in the design of contemporary work environments, that are more and more based on the Activity-Based Working (ABW) concept (Vos & Van der Voordt, 2001; Cushman & Wakefield, 2013). In these ABW environments, workers are assumed to work flexibly, using different types of non-assigned activity settings (Veldhoen, 2008; Jones Lang Lasalle, 2012). The term 'activity setting' covers different types of workstations, rooms, and areas within the work environment, each designed to support a specific type of work activity e.g. places for collaboration, concentration, communication, creativity, confidentiality, and contemplation (Harris, 2015). The basic assumption underlying the ABW concept is that it enables workers to use the most appropriate activity setting at all times, by switching between different activity settings whenever they switch between different types of work activities (Van Koetsveld & Kamperman, 2011).

So far, empirical research regarding ABW environments has produced two important findings. First, satisfaction with ABW environments appears to be below expectations, with concentration, privacy, and the loss of an assigned workstation as major issues (Van der Voordt, 2004; Bodin Danielsson & Bodin, 2009; De Been & Beijer, 2014). Second, workers typically do not seem to switch frequently, or not at all, between different activity settings (Qu et al., 2010; Appel-Meulenbroek et al., 2011). This finding corresponds with lots of anecdotal evidence and qualitative case studies (Vos & Van der Voordt, 2001), indicating that many workers are using the same workplace every day and that they tend to use it for different types of activities.

The combination of these findings raises a question that has not been studied before: Is there a connection between switching behavior and satisfaction with ABW environments? Understanding why actual switching behavior deviates from the assumption underlying the ABW concept, might provide CRE practitioners and academics with starting points for optimizing user satisfaction, either by adjusting behavioral patterns to the concept or by adjusting the concept to behavioral patterns. Optimizing satisfaction with the physical work environment is important for organizations, since it has found to be directly related to job satisfaction and

indirectly to other organizational outcomes such as commitment, intent to leave, and absenteeism (Carlopio, 1996; Veitch et al., 2007; Rashid & Zimring, 2008). Hence, the purpose of the current study was to answer two main questions: (1) Is switching behavior related to satisfaction with ABW environments? (2) Which factors may explain switching behavior?

Relationship between switching behavior and satisfaction with ABW environments

The basic assumption underlying the ABW concept leads to an expected *positive* relationship between switching frequency and satisfaction with ABW environments, since it implies that workers need to switch between different activity settings in order to benefit from the ABW concept. However, based on previous research, we could rather expect a *negative* relationship. Several drawbacks associated with switching between different activity settings were reported, including the fact that workstations can not be personalized (Bodin Danielsson & Bodin, 2009) and loss of time used for installation, acclimatizing time, and lugging things around (Van der Voordt, 2004). Also, it was found that workers who are forced to switch frequently, while colleagues claim a workstation for themselves, may experience a sense of marginalization (Hirst, 2011). Hence, in the first study on this issue, we explored the relationship between switching frequency (i.e., how often does a worker report to usually switch between different activity settings) and satisfaction with the ABW environment (i.e., satisfaction with the office concept, productivity support, and pleasantness).

Factors that may explain switching behavior

Searching for factors that may explain why switching behavior seems to deviate strongly from the basic assumption underlying the ABW concept, the following work pattern-related variables were examined: (1) heterogeneity of the activity profile, (2) share of concentration work, (3) share of communication work, and (4) external mobility.

According to the basic assumption underlying the ABW concept, we may expect a positive correlation between the heterogeneity of workers' activity profiles – i.e. the

extend to which the total working time is spread out over different types of work activities – and their switching frequencies. Within the activity profiles, the share of concentration work and the share of communication work may also be associated with switching frequencies, since the environmental requirements for conducting these specific activity types have found to be incompatible (Stone & Luchetti, 1985; De Been & Beijer, 2014). The degree of external mobility may be related to switching behavior, because workers who divide their working time between different locations (office, home, other locations) are more likely to adopt a more flexible work style, also within the office (Greene & Myerson, 2011).

In addition to these work pattern-related variables, we explored the reasons for workers' (non-)switching behavior. Besides work pattern-related factors, these reasons may be associated with other types of factors such as social ties and norms, practical drawbacks of switching, and place attachment.

Method

Sample

The data that were used for this study were gathered by the Dutch Center for People and Buildings, using a standardized online tool for post-occupancy evaluation: WODI (Work Environment Diagnostic Instrument) (Maarleveld et al., 2009). For this study, we selected cases in which an ABW concept was fully implemented. Respondents who stated to have an assigned workplace (as an exception within the ABW environment) were filtered out, because their behavior and experience will differ from respondents who are using non-assigned workplaces. The resulting selection includes data reported by 3,189 respondents, working at seven different organizations and 18 different locations. Table 2.1 summarizes descriptive information about the dataset.

Table 2.1 Descriptive information about the cases included in this study.

<i>Organi- zation</i>	<i>Organization type</i>	<i>Location</i>	<i>Population size (n)</i>	<i>Sample size (n)</i>	<i>Sharing ratio</i>	<i>Provided types of activity settings</i>	<i>Measure- ment period</i>
A	Semi-public organization	Schiedam, NL	533	287	± 0,96	1-, 2-, 3- and 4-pers. rooms / open spaces / half-open spaces / concentration spaces / team spaces / <i>open and enclosed meeting spaces / meeting area / coffee corners / vide</i>	Nov 2012
B	Higher educational organization	Two locations in Utrecht, NL	360	104	± 0,75	1-, 2-, 3-, 4-, 5-, 6-, 7- and 8-pers. rooms / open spaces concentration spaces / <i>canteen flex space/ project space / enclosed meeting spaces</i>	Nov – Dec 2012
C	Public organization	Seven locations, NL	544	243	N/A	open spaces / concentration spaces / team workspaces / <i>open and enclosed meeting spaces / café workplaces / short term touch down space / meeting area</i>	March 2013
D	Higher educational organization	Wageningen, NL	120	68	± 0,75	bench workplace / open workplace / coupe workplace / concentration spaces / lounge workstations / study / lounge <i>/ pantry / enclosed meeting spaces / Wll corner</i>	June 2013
E	Commercial organization	Geneva, CH	93	67	± 0,90	1-, 2- pers. rooms / team rooms (3-6 pers.) / concentration spaces / open spaces / lounge workstations / <i>open and enclosed meeting spaces / relaxing space</i>	Sept 2013
F	Public organization	Doetinchem, NL	367	198	0,76	1-, 2-pers. enclosed spaces / 6-pers. enclosed spaces/open spaces / half-open spaces / lounge workstations / <i>meeting spaces / pantry</i>	Oct – Nov 2013
G	Commercial organization	Five locations in Brussels, BE	4,278	2,222	± 0,85	open spaces / concentration spaces / small enclosed rooms / lounge workstations / <i>half-open meeting spaces / enclosed meeting rooms</i>	Dec 2013 – Jan 2014
Total dataset			6,295	3,189			Nov 2012 – Jan 2014

Note. Sharing ratio: number of workstations *per fte*; activity settings in *italics* were not included in the calculation of the sharing ratio.

Procedure

In all case studies the same procedure was used. All users of the regarding office environment were invited per e-mail to participate in the research. The e-mail provided a link, which directed them to the introduction page of the online questionnaire. On the introduction page, general information was given about the purpose of the research, how to fill out the questionnaire and the anonymity of the data. After one week, users received a reminder e-mail in case they had not yet filled out the questionnaire. The minimum response time was two weeks. On average, it took respondents about 15 minutes to complete the questionnaire.

Measures

WODI is basically designed to measure employee satisfaction concerning a broad range of aspects of their work environment. The questions are based on extensive literature research and the tool is thoroughly tested in several pilot studies (Maarleveld et al., 2009).

Switching behavior was measured in terms of switching frequency through the question "How frequently do you usually switch between workplaces?", using an ordinal seven-point scale, ranging from (1) "never" to (7) "multiple times a day".

Satisfaction with the ABW environment. Respondents were asked to rate their overall satisfaction with the office concept, the productivity support provided by the work environment and the pleasantness of the work environment on ten-point scales ranging from (1) "lowest grade" to (10) "highest grade".

Explanatory factors. (1) *Heterogeneity of the activity profile* was assessed with the following item: "What percentage of your time at the office do you spend at the following activities?" which resulted in a series of nine percentages with a sum of 100% for each individual respondent. Since it is a measure for the degree of dispersion within any series of values, the standard deviation of this series of percentages is used as a measure of homogeneity of the activity profile. The homogeneity score can range from zero (in case of nine equal percentages i.e. of 11.1% per activity) to 33.3% (in case of 100% allocated to one single activity). Next, the homogeneity score was transformed into a heterogeneity score by reversing the

scale: each value was subtracted from the maximum value (33.3%). (2) As a measure for the *share of concentration work*, we added up the percentages for two types of activities: “deskwork that requires concentration” and “reading (longer than 30 minutes)”. (3) As a measure for the *share of communication work*, we added up the percentages for three types of activities: “scheduled meetings”, “unscheduled meetings” and “telephone calls”. (4) In response to another item the respondents indicated the percentage of their working time they spend at specified locations, including the main office building. The percentage of the time they did not work at the main office building represents their degree of *external mobility*. (5) From a list of eleven different reasons, the respondents were asked to indicate their *reasons to switch*, and (6) from a list of ten different reasons, their *reasons not to switch*. The lists of reasons (not) to switch, see Table 2.2, were derived from literature research and interviews and tested in order to match perceptions of users of ABW environments.

Table 2.2 *Pre-defined reasons (not) to switch.*

<i>Pre-defined reasons to switch</i>	<i>Pre-defined reasons not to switch</i>
Because another workplace is more suitable for my activities	Necessity to move stuff
To sit near a certain support space (e.g. printer, pantry, etc.)	Someone else might take the workplace
To sit near colleagues	Hard to find for colleagues
To sit on the same floor as my team/department	No better place available
Because I find another place more comfortable	I always use the same place
Because my favorite place is occupied by someone else	IT supplies fall short
Because there is too much noise	Than I would be too far from my unit
Because I am bothered by the indoor climate	Necessity to readjust furniture
Just for a change	Another reason
Another reason	There is no reason not to change workplaces
There is no reason to change workplaces	

Results

Descriptive statistics

The distribution of switching frequency is shown in Figure 2.1. Only 4% of the respondents reported to switch multiple times during an average working day. Almost half of the population (48%) reported to switch never or less than once a week.

Figure 2.1 *Distribution of respondents over switching frequency groups (n = 3,189).*

Descriptive statistics for the continuous variables are summarized in Table 2.3. The substantially smaller sample size for satisfaction with productivity support is due to the fact that the concerning question was not included in all of the cases.

Table 2.3 *Descriptive statistics.*

<i>Variable</i>	<i>n</i>	<i>Min.</i>	<i>Max.</i>	<i>Mean</i>	<i>SD</i>
Satisfaction with office concept	3,113	1	10	5.42	2.38
Satisfaction with productivity support	939	1	10	5.66	1.98
Satisfaction with pleasantness	3,156	1	10	5.79	2.08
Heterogeneity of activity profile	3,189	0.0	31.1	17.78	6.32
Share of concentration work	3,189	0	100	21.66	18.92
Share of communication work	3,189	0	100	26.12	17.95
External mobility	3,189	0	100	23.40	23.78

The distribution of the overall appreciation of the office concept, productivity support and pleasantness, scored on a 10-point scale rating from 1 (lowest score) to 10 (highest score), is shown in Figure 2.2. This figure shows that around 40% of all respondents rated the items with a 5 or lower, which means they can be regarded as dissatisfied according to the grading system that is commonly used in schools in The Netherlands, in which a (rounded) 6 defines the distinction between 'pass' and 'fail'.

Figure 2.2 *Distribution of three satisfaction ratings in cumulative percentages of respondents.*

Relationship between switching behavior and satisfaction with ABW environments

To examine the link between switching behavior and satisfaction in more detail, we conducted a two-way ANOVA, followed by analysis of deviation contrasts. In addition to switching frequency, the variable location was included in the two-way ANOVA as a random factor, in order to control for possible systematic differences between data collected at different locations. The results of the ANOVA, as summarized in Table 2.4, indicate that the relationship between switching frequency and satisfaction with the work environment is - in general terms - non-significant, whereas the location appeared to be significantly ($p < .01$) related to satisfaction with the work environment.

Table 2.4 *Results of the two-way ANOVA.*

	<i>Satisfaction with office concept</i>	<i>Satisfaction with productivity support</i>	<i>Satisfaction with pleasantness</i>
<i>Switching frequency</i>	$F(6, 1164) = 2.05$ $p = .06$	$F(6, 203) = 1.51$ $p = .18$	$F(6, 1101) = 1.69$ $p = .12$
<i>Location</i>	$F(18, 560) = 10.61$ $p < .01$	$F(13, 150) = 7.38$ $p < .01$	$F(18, 539) = 8.59$ $p < .01$
<i>Switching frequency × location</i>	$F(89, 3016) = 1.12$ $p = .20$	$F(60, 876) = 1.79$ $p = .00$	$F(90, 3058) = 1.24$ $p = .07$

In order to examine the relationship between switching frequency and satisfaction with the work environment more closely, the ANOVA was followed-up by an analysis of deviation contrasts (see, e.g., Baguley, 2014, Ch. 15). In this procedure, the average satisfaction ratings of the switching frequency groups were compared with the average satisfaction ratings of the entire sample. The results are summarized in Table 2.5. Respondents who switched several times a day appeared to be significantly ($p < .05$) more satisfied than average with regard to the office concept and productivity support; they rated their satisfaction around 0.7 point above average.

Table 2.5 Differences between means of switching frequency groups and overall means of the total sample regarding satisfaction with the work environment.

<i>Switching frequency</i>	<i>Satisfaction with office concept</i>	<i>Satisfaction with productivity support</i>	<i>Satisfaction with pleasantness</i>
Never	-.15	-.04	-.05
Less than once a week	-.10	-.04	.18
1-2 times a week	.11	-.11	.01
3-4 times a week	.26	.55	.25
At the start of each day	.24	-.31	-.11
Once during each day	-.82	-.74	-.68
Multiple times a day	.68 *	.70 *	.40

Note. *p*-values resulting from default *t*-tests after performing deviation contrasts; * significant at $p < .05$.

Factors that may explain switching behavior

To examine which work pattern-related factors may, in combination, explain switching behavior, a multinomial logistic regression analysis was conducted (cf. Baguley, 2012, Section 17.4). For this purpose, three aggregated switching frequency groups were created: (1) never or less than once a week, (2) once till five times a week, and (3) once or multiple times a day. The variable location was included in the logistic regression model, in order to control for possible systematic differences between data collected at different locations. Subsequent switching frequency groups were compared with each other. The results are summarised in Table 2.6. Due to the relatively small number of observations in the third switching frequency group, the model that compares groups 2 and 3 suffers from some computational instability and the results should be interpreted with some caution.

Table 2.6 Results of logistic regression analysis, with three categories of switching frequencies as dependent variable.

Independent variable	Switching frequency group 2 versus 1		Switching frequency group 3 versus 2	
	Significance	Odds-ratio	Significance	Odds-ratio
Heterogeneity of activity profile	.00	1.023	.26	0.982
Share of concentration work	.61	1.001	.81	1.001
Share of communication work	.01	1.006	.00	1.045
External mobility	.00	1.007	.00	1.012

Note. Group 1: < once a wee, group 2: once – five times a week, group 3: ≥ once a day; *p*-values computed using Wald's test.

Regarding the heterogeneity of the activity profile, the comparison between switching frequency group 1 and 2 revealed a significant ($p < .01$) positive relationship, indicating that workers will be more likely to switch once till five times a week than less than once week when they divide their time in the office more evenly over different activities. When comparing switching frequency groups 2 and 3 however, no significant relationship between these variables was found. Share of concentration work appeared not to be significantly related to switching frequency. In both comparisons, switching frequency appeared to be significantly ($p \leq .01$) positively related to share of communication work and external mobility. This means that workers will switch more frequently when they: (i) spend more office time on meetings and/or (ii) spend less working time at the office.

Table 2.7 Top 3 rankings of reasons (not) to switch per switching frequency group, with percentages of respondents who selected these reasons (multiple reasons could be selected).

Switching frequency:	Total sample	Never	Less than once a week	1-2 times a week	3-4 times a week	At the start of each day	Once during each day	Multiple times a day
Reasons to switch								
To sit near colleagues	1 (46%)	3 (23%)	2 (38%)	1 (52%)	1 (54%)	1 (59%)	3 (40%)	2 (43%)
My favorite place is occupied by someone else	2 (35%)		1 (44%)	2 (41%)	3 (35%)	2 (35%)		
Because there is too much noise	3 (32%)	2 (26%)	3 (31%)				2 (47%)	3 (33%)
Another workplace is more suitable for my activities				3 (35%)	2 (39%)	3 (33%)	1 (56%)	1 (90%)
There is no reason to change workplaces		1 (44%)						
Reasons not to switch								
Necessity to move stuff	1 (38%)	3 (28%)	1 (37%)	1 (43%)	1 (44%)	1 (47%)	1 (49%)	2 (30%)
Then I would be far from my unit	2 (32%)	2 (29%)	3 (37%)	2 (34%)	2 (30%)		3 (24%)	3 (21%)
Necessity to readjust furniture	3 (30%)			3 (32%)	3 (28%)	3 (29%)		
I always use the same place		1 (44%)	2 (37%)					
There is no reason not to change workplaces						2 (29%)	2 (32%)	1 (43%)

For each switching frequency group and for the whole sample a top 3 ranking of reasons (not) to switch was extracted from the dataset (Table 2.7). For all groups, contact with colleagues appeared to be an important reason (not) to switch: “to sit near colleagues” and “then I would be far from my unit” are included in almost every top three. All groups recognized the “necessity to move stuff” as an important reason for not switching. Non-switchers mostly saw no reason to do so, whereas the most-frequent switchers mostly saw no reason *not* to do so. The reason “because another workplace is more suitable for my activities” was selected more often as respondents switch more frequently. This is the number one reason for respondents who switch at least once during each day and it was selected by 90% of the respondents who switch multiple times a day. The reason “because my favorite place is occupied by someone else” appeared to be the most important reason to switch for respondents who switch less than once a week.

Discussion

Interpretation and explanation of the results

Consistent with previous research, we found that around 40% of the people were not satisfied with their ABW environment. We also replicated previous findings that workers typically do not switch frequently, or not at all, between different activity settings (Qu et al., 2010; Appel-Meulenbroek et al., 2011). The added value of our research is that we observed a positive relationship between switching frequency and satisfaction with the ABW environment, suggesting that known drawbacks of switching (Van der Voordt, 2004; Hirst, 2011) can be outweighed by its benefits. Remarkably, this only seems to apply to workers who say to switch multiple times a day, suggesting that switching frequently might be a prerequisite for benefiting optimally from the ABW concept. However, as strong objections against switching were observed and switching frequently does not seem to be compatible with all work patterns, this will presumably not work for everyone. Our findings seem to indicate that the ABW concept fits the needs of only a small minority of the workers in our sample.

Heterogeneity of the activity profile, share of communication work, and external mobility were identified as factors that may explain switching behavior. However, with regard to the basic assumption underlying the ABW concept, the relationship

with the heterogeneity of the activity profile appeared to be surprisingly weak. This may be partially explained by the fact that major reasons to switch appeared to be not activity-related. Also, it might be very difficult to divide the working time into separate activity blocks when having a very heterogeneous activity profile, resulting in a multi-tasking work style (Mark et al., 2005) that requires a single (preferably multifunctional) workstation. The link between share of communication work and switching frequency may be explained by the fact that (1) meetings usually require activity settings that are obviously different from regular workstations, (2) the selection of a place for a meeting usually derives from a collective decision and, (3) this selection is sometimes made in advance for reasons of scheduling. The finding that high external mobility goes hand in hand with high switching frequency, may indicate that these workers are less prone to place attachment (Lewicka, 2011).

Furthermore, we revealed that besides activity-related reasons, social ties and norms, practical drawbacks of switching, and place attachment are important reasons (not) to switch. The overall most important reason to switch has a primarily social nature ("to sit near colleagues"). The overall second-most important reason has to do with place attachment ("because my favorite place is occupied by someone else"). These findings are consistent with an empirical study that demonstrated that behavioral patterns are not only related to activities and functional aspects of workplaces, but also to environmental and user characteristics (Kleijn et al., 2012). We further demonstrated an important distinction between positive reasons (e.g. "because another workplace is more suitable for my activities") and negative reasons (e.g. "because there is too much noise") for switching between activity settings that may be associated with higher/lower levels of satisfaction with the work environment. Workers who switch multiple times a day selected positive reasons mostly, whereas workers who switch less than once a week selected negative reasons mostly.

Limitations and perspectives for further research

Although the opening part of the WODI questionnaire we used clearly suggests that the term 'workplace' should be understood in a broad sense, including all types of activity settings, we cannot completely rule out the possibility that some respondents may have answered the question about switching frequency with only desk workstations in mind. This means that in reality the switching frequencies

might be somewhat higher than the findings suggest. This limitation might also partly explain why such a remarkably high percentage of the participants (48%) indicated to switch never or less than once a week. In future research focusing on ABW environments, the concept 'activity setting' should be carefully defined and explained in order to avoid misinterpretations.

If more specific information would have been recorded about the context in which the switching behavior took place, the interpretation of results could have been further elaborated. Most importantly, this regards the amounts of different types of activity settings and the occupancy rates of these activity settings, as these factors determine the range of choice that is offered. Also, data on scheduled meetings might have been useful to verify plausibility of reported switching frequencies, as each scheduled meeting usually implies switching to a meeting room or area. Analysis of satisfaction with the work environment through single item scores provides limited reliability, however the three items that were used in this study appeared to be highly correlated. More importantly, this study revealed the dominant influence of locational factors on satisfaction with the work environment in relation to other relevant factors. This underlines the importance of including these factors (e.g. implementation process, organizational culture, interior design, occupancy rates) in future research.

Questionnaire data regarding behavioral patterns and experiences have a limited reliability by nature since they are based on retrospective recall of experiences (Shiffman et al., 2008). This is especially important since behavioral patterns within the work environment probably fall, at least partly, into a category known as unconscious automated behavior (Aarts & Dijksterhuis, 2000). This makes it very difficult for respondents to estimate accurately and detailed how often they switch between activity settings or what percentages of their working time they spend on different locations and different activities. At the same time, higher levels of reliability and detail are needed in order to analyse how specific activity settings are exactly used and experienced: by whom, how often, how long and for which types of activities. This type of data would provide a basis for more specific diagnoses regarding the low levels of satisfaction with ABW environments that were found. For this reason, in future research, alternative methods for data collection (e.g. direct observations, experience sampling, diaries) should be considered. Switching frequencies and satisfaction ratings appear to differ strongly among workers. This variance can only be partly be explained by the factors included in this

study. Therefore, further research should include a broader range of independent variables including situational factors (e.g. satisfaction with the organization, implementation process, organizational culture, interior design, occupancy rates) and personal factors (e.g. job demands, skills, physical and mental abilities, age, gender, education level and psychological needs and abilities).

Implications for theory and practice

Since satisfaction with ABW environments is found to be below expectations, their effectiveness in terms of impact on job satisfaction and wider organizational outcomes is questionable, at least as a one-size-fits-all solution. This insight reinforces the need for further research that should enable more in-depth diagnoses regarding causes of dissatisfaction. We believe that the relationship between workspace, behavior and satisfaction should be a central item on the research agenda. It may be the *interaction* between workers – all with their specific individual needs, perceptions, and behaviors – and their work environment that determines whether satisfaction with the work environment and associated organizational outcomes are promoted or harmed. Advanced knowledge about this interaction may contribute to the person-environment fit theory (Edwards et al., 1998), which so far does not seem to recognize the influence of physical aspects of the work environment.

When implementing an ABW concept, CRE practitioners and workspace designers should be aware of the fact that place does not simply follow activity. A more realistic approach would be to assume that workers need to see strong reasons for themselves to switch between different activity settings. This implies that the distinction between different types of activity settings should be meaningful and recognizable and that switching between them should be supported by providing necessary facilities and diminishing (practical) hindrances in the work environment. Activity settings that will be used for concentration work deserve special attention in order to avoid complaints about distractions and lack of privacy.

Our findings suggest that the ABW concept does not fit the individual needs of all workers. Some workers are satisfied because they switch quite frequently whereas others may be better off with an assigned (multifunctional) workstation. We recommend managers, employees, and CRE practitioners to pay more attention to

assessing, discussing, and facilitating individual needs and preferences as it does not seem possible to provide a one-size-fits-all solution, even if this solution provides flexibility in use.

CHAPTER 3

Individual differences in satisfaction with activity-based work environments⁷

Abstract

Satisfaction with activity-based work environments (ABW environments) often falls short of expectations, with striking differences among individual workers. A better understanding of these differences may provide clues for optimising satisfaction with ABW environments and associated organisational outcomes. The current study was designed to examine how specific psychological needs, job characteristics, and demographic variables relate to satisfaction with ABW environments. Survey data collected at seven organizations in the Netherlands (N = 551) were examined using correlation and regression analyses. Significant correlates of satisfaction with ABW environments were found: need for relatedness (positive), need for privacy (negative), job autonomy (positive), social interaction (positive), internal mobility (positive), and age (negative). Need for privacy appeared to be a powerful predictor of individual differences in satisfaction with ABW environments. These findings underline the importance of providing work environments that allow for different work styles, in alignment with different psychological need strengths, job characteristics, and demographic variables. Improving privacy, especially for older workers and for workers high in need for privacy, seems key to optimizing satisfaction with ABW environments.

⁷ This chapter is based on Hoendervanger, J. G., Ernst, A., Albers, C. J., Van Yperen, N. W., & Mobach, M. P. (2018). Individual differences in satisfaction with activity-based work environments. *PLoS ONE*, 13(3), 1-15. <https://doi.org/10.1371/journal.pone.0193878>

Introduction

In order to cut costs and support contemporary knowledge work, a growing number of organizations is adopting a work environment based on the principles of activity-based working (ABW) (Cushman & Wakefield, 2013; Wohlers & Hertel, 2017; Leesman, 2017). In ABW environments, workers do not have assigned workstations but instead share an area with different types of non-assigned 'activity settings', e.g., workstations in open-plan areas and in closed rooms, open meeting spaces, and closed meeting rooms. These different settings are designed for different types of activities (Veldhoen, 2008; Jones Lang Lasalle, 2012; Becker, 1999), e.g., collaboration, concentration, communication, creativity, confidentiality, and contemplation (Harris, 2015). Because there are fewer workstations than workers in ABW environments, less office space is needed and hence cost-cutting targets are usually met (Oseland & Webber, 2012). However, when it comes to supporting the work, the effectiveness of ABW environments is not evident.

So far, empirical findings have shown that satisfaction with ABW environments is usually below expectations, with concentration, privacy, and the loss of an assigned workstation major self-reported issues (Van der Voordt, 2004; Bodin Danielsson & Bodin, 2009; De Been & Beijer, 2014). Optimizing satisfaction with the physical work environment is important for organizations, since this has been found to be related directly to job satisfaction and indirectly to other organizational outcomes such as commitment, intention to leave, engagement, and absenteeism (Carlopio, 1996; Veitch et al., 2007; Rashid & Zimring, 2008; Ipsos, 2016). The costs associated with decreased commitment, increased staff turnover, and increased absenteeism may easily exceed the savings regarding real estate, as these latter costs typically comprise less than 10% of the total costs of knowledge work (Brill & Weidemann, 2001; Kampschroer & Heerwagen, 2005). Hence, dissatisfaction with the work environment may not only be an indicator of sub-optimal support of knowledge work, but also a threat to the objective to cut costs.

Searching for factors that may explain differences in satisfaction with ABW environments, and hence provide clues for optimizing associated organizational outcomes, Brunia et al. (2016) compared four case studies conducted at four different branches of one organization. They found large differences in satisfaction with the work environment that were mainly related to interior design, level of openness, subdivision of space, number and diversity of workplaces, and

accessibility of the building. Furthermore, satisfaction with the work environment appeared to be associated with the process of implementing it and with satisfaction with the organization in general. Besides these situational differences, large differences in satisfaction with the work environment have also been observed among individual workers who share the same ABW environment (Hoendervanger et al., 2016). Wohlers and Hertel (2017) suggest that both person-related and job-related variables may play a role in these differences. Several scholars have addressed the importance of individual differences with regard to perception of work environments (e.g., Van der Voordt, 2004; Seddigh et al., 2016; Oldham & Fried, 1987; Maher & Von Hippel, 2005). According to Person-Environment fit (P-E fit) theory, dissatisfaction may result from a misfit between certain psychological needs and environmental conditions (Edwards et al., 1998; Kristof-Brown et al., 2005). In this respect, empirical studies have shown the relevance of need for autonomy, need for relatedness, and need for structure in relation to flexible working across different locations (Van Yperen et al., 2014), and of need for privacy in relation to workspace layout (Oldham, 1988). These findings suggest that these particular psychological needs may be relevant for achieving P-E fit in ABW environments. However, similar studies within ABW contexts have not yet been conducted. Since the concept of ABW was developed with specific job characteristics in mind – i.e., high job autonomy, high social interaction, and high internal mobility (Duffy & Powell, 1997; Van Koetsveld & Kamperman, 2011) – it seems likely that these job characteristics are positively related to satisfaction with ABW environments. However, these assumed relationships have not yet been tested in empirical research. With regard to demographic variables, age and gender seem relevant. Empirical findings indicate that age may be negatively associated with satisfaction with ABW environments (Pullen, 2014), while a positive relationship might be expected based on the literature on age-related differences in the workplace (Wohlers & Hertel, 2017). Although men and women seem to experience certain aspects of ABW environments differently (Wohlers & Hertel, 2017), they have been found to be equally satisfied with ABW environments (Leesman, 2017).

Given these research gaps, the current study was designed to empirically examine how satisfaction with ABW environments is associated with the aforementioned psychological needs (i.e., need for autonomy, relatedness, structure, and privacy), job characteristics (i.e., job autonomy, social interaction, and internal mobility), and demographic variables (i.e., gender and age). The first aim was to test literature-

based hypotheses for each of these independent variables. The second aim was to find out which of these variables are useful for predicting individual differences in satisfaction with ABW environments. In explaining such differences, this study may contribute to the furthering of P-E fit theory. Its practical relevance concerns the optimization of satisfaction with work environments and associated organizational outcomes.

Psychological needs

We included four basic psychological needs that seem particularly relevant in the context of ABW environments: (1) need for autonomy, (2) need for relatedness, (3) need for structure, and (4) need for privacy. In line with P-E fit theory (Edwards et al., 1998; Kristof-Brown et al., 2005) and other organizational theories that recognize the importance of individual differences (e.g., Hackman & Lawler, 1971; McClelland & Burnham, 1976), we focused on psychological needs strength. According to P-E fit theory, workers high in need for X will be more satisfied with a work environment providing X, and less satisfied with a work environment lacking X, compared with workers low in need for X.

Need for autonomy is defined as workers' "desire to feel volitional and to experience a sense of choice and psychological freedom when carrying out an activity" (Van den Broeck et al., 2010, p. 982). ABW environments provide a high level of autonomy because workers have freedom of choice regarding the use of different work settings, instead of being assigned to one specific workstation (Wohlers & Hertel, 2017). Van Yperen et al. (2014) demonstrated that workers high in need for autonomy preferred location-independent working, i.e., flexibility in where work gets done across different locations (including the office). In line with these findings, we expected workers high in need for autonomy to prefer flexibility in where work gets done *within* the office. Hence, we hypothesized (*Hypothesis 1*) that workers' need for autonomy would be *positively* associated with satisfaction with ABW environments.

Need for relatedness, defined as workers' "propensity to feel connected to others, that is, to be a member of a group" (Van den Broeck et al., 2010, pp. 982-983), requires "frequent, affectively pleasant or positive interactions with the same individuals (...) in a framework of long-term, stable caring and concern" (Baumeister

& Leary, 1995, p. 520). ABW environments are usually designed to promote social interaction through openness, transparency, and informal meeting spaces (Wohlers & Hertel, 2017). As a consequence, ABW environments should provide ample opportunity to build and maintain strong relationships with colleagues. Accordingly, we hypothesized (*Hypothesis 2*) that workers' need for relatedness would be *positively* associated with satisfaction with ABW environments.

Need for structure is defined as a workers' "need for clarity and intolerance of ambiguity" and refers to a "preference for structured and predictable situations" (Slijkhuis, 2012, p. 23). Workers high in need for structure may dislike the fact that uncertainty about the availability of specific work settings at specific moments is inherent to the ABW concept, as this may create ambiguity. Van Yperen et al. (2014) demonstrated that – probably for the same reason – workers low in need for structure preferred blended working (i.e., time-independent and location-independent working). In the current study, we hypothesized (*Hypothesis 3*) that workers' need for structure would be *negatively* associated with satisfaction with ABW environments.

Need for privacy, defined as a worker's "need for physical isolation from stimuli" (Oldham, 1988, p. 255), refers to architectural privacy (i.e., visual and acoustic isolation) that contributes to psychological privacy (i.e., sense of control over access to oneself) (Sundstrom et al., 1980). Altman (1975) proposed that people try to achieve an optimal level of privacy, in accordance with their needs and circumstances, by seeking or avoiding social interaction. In an empirical study, a high need for privacy was found to be associated with a preference for working in enclosed instead of open workspaces (Oldham, 1988). Although ABW environments typically provide both open and enclosed workspaces, the design is usually predominantly open and transparent (Wohlers & Hertel, 2017). Previous research indicates that an experienced lack of privacy may be one of the major complaints underlying low levels of satisfaction with ABW environments (Van der Voordt, 2004; De Been & Beijer, 2014). Therefore, we hypothesized (*Hypothesis 4*) that workers' need for privacy would be *negatively* associated with satisfaction with ABW environments.

Job characteristics

We included three job characteristics on which the ABW concept is grounded: (1) job autonomy, (2) social interaction, and (3) internal mobility. According to Davenport [38], these job characteristics are typical of contemporary knowledge workers. Duffy and Powell (1997) theorized that an ABW environment (a 'club' in their terminology) would be particularly suitable for 'transactional knowledge work', i.e., work that is characterized by a high level of job autonomy and a high level of social interaction. In their view, workers in this type of job should be enabled to move freely and frequently across the work environment, alternating the use of settings for solo work and settings for meetings and collaborative tasks.

Job autonomy refers to the degree of control of an employee over how to carry out the job task (Hackman & Oldham, 1980). In an ABW context, this particularly includes choices regarding the use of different places for different activities. Since ABW environments typically provide a range of choices of different settings for different activities, which can be freely used on an as-needed basis (Veldhoen, 2008; Jones Lang Lasalle, 2012; Becker, 1999; Harris, 2015), we may expect a good fit with high job autonomy. Hence, we hypothesized (*Hypothesis 5*) that job autonomy would be *positively* associated with satisfaction with ABW environments.

Research on knowledge sharing has shown the importance of unplanned face-to-face meetings for sharing tacit knowledge, and how spatial variables (i.e., visibility, proximity) may facilitate such meetings (Appel-Meulenbroek et al., 2017). In line with these insights, ABW environments are usually designed to promote social interaction through openness, transparency, and informal meeting spaces (Wohlers & Hertel, 2017). Accordingly, we hypothesized (*Hypothesis 6*) that workers' perceptions that social interactions are part of their jobs would be *positively* associated with satisfaction with ABW environments.

Mobility within the work environment is directly related to the basic idea underlying the ABW concept, as workers need to move around to be able to use different types of activity settings for different types of activities (Becker, 1999; Van Koetsveld & Kamperman, 2011). This internal mobility may typically go hand in hand with social interactions across the office building (Greene & Myerson, 2011). Since ABW environments facilitate internal mobility, a good fit – resulting in satisfaction with the work environment – may be expected with jobs that require workers to move

frequently between different workplaces. A recent empirical study indeed found a positive relationship between switching frequency and satisfaction with ABW environments (Hoendervanger et al., 2016). Hence, we hypothesized (*Hypothesis 7*) that workers' perceptions that internal mobility is a characteristic of their jobs would be *positively* associated with satisfaction with ABW environments.

Demographic variables

Two basic demographic variables were examined in this study: age and gender. It has been found that older workers report lower satisfaction ratings with ABW environments than younger workers (Leesman, 2017; Pullen, 2014; Volker & Van der Voordt, 2005). According to Pullen (2014), this might be related to an increased sensitivity to auditory and visual distractions at greater ages, as observed in several studies (e.g., Li et al., 1998; Horváth et al., 2009). This seems to be confirmed by his data: older workers are negative about the openness and transparency of ABW environments compared with cell offices, whereas younger workers regard this difference positively (Pullen, 2014). Hence, we hypothesized (*Hypothesis 8*) that age would be *negatively* associated with satisfaction with ABW environments.

According to Wohlers and Hertel (2017), men and women may experience certain aspects of ABW environments differently. As women are more inclined to personalize their workspaces (Wells, 2000), which is typically not allowed in ABW environments, they might be less satisfied than men. Also, women have been found to complain more about noise distractions in open-plan environments than men (Volker & Van der Voordt, 2005 ; Kaarlela-Tuomaala et al., 2009). On the other hand, it has been observed that men complain more about desk-sharing than women (Volker & Van der Voordt, 2005). A recent study by Leesman (2017) found no significant differences between men and women regarding their satisfaction with ABW environments. Since previous findings regarding possible gender differences were inconclusive, we included this variable in the current study without relating it to a hypothesis.

Method

Ethics statement

This research was reviewed and approved by the ethics committee of the Department of Psychology, University of Groningen. The data were analyzed anonymously.

Sample

The current study was cross-sectional; an online questionnaire was administered to employees once. Data were collected in seven Dutch organizations, found within the researchers' networks, that agreed to cooperate by allowing their employees to take part in the survey. The researchers monitored the data collection process and inspected the work environments of the participating organizations. All work environments were based on the ABW concept, offering a variety of non-assigned activity settings, including a main area with workstations in an open-plan layout and (semi-)enclosed back-up spaces for meetings, concentration work, and phone calls. Apart from these similarities, there were also situational differences between the seven organizations (e.g., interior design, work processes, organizational culture, implementation processes) that were beyond the scope of this study. We statistically controlled for these situational differences by including organizational affiliation in the regression analysis.

The total sample comprised data provided by 551 knowledge workers at seven different organizations. These organizations operate in different parts of the private and public sector, and are located in different Dutch cities. Descriptive information about the organizations is presented in Table .31. The large sample size ensures high power: $N = 551$ gives a power of .8 to find a significant effect at the $\alpha = .05$ level for a correlation of $r = .12$. Examination of the residuals of the final regression model showed no violations of independence, normality, homogeneity, or linearity assumptions (see Appendix 3.1).

Table 3.1. *Descriptive information about the included organizations.*

Organiza- tion	Organization type	Location	n	Age				% male
				Mean	SD	Min.	Max.	
1.	Public organization	Groningen	168	49.69	9.60	22	64	60%
2.	Private company	Groningen	53	40.92	9.52	23	63	74%
3.	Public organization	Assen	117	43.04	9.92	28	60	43%
4.	Educational organization	Utrecht	23	47.19	10.26	25	64	46%
5.	Public service provider	Multiple locations	108	44.56	10.33	25	63	54%
6.	Private company	Amsterdam	50	37.22	7.78	23	68	34%
7.	Private company	Amsterdam	32	45.25	9.62	29	60	28%
Total sample			551	45.64	10.43	22	68	52%

Measures

Satisfaction with the work environment was assessed using a single item with response values ranging from one to ten, also allowing quarter values, with lower values corresponding to lower satisfaction. We consider use of a single item acceptable because workplace satisfaction is a sufficiently narrow and unambiguous construct (Wanous et al., 1997).

Psychological needs for autonomy, relatedness, and structure were assessed using the questionnaire developed by Van Yperen et al. (2014), drawing on existing measures used to assess need satisfaction (autonomy and relatedness) rather than need strength (Van den Broeck et al., 2010) and personal need for structure (Thompson et al., 2001). It includes questions such as: "I need to have a say in determining my activities and tasks" (need for autonomy), "I have the need to feel like I am part of a team or a group" (need for relatedness), and "I have the need for a daily routine" (need for structure). The reliabilities of all subscales were high, with Cronbach's alphas of .89 for need for autonomy, .86 for need for relatedness, and .80 for need for structure.

Need for privacy was determined using a subsection of the Environmental Response Inventory (McKechnie, 1977; Bruni et al., n.d.), which yielded a Cronbach's alpha of .84 on our sample. The scale consists of four questions, such as, "I get distracted easily".

Job characteristics were assessed using one statement for each job characteristic. These were: (1) "I have freedom to carry out my tasks the way I prefer" (job autonomy); (2) "My work involves interaction with other people" (social interaction); (3) "I work at different places within the office building" (internal mobility). We consider use of single items acceptable because these job characteristics are sufficiently narrow and unambiguous constructs (Wanous et al., 1997).

All psychological needs and job characteristics variables were scored on a scale with values from one ("very strongly disagree") to five ("very strongly agree"), allowing quarter values (i.e., possible values increased in a .25-step fashion). For the complete questionnaire, see Appendix 3.2.

Results

Descriptive statistics

In Table 3.2, descriptive statistics are presented for all included continuous variables. Satisfaction with the work environment was rated 6.9 on average, with individual ratings ranging from 1 till 10. Further examination of these ratings showed that 84% of all respondents rated their satisfaction level as 5.5 or higher. This means that this group may be regarded as (more or less) satisfied according to the grading system that is commonly used in schools in the Netherlands, in which a (rounded) 6 defines the distinction between "pass" and "fail".

Table 3.2. Descriptive statistics for the included continuous variables.

Variable	Mean	SD	1.	2.	3.	4.	5.	6.	7.	8.
1. Satisfaction with the work environment	6.87	1.57	-							
2. Need for autonomy	3.83	.73	.05	-						
3. Need for relatedness	3.01	.74	.10*	.04	-					
4. Need for structure	2.52	.71	-.07	-.27***	.12**	-				
5. Need for privacy	2.52	.79	-.39***	.06	-.13**	.27***	-			
6. Job autonomy	3.87	.79	.21***	.51***	.04	-.23***	-.09*	-		
7. Social interaction	3.92	.82	.22***	.40***	.18***	-.19***	-.15***	.40***	-	
8. Internal mobility	2.54	1.12	.14***	.21***	.03	-.24***	-.01	.30***	.25***	-
9. Age	45.64	10.43	-.21***	-.04	-.22***	-.07	-.01	-.01	-.11**	-.19***

Note. Pearson product-moment correlations are shown in column 1 – 8 (column labels refer to the corresponding variables in rows 1 – 8); * $p < .05$; ** $p < .01$; *** $p < .001$; the supplementary table in Appendix 3.3 provides 95% confidence intervals and exact p -values for the correlations.

The correlation coefficients in Table 3.2 (column “1.” – “8.”) indicate how the variables are related to each other. Need for privacy comes to the fore as the strongest correlate of satisfaction with the work environment.

Our sample contains 52% male and 48% female workers. The results of a two-sided *t*-test suggest that there is no significant gender difference in satisfaction with ABW environments ($t = 1.80$, $df = 549$, $p = .07$).

Hypothesis testing

The correlation coefficients (see Table 2, column “1.”) indicate that empirical support was found for six of our hypotheses: satisfaction with ABW environments is positively and significantly associated with need for relatedness (*Hypothesis 2*), job autonomy (*Hypothesis 5*), social interaction (*Hypothesis 6*), and internal mobility (*Hypothesis 7*), and it is negatively and significantly associated with need for privacy (*Hypothesis 4*) and age (*Hypothesis 8*). According to the correlation coefficients, the effect sizes of the associations can be regarded as ‘medium to large’ for need for privacy, ‘small’ for need for relatedness, and ‘small to medium’ for the other significant associations (Cohen, 1992). No empirical support was obtained for our hypotheses regarding need for autonomy (*Hypothesis 1*) and need for structure (*Hypothesis 3*).

Regression analysis

To identify useful predictors of satisfaction with ABW environments, a regression model was developed using a stepwise forward model selection procedure. The control variable organizational affiliation was constrained to be included in the minimal model after an ANOVA *F*-test showed that satisfaction with the work environment differed significantly between the organizations in our sample ($F = 22.24$, $df = 544$, $p < .001$). Other variables were added to this minimal model one by one. At each step the variable was added which explained the most variance in the outcome variable that was still left unexplained by the variables already included in the model. This forward selection was terminated when none of the remaining variables improved the model fit to a substantial extent, as indicated by the Bayesian Information Criterion (BIC). The BIC is an indicator of model fit that

penalizes the inclusion of parameters, thereby favoring more simplistic models with fewer parameters (Schwartz, 1978). Consequently, predictors will only be selected to the final model if they are associated with a considerable increase in model fit, and the final model will consist of only the most powerful predictors of satisfaction with ABW environments. The order in which variables were added to the minimal model, which included only organizational affiliation as predictor, is shown in Table 3.3. Through the increase in adjusted R^2 this table indicates the amount of remaining variance the newly added variable explains over and above what is already explained by the variables already included in the model at that stage. Thus, the stepwise selection procedure identified a regression model that includes organizational affiliation, need for privacy, age, job autonomy, and need for autonomy as the ideal model. The results of this model are summarized in Table 3.4.

Table 3.3 Steps in the model selection procedure.

<i>Predictor added to the regression model</i>	<i>BIC of the regression model after each step</i>	<i>Adjusted R^2 of the regression model after each step</i>
Start: Organizational affiliation (minimal model)	423.99	.18
Step 1: Need for Privacy	348.48	.29
Step 2: Job autonomy	343.64	.30
Step 3: Age	341.28	.32
Step 4: Need for autonomy	340.17	.32

Note. Table 3.3 presents the increase in model fit after each variable was added in a stepwise fashion in the model selection procedure. In each step the variable that explained the most of the remaining variance in the outcome variable was added to the regression model.

Table 3.4 *Results of the final regression model.*

	<i>Standard Error</i>	<i>Estimate</i>	<i>95% confidence interval</i>	<i>p-value</i>
β_0 (Intercept)	.47	8.00	7.07- 8.92	> .001
$\beta_{\text{Organisation 2}}$	.21	1.36	.94 – 1.78	> .001
$\beta_{\text{Organisation 3}}$	.30	1.19	.62 – 1.77	> .001
$\beta_{\text{Organisation 4}}$	.16	.84	.52 – 1.16	> .001
$\beta_{\text{Organisation 5}}$	.17	1.31	.98 – 1.64	> .001
$\beta_{\text{Organisation 6}}$	.23	1.28	.83 – 1.72	> .001
$\beta_{\text{Organisation 7}}$	.26	1.28	.78 – 1.78	> .001
$\beta_{\text{Need for privacy}}$	.07	-.64	-.78 – -.49	> .001
$\beta_{\text{Job autonomy}}$	.08	.36	.19 – .52	> .001
β_{Age}	.01	-.02	-.03 – -.01	.004
$\beta_{\text{Need for autonomy}}$	.09	-.25	-.43 – -.07	.007

Note. Table 3.4 presents standard errors, estimates, confidence intervals, and p -values of the final regression model; organization 1 is the baseline with which other organizations are compared

The final model explains 32% of the variance in satisfaction with ABW environments ($R^2_{\text{Adj}} = .32$). As the stepwise increases in R^2 in Table 3.3 indicate, the lion's share of this percentage is contributed by organizational affiliation and need for privacy. After need for privacy was included, age, job autonomy, and need for autonomy added marginal predictive power to the model. Hence, the regression results indicate that, for a given organization, workers' need for privacy may be used to predict their satisfaction with the ABW environment.

Job autonomy is the only job characteristic that was included in the final model; social interaction and internal mobility were also significantly correlated with satisfaction with the work environment. This implies that social interaction and internal mobility do not explain a significant proportion of variance in satisfaction

with ABW environments over and above the variance explained by job autonomy; this may be due to significant mutual correlations (see Table 3.2). Similarly, need for relatedness, although correlated with satisfaction with the work environment, did not additionally explain any variance.

The inclusion of need for autonomy in the final model as a (weak) negative predictor was unexpected, both in relation to our hypothesized positive association (*Hypothesis 1*) and in relation to its non-significant correlation with satisfaction with the work environment (see Table 3.2). Apparently, need for autonomy added marginal predictive power to the model due to its relations with the other predictor variables.

Residuals of our final regression model were examined closely for violation of the independence, normality, and linearity assumptions. No violation of regression assumptions was detected, indicating that model errors are uncorrelated between employees even though employees were sampled nested within organizations. Diagnostic plots of our model residuals can be found in Appendix 3.1.

Discussion

Interpretation and explanation of the results

This study identified two psychological needs, three job characteristics, and one demographic variable as significant correlates of satisfaction with ABW environments: need for relatedness (positive), need for privacy (negative), job autonomy (positive), social interaction (positive), internal mobility (positive), and age (negative). No empirical support was found for the hypothesized associations with need for autonomy and need for structure.

Need for privacy appeared to be a powerful predictor of individual differences in satisfaction with ABW environments.

Although weak and barely significant ($r = .11, p < .05$), the correlation between need for relatedness and satisfaction with ABW environments indicates that the openness, transparency, and informal meeting spaces typical of ABW environments (Wohlers & Hertel, 2017) are valued by workers who focus on social interactions.

The strong association with need for privacy clearly confirms previous findings indicating that ABW environments fail to provide satisfactory levels of privacy (Van der Voordt, 2004; De Been & Beijer, 2014). This shows an important downside of the aforementioned openness and transparency. The work environments included in this study all feature a main area with workstations in an open-plan layout, providing low levels of acoustic and visual privacy. Especially since most workers switch seldom or not at all between different activity settings (Hoendervanger et al., 2016), they may frequently find themselves in these open-plan areas, also when performing activities that require concentration. Apparently, the enclosed quiet spaces for concentration work, which were present in all work environments as well, do not resolve privacy issues adequately.

Need for autonomy did not show a significant correlation with satisfaction with ABW environments; however, it was included in the final regression model as a weak negative predictor of satisfaction with ABW environments. Apparently, the range of choices of different activity settings falls short of fulfilling the need for autonomy of those workers who strongly feel this need. Referring to a study by Gerdenitsch et al. (2015), this may indicate that the freedom of choice in ABW environments is perceived as not only autonomously but also externally controlled. In this context, perceived external control might be related to social barriers (e.g., social norms) and practical barriers (e.g., limited availability of preferred settings) to using different activity settings freely. Also, not having any personal territory within the work environment might lead to a perception of external control.

Need for structure does not seem to be associated with satisfaction with ABW environments. Uncertainty about the availability of specific work settings at specific moments does not seem to harm workers' sense of structure. This finding might be explained by the aforementioned low switching frequencies (Hoendervanger et al., 2016); workers who mostly or always use the same activity setting may not actually experience uncertainty regarding their use.

Workers who perceived their jobs as providing a high degree of autonomy (i.e., freedom to choose when, where, and how to work) reported higher satisfaction ratings. A possible explanation is that this freedom enables workers to benefit from the opportunity offered by an ABW environment to choose an activity setting that fits their needs at all times. We might also expect these workers to avoid certain drawbacks of ABW environments (e.g., lack of privacy, shortage of favorite activity

settings) by working at alternative locations (e.g., at home, co-working space) whenever they like.

In line with our hypothesis, workers in jobs that require a high degree of social interaction and workers in jobs that require a high degree of internal mobility expressed higher levels of satisfaction with ABW environments. This seems to indicate that ABW environments support job-related social interactions and internal mobility.

The observed negative association between age and satisfaction with ABW environments indicates, in accordance with Pullen (2014) and Leesman (2017), that these environments are less well suited to the needs and preferences of older workers. Our finding regarding need for privacy seems to confirm the idea, put forward by Pullen (2014), that this might be due to an increased sensitivity to auditory and visual distractions at greater ages. In addition, our finding regarding age seems to match with the observation that older knowledge workers particularly miss quiet spaces to contemplate and recuperate (Myerson et al., 2010). Our finding regarding age contradicts the expectations of Wohlers and Hertel (2017), based on the more active coping strategies and better self-regulation skills found in older workers compared with younger workers. Apparently, these better developed skills are not helping older workers sufficiently to resolve their problems with concentration and privacy in ABW environments.

In line with previous research by Leesman (2017), we found male and female workers to be equally satisfied with ABW environments. This may indicate that gender-based affective differences regarding certain aspects of ABW environments, as mentioned by Wohlers and Hertel (2017), do not greatly affect overall satisfaction, possibly because male and female complaints (regarding different aspects) balance each other out.

Limitations and perspectives for further research

The size of our data set, and its combination of data from seven different organizations, enabled us to draw clear conclusions about factors associated with individual differences in satisfaction with ABW environments. Since ABW is an international trend (Cushman & Wakefield, 2013; Wohlers & Hertel, 2017; Leesman,

2017), it would be interesting to confirm the international relevance of our findings in further research, by including data from organizations in different countries.

Although any survey-based study, like the current one, is limited with regard to the number of factors that can be included, the search for factors that may explain individual differences in satisfaction with ABW environments might be broadened in future research. For instance, certain personality traits (e.g., Big Five dimensions) might be included to enable replication of previous findings in this field (e.g., Seddigh et al., 2016). Also, more job-related variables might be included in further research, such as aspects of activity profiles (e.g., share of office time spent on different types of activities). As the heterogeneity of activity profiles (i.e., dispersion of office time over different types of activities) was found to be related to switching behavior (Hoendervanger et al., 2016), it might also affect satisfaction with ABW environments.

Our main finding regarding the need for privacy stresses the need for further research focusing on why workers, and especially older workers and workers high in need for privacy, experience a lack of privacy in ABW environments and how this issue might be resolved. Zooming in on this complicated matter, which seems to involve an interplay of multiple functional factors (e.g., architectural privacy, availability of settings for concentrated work), physiological factors (e.g., increased sensitivity to auditory and visual stimuli), psychological factors (e.g., need for privacy, switching behavior), and social factors (e.g., social interaction and social norms), probably requires a qualitative research design, using techniques like close observations and in-depth interviews.

Many of our findings, including non-significant relationships, seem to be associated with workers' choice behaviors and switching behaviors in ABW environments. Further research might explain (individual differences regarding) these behaviors and their impacts on satisfaction with ABW environments. Thorough examination of behavioral patterns requires advanced measurement techniques (e.g., experience sampling, sensor-based location tracking), which do not rely on retrospective recall of these patterns.

Although it was beyond the scope of the current study, our results strongly confirm that satisfaction with ABW environments may differ widely across organizations. Highly significant differences were found in our sample, with a 1.36 difference on

average (on a ten-point scale) between the organization with the highest ratings and the organization with the lowest ratings. Compared with a different dataset that was previously used by Hoendervanger et al. (2016), the average satisfaction score in the current sample was high (6.9 vs. 5.6), with a greater share of workers that may be regarded as satisfied (84% vs. 60%). These striking differences call for further research examining situational differences, in line with the comparative case study by Brunia et al. (2016).

Implications for theory and practice

We believe that our findings are relevant to P-E fit theory (Edwards et al., 1998; Kristof-Brown et al., 2005). In line with this theory, satisfaction with ABW environments appeared to be related to individual differences (i.e., strength of need for privacy, need for relatedness, and age), suggesting that establishing needs-supply fit is important for optimizing satisfaction with the work environment. In addition, our findings regarding job characteristics (i.e., job autonomy, social interaction, and internal mobility) suggest that, in close analogy with P-E fit, Job-Environment fit (J-E fit) deserves attention as well: job characteristics may influence a person's needs. Thus, P-E fit theory seems to provide a useful framework for further elaborating our understanding of the complex relationships between individual differences among workers, their various job characteristics, and their work environments. At the same time, advanced knowledge about these relationships may contribute to the further development of P-E fit theory. In particular, this may broaden the scope of P-E fit theory, by acknowledging how specific perceived qualities of the physical work environment (e.g., availability, functionality, comfort, and aesthetic quality of different types of settings) may be instrumental for creating P-E fit.

With regard to job characteristics, our findings confirm the model developed by Duffy & Powel (1997), which assumes that ABW environments are suitable specifically for work that is highly interactive and highly autonomous. This also implies that they are less suitable for other types of jobs, which may help explain why satisfaction with ABW environments often falls short of expectations. Probably the most important implication for practice is that managers and workplace professionals should seriously consider individual differences among workers. Our findings underline the importance of analyzing psychological needs,

job characteristics, and demographic variables within the population of workers before designing a new work environment for them. Specifically, need for privacy should be examined as this factor may indicate if and how an ABW environment might be successfully implemented. In general, it is advisable to create a work environment and an associated work culture that allow for different work styles in alignment with different needs strengths, job characteristics, and demographic variables. For example, some workers may want to switch between different workstations in quiet and busy zones, while others may always need a distraction-free workstation at the office, and still others may prefer to use their home office for individual tasks and attend the office exclusively for social interaction and collaborative work.

To enhance satisfaction with ABW environments in practice, it seems of utmost importance to increase experienced levels of privacy, especially for workers high in need for privacy and for older workers. Activity settings that are intended to be used for concentration work deserve special attention, as these should be sufficiently available and tailored to specific person-related and job-related needs. In addition, attention should be paid to minimizing psychological, social, and practical barriers that may prevent workers from using these activity settings when they need to concentrate. It is advisable to consider the privacy offered in other activity settings as well, especially in the main area, which usually has an open-plan layout. Here, the experienced level of privacy may be increased through acoustic measures (e.g., sound-absorbing materials), layout choices (e.g., dividers and distance between workstations), provision of back-up spaces for noise-producing activities (e.g., phone calls, informal meetings), and implementing behavioral rules (e.g., leave the area to make a phone call). For workers high in need for privacy, workstations in (private or shared) closed rooms may be preferred as main workstations instead of workstations in an open-plan layout. In addition, increasing the autonomy of workers with regard to the use of alternative locations (e.g., home office, co-working space) when they need a higher level of privacy than the ABW environment at the office provides, may help resolve privacy issues. Our findings underline the importance of taking an integrated approach, recognizing the interplay between the aforementioned physical and psychosocial factors. The typical ABW solution of providing a number of quiet back-up spaces does not seem sufficient to satisfy all workers.

The share of older workers will grow in many organizations in the near future, especially in European countries, due to demographic changes and regulations that push retirement age up (Aiyar et al., 2016). The distinct privacy needs of an ageing workforce (Myerson et al., 2010), together with the increasing value of 'deep work' (i.e., individual focus work) within the emerging knowledge economy (Newport, 2016), should urge practitioners to effectively resolve privacy issues in ABW environments.

Appendix 3.1:

Assumptions and diagnostic plots of model residuals

The residuals appear to be independently distributed as indicated by a plot of successive residuals displayed in Figure I. Even though the assumption of uncorrelated errors was rejected by the Durbin-Watson test ($p = .02$), which tests for autocorrelation between the residuals, this might be due to the large sample size as no obvious problems with correlations are indicated by Figure I. The plot in Figure I indicates a single outlier, which gets plotted twice in this plot. This finding might imply that model errors are uncorrelated between employees even though employees were sampled nested within companies. Hence, even though employees are spatially related this did not result in dependence between their data. Furthermore, a QQ-plot of the residuals shows that the model residuals are roughly normally distributed, as can be seen in the upper right plot of Figure II. The upper left plot of Figure II plots the residuals against predicted values, the lower left plot shows square root standardized residuals against predicted values. The plots suggest that residuals appear to exhibit constant variance. Further, the upper left plot suggests that the relationship between the predictors and workplace satisfaction can be modeled in a linear fashion, though an outlier is visible in all plots included in Figure II (participant 337). A plot of residuals against leverages, depicted in the lower right of Figure II, suggests that there are no data points which severely distort the model prediction, while one outlier is visible in the final model (participant 337). This outlier has associated values of one on satisfaction with the work environment (*Cook's distance* = .04). However, a comparison of the final model with an equivalent model with the outlier excluded demonstrated that the outlier did not influence the model in any relevant way. The outlier was included in the final model.

Figure I. *Successive Residuals of the final regression model.*

Figure II. *Assumption checks of the final linear regression model.*

Note. The upper left and lower left plot show the residuals and square-root standardized residuals plotted against their predicted values, respectively. The upper right plot depicts a QQ-plot of the residuals. The lower-right plot allows for detection of influential points by plotting residuals against leverage.

Appendix 3.2: Questionnaire

Question

1. Gender: male / female
2. Age: years
3. I have freedom to carry out my tasks the way I prefer.*
4. My work involves interaction with other people.*
5. I work at different places within the office building.*
6. Satisfaction with my work environment: grade (1 - 10)
7. I have the need to have a say in determining my activities and tasks.*
8. I have the need for rules and guidelines that I can follow.*
9. I have the need to determine on my own how to best approach my work.*
10. I have the need for complete silence.*
11. I have the need to be around people so I do not feel alone.*
12. I get irritated when colleagues are noisy.*
13. I have the need to feel like I am part of a team or a group.*
14. I have the need to hang out with people.*
15. I get distracted easily.*
16. I have the need for a daily routine.*
17. I have the need to know exactly what to expect.*
18. I have the need to decide on my own how to go about getting my job done.*
19. I have difficulty concentrating when things are noisy.*
20. I have the need for freedom to do my work the way I think is best.*
21. I have the need to be with other people.*
22. I am easily distracted by people moving about.*
23. I have the need for order and regularity.*

* five-point scale: (1) very strongly, (2) strongly, (3) moderately, (4) slightly, (5) not at all

Relations between questions and variables

- Gender = 1
- Age = 2
- Job autonomy = 3
- Social interaction = 4
- Internal mobility = 5
- Satisfaction with the work environment = 6
- Need for structure = 8 + 16 + 17 + 23
- Need for autonomy = 7 + 9 + 18 + 20
- Need for relatedness = 11 + 13 + 14 + 21
- Need for privacy = 10 + 12 + 15 + 19 + 22

Appendix 3.3: 95% confidence intervals and exact *p*-values for the correlations.

<i>Variable</i>	1.	2.	3.	4.	5.	6.	7.	8.
1. Satisfaction with the work environment	-							
2. Need for autonomy	-.04 - .13 (.260)	-						
3. Need for relatedness	.02 - .19 (.014)	-.04 - .13 (.329)	-					
4. Need for structure	-.15 - .02 (.122)	-.34 - -.19 (.000)	.04 - .20 (.005)	-				
5. Need for privacy	-.46 - -.32 (.000)	-.03 - .14 (.167)	-.21 - -.04 (.003)	.19 - .35 (.000)	-			
6. Age	-.29 - -.13 (.000)	-.13 - .04 (.342)	-.30 - -.14 (.000)	-.15 - .02 (.116)	-.09 - .07 (.801)	-		
7. Job autonomy	.13 - .29 (.000)	.44 - .57 (.000)	-.05 - .12 (.395)	-.31 - -.15 (.000)	-.17 - -.01 (.031)	-.09 - .07 (.813)	-	
8. Social interaction	.13 - .29 (.000).	.33 - .47 (.000)	.09 - .26 (.000)	-.27 - -.11 (.000)	-.23 - -.07 (.000)	-.20 - -.03 (.007)	.35 - .48 (.000)	-
9. Internal mobility	.06 - .22 (.001)	.13 - .29 (.000)	-.05 - .11 (.471)	-.31 - -.16 (.000)	-.10 - .07 (.769)	-.27 - -.11 (.000)	.17 - .32 (.000)	.19 - .35 (.000)

CHAPTER 4

Perceived fit in activity-based work environments and its impact on satisfaction and performance⁸

Abstract

Activity-based work environments are widely adopted; however, research shows mixed findings regarding privacy issues, satisfaction with the work environment, and task performance. To further our understanding, two complementary studies drawing on Person-Environment fit theory were conducted: (1) A field study using experience sampling, and (2) A lab study in a virtual reality studio. The results from both studies confirm that perceived fit is a function of activity, work setting, and personal need for privacy, with indirect effects on satisfaction with the work environment (Studies 1 and 2) and task performance (Study 2). Across both studies, a misfit was perceived particularly among workers high in personal need for privacy when performing high-complexity tasks in an open office work setting. Hence, we recommend that organizations facilitate and stimulate their workers to create better fits between activities, work settings, and personal characteristics.

⁸ This chapter is based on Hoendervanger, J. G., Van Yperen, N. W., Mobach, M. P., & Albers, C. J. (2019). Perceived fit in activity-based work environments and its impact on satisfaction and performance. *Journal of Environmental Psychology*, 65. <https://doi.org/10.1016/j.jenvp.2019.101339>

Introduction

Growing numbers of organizations worldwide are adopting work environments based on the principles of Activity-Based Working (ABW) (Cushman & Wakefield, 2013; Leesman, 2017; Wohlers & Hertel, 2017). In these environments, workers do not have assigned workstations, but instead share an office space offering different types of non-assigned work settings, which are intended to be used for different types of activities (Becker, 1999; Jones Lang Lasalle, 2012; Veldhoen, 2005). A recent systematic review, based on seventeen field studies, found that an ABW environment may have merits with regard to social interaction, perceived control, and satisfaction with the work environment. However, an ABW environment seems to hamper workers' concentration and privacy (Engelen et al., 2019). Other studies have shown that satisfaction with ABW environments may differ strongly between and within organizations (Brunia et al., 2016; Göçer et al., 2018; Hoendervanger et al., 2018; Leesman, 2017). In a number of field studies, satisfaction was below expectations, with concentration, privacy, and the loss of an assigned workstation listed as major self-reported issues (Babapour, 2019; Bodin Danielsson & Bodin, 2009; De Been & Beijer, 2014; Van der Voordt, 2004).

Hence, in this paper, we present two complementary studies that were aimed at explaining these mixed outcomes of ABW environments. The basic rationale underlying ABW is that, when offered different types of work settings, workers will use these in accordance with their activities and needs (Becker, 1999; Gibson, 2003). Similarly, Person-Environment (P-E) fit theory defines P-E fit as a match between workers' characteristics, their work environment, and their tasks (Edwards et al., 1998; Kristof-Brown et al., 2005). Hence, we assume that a (perceived) fit between work settings, activities, and workers' personal needs produces positive outcomes such as satisfaction and performance (Vischer, 2007; Wohlers & Hertel, 2017). Three recent studies conducted in ABW environments provide initial empirical support for the link between (perceived) fit and positive outcomes (Gerdenitsch et al., 2018; Haapakangas et al., 2018b; Wohlers et al., 2019).

Drawing on P-E fit theory, the current studies were designed to further examine when and why ABW environments do (not) work. In line with P-E fit theory (Edwards et al., 1998; Kristof-Brown et al., 2005), we expected a worker's personal need for privacy (PNP) to moderate perceived fit between activity and work setting. Consistent with previous findings (Gerdenitsch et al., 2018; Kristof-Brown & Guay,

2011), we assumed perceived fit to be related to important organizational outcomes of satisfaction with the work environment (Studies 1 and 2) and task performance (Study 2). Note that we specifically focused on high-complexity versus low-complexity tasks to gain a better understanding of often-reported privacy and concentration issues (Babapour, 2019; Bodin Danielsson & Bodin, 2009; De Been & Beijer, 2014; Engelen et al., 2019; Van der Voordt, 2004).

Figure 4.1 *Research model.*

Note. Task performance could only be assessed and tested in Study 2.

To test our research model (see Figure 4.1), we conducted two complementary studies. In Study 1, a field study with a high level of ecological validity, we examined the actual use of private and open office work settings for high-complexity versus low-complexity tasks and related experiences of fit. In line with the recommendations of Davis, Leach, and Clegg (2011), we used experience sampling (Larson & Csikszentmihalyi, 1983; Totterdell, 2006) to collect detailed and reliable data, and to address potential recall bias (Shiffman et al., 2008) associated with unconscious automated behavior (Aarts & Dijksterhuis, 2000). In Study 2, a laboratory experiment, we relied on virtual reality (VR) to simulate the typical working conditions of a private and an open office work setting. Under these controlled conditions, we were able to test the causal relations between activity and work setting (independent variables), PNP (moderator), and satisfaction with the work environment and objectively measured task performance (dependent variables). To our knowledge, this is the first experimental study to test the basic assumption underlying the ABW concept drawing on P-E fit theory: that is, a (perceived) fit between activity and work setting produces positive outcomes.

Perceived fit as a function of activity and work setting

In our studies, we focused on two common types of (unassigned) work settings that offer high versus low levels of privacy and concentration: A private office, or workstation in an enclosed individual room (sometimes referred to as 'concentration cell'), and an open office, that is, a workstation in an open-plan area. We specifically selected these two types of work settings because they can be considered as extreme opposites in terms of privacy offered, whereas other types offer moderate or varying privacy levels (e.g., semi-enclosed workstations, shared rooms for quiet working). As task complexity is directly linked to the required level of concentration (Bedny et al, 2012), the rationale underlying ABW is that private office and open office work settings fit with high-complexity tasks (e.g., writing a business case report, reviewing a complex contract) and low-complexity tasks (e.g., answering simple e-mails, reading news letters), respectively. Conversely, the use of private office work settings for low-complexity tasks and the use of open office work settings for high-complexity tasks are considered to be misfits. In terms of P-E fit theory, to create need-supply fit, the activity-induced need (e.g., the need to concentrate) should be fulfilled by the work setting (Edwards et al., 1998; Kristof-Brown et al., 2005).

With regard to high-complexity tasks, numerous studies indeed suggest a better perceived fit with private office rather than open office work settings (e.g., Compernelle, 2014; De Been & Beijer, 2014; Kaarlela-Tuomaala et al., 2009; Kim & De Dear, 2013). For example, workers who rated their job as requiring high concentration were found to experience lower levels of environmental distraction and stress in cell offices compared with open-plan offices (Seddigh et al., 2014). Other studies showed that, particularly among workers in highly complex jobs, working in open-plan offices was negatively associated with satisfaction, workplace attitudes, withdrawal behaviors, and performance (Block & Stokes, 1989; Maher & Von Hippel, 2005; Sundstrom et al., 1980).

With regard to low-complexity tasks, Compernelle (2014, p. 24) suggested that routine work fits better with an open-plan environment because "... some distraction helps to prevent this work from becoming too boring and increases the performance and feeling of wellbeing". This idea is in line with arousal theory, which suggests that a certain level of arousal, which may be caused by ambient noise, is required for optimal task performance (Staal, 2004). Similarly, based on a literature

review, Hockey (1979) concluded that performance improvement from noise exposure is often seen in less complex tasks or those in which boredom is experienced, while negative effects are more likely in complex tasks. However, to date, the empirical evidence is limited and contradictory. McBain (1961) found that the performance of monotonous work improved with exposure to certain types of noise (i.e., low in intelligibility, high in variability). Likewise, in a laboratory study, workers performed better at routine tasks in a shared office (with three co-workers) compared with a private office (Block & Stokes, 1989). In contrast, in a field study by Sundstrom et al. (1980), the hypothesis that performance and satisfaction would be higher when routine work was carried out in non-private work settings, was rejected; private rooms were preferred for all types of work.

Personal need for privacy (PNP) as a moderator

In addition to task characteristics, individual differences among workers seem to be important as well. In line with P-E fit theory (Edwards et al., 1998; Kristof-Brown & Guay, 2011), and other organizational theories that recognize the importance of individual differences (e.g., Hackman & Lawler, 1971; McClelland & Burnham, 1976), the preference for a particular work setting when working on a particular task may be a function of individual differences (Van Yperen & Wörtler, 2017). With regard to office design, Oseland (2009) argued that both task requirements and psychological needs should be addressed. In the present research, we propose that particularly for workers high in PNP, a private office work setting may lead to more favorable outcomes, particularly when high-complexity tasks are carried out. PNP was introduced and conceptualized by McKechnie (1977) as an individual's preference for protection from unwanted external interruptions and distractions (rather than protection from sharing confidential information, being overheard, or being watched; Kupritz, 1998). For example, Oldham (1988) found that people high in PNP preferred working in closed, preferably individual rooms rather than working in an open-plan office. In a more recent field study, it was found that workers high in PNP generally reported lower satisfaction with ABW environments (Hoendervanger et al., 2018). Accordingly (see also Figure 1), we expected to find a moderation effect of PNP such that perceived fit between open office work settings and high-complexity tasks would be low, particularly among workers *high* in PNP. Conversely, we expected perceived fit between open office work settings and low-complexity tasks to be high, particularly among workers *low* in PNP.

Indirect effects on satisfaction with the work environment and task performance

P-E fit theory states that a perceived misfit between personal needs (e.g., PNP) and environmental supply (e.g., privacy offered by the work setting) causes psychological strain such as dissatisfaction (Edwards et al., 1998; Kristof-Brown et al., 2005). Accordingly, Wohlers and Hertel (2017, p. 475) proposed that when workers are using work settings “according to their task’s needs [...] high Task-Environment fit decreases negative effects of acoustic disturbances and distractions”. Initial empirical support for this relationship was found by Gerdenitsch et al. (2018). They showed that, after relocation to an ABW environment, workers reporting higher levels of perceived fit between activities and work settings demonstrated a stronger increase in satisfaction with their work environment. Hence, we expected an interactive, indirect effect of activity, work setting, and PNP on satisfaction with the work environment through perceived fit.

As noted by Wohlers and Hertel (2017), P-E fit theory suggests that also task performance may be affected by a (mis)match between personal needs (which may be induced by the task at hand) and the work environment (cf., Edwards et al., 1998). In the P-E fit literature, person-organization fit and person-job fit are typically positively associated, albeit weakly, with task performance (Kristof-Brown & Guay, 2011), a finding that has been supported in workplace research as well (e.g., Block & Stokes, 1989; Maher & Von Hippel, 2005; Sundstrom et al., 1980). Hence, we expected activity, work setting, and PNP to have an interactive indirect effect on task performance through perceived fit.

Methods study 1

Sample

Data were collected in a Dutch organization, found within the researchers' network, that agreed to cooperate by allowing workers to take part in the research on a voluntary basis. The organization is a large public organization (around 500 workers) employing knowledge workers mainly. A total of 61 workers participated in the study (51% male; average age 46.2 years; educational attainment: 38% master's degree or higher). The work environment, which had been in use for more

than two years, was based on the ABW concept, providing different types of work settings, i.e., open-plan workstations, private rooms, meeting rooms, open meeting places, lounge workstations, and telephone booths. These work settings were designed for different types of activities and were not assigned to individual workers (free seating). The desk-sharing ratio was 1.2 persons per desk, with 12% of the desks situated in private office work settings.

Procedure

All workers were informed about the purpose and the procedure via intranet and an e-mail inviting them to attend a presentation session if they were interested in participating. About a week before the start of the measurement period, they all received an e-mail invitation. Following the link in this e-mail, they could first fill out an online questionnaire in which their PNP and satisfaction with the work environment were assessed. Next, they could install a mobile application on their smartphone or tablet. We tested and optimized the application before using it in the current study (Hoendervanger et al., 2015). During the measurement period of two weeks (10 working days), at six randomly chosen times during office hours, participants received a request (push notification) to answer three straightforward questions. Participants could answer these questions right away or later the same day (until midnight). The research procedure was reviewed and approved by the Ethical Committee Psychology of the University of Groningen.

Measures

Activity and perceived task complexity were measured repeatedly through the experience-sampling application. Answering the question “I’m currently working on ...”, participants could select from a list of pre-defined options. Two of these options were included in this study: “individual work that requires a high level of concentration” (coded as 0) and “individual work that requires a low level of concentration” (coded as 1). The answers to this question should be considered as subjective judgments of the required level of task-related concentration, which may be influenced by comparisons with implicit social or psychological standards (Edwards et al., 2006). Since perceived task complexity is directly linked to the

perceived level of concentration that the task requires (Bedny et al., 2012), we used this measure as an indicator for perceived task complexity.

Work setting was measured repeatedly using the experience-sampling application. Answering the question “I’m currently working at/on/in...”, participants could select from a list of pre-defined options based on the actual range of choice of work settings and the terms that were used in that organization. Two of these options were included in this study: “workstation in open plan” (coded as 0) and “workstation in closed private room” (coded as 1).

Personal need for privacy (PNP) was measured at the outset using five items derived from the Environmental Response Inventory (Bruni et al., n.d.; McKechnie, 1977): (1) “I get irritated when colleagues are noisy”, (2) “I have difficulty concentrating when things are noisy”, (3) “I am easily distracted by people moving about”, (4) “I need complete silence”, (5) “I get distracted easily”. Scores ranged from 1 (*do not agree at all*) to 5 (*very strongly agree*). Cronbach’s alpha in our sample was .87.

Perceived fit between activity and work setting was measured repeatedly using the experience-sampling application. Participants reported to what extent they agreed with the statement “I can carry out this activity well at this workstation” using a six-point scale, ranging from “very strongly disagree” (coded as 1) to “very strongly agree” (coded as 6). This measure is similar to measures typically used in PE fit studies (Kristof-Brown & Guay, 2011) and in line with the ‘molar’ approach introduced by Edwards et al. (2006). Use of a single-item measure was desirable to keep the experience-sampling questionnaire as short as possible. This is acceptable because perceived fit is a sufficiently narrow and unambiguous construct (Wanous et al., 1997).

Satisfaction with the work environment was measured at the outset using the question ‘How do you rate your satisfaction with the work environment?’ (1 = lowest rate, 10 = highest rate). A single-item measure was used to minimize the burdening of participants during working time. This is acceptable because workplace satisfaction is a sufficiently narrow and unambiguous construct (Wanous et al., 1997).

Statistical analyses

An ordinal probit regression model was constructed to analyze perceived fit between activity and work setting as a function of activity, work setting, and PNP. Linear regression analysis was not possible due to the use of a single-item measure for the dependent variable, perceived fit. In line with our research model (see Figure 4.1), main effects, two-way interactions, and the three-way interaction were included. Since activity, work setting, and perceived fit were measured repeatedly per individual, whereas PNP was administered once per individual, a hierarchical model with two levels was used. The resulting model is a generalized linear mixed model, which was fit through Bayesian MCMC using the MCMCglmm package (Hadfield, 2010) in R (R Core Team, 2015). Follow-up simple slope analyses (Aiken & West, 1991) were used to interpret interaction effects.

In Study 1, we followed the procedure proposed by Baron and Kenny (1986) to test the expected mediation effect through perceived fit on satisfaction. The more advanced approach introduced by Hayes (2017a), which we used for the lab study (Study 2), was not readily applicable to our ordinal-probit regression model. We set up two single-level weighted least squares regression models, linking the percentage of time spent on high-complexity tasks, the percentage of time spent in an open office work setting, the need-for-privacy score, and the average perceived-fit score to the reported satisfaction level for each individual participant. The numbers of entries per participant were used as weights.

Results Study 1

Descriptive statistics

A total of 2,306 measurements were collected. The time gap between sending out the questions and receiving the answers was less than one hour in 69% of the cases, and more than five hours in 6% of the cases ($M = 56$ min.; $m = 33$ min.; $SD = 0.09$). For our analyses, we selected the 975 measurements that concerned the reported use of a workstation in an open office or a private office work setting for an individual work activity (high- or low-complexity task). This subset comprised 42% of the measurements; the rest concerned work outside the office, commuting and

time off (32%), communication activities and breaks (24%), and individual activities carried out in work settings other than open office and private office (2%).

The observed frequencies for the variables activity and work setting showed that most individual work concerned high-complexity tasks (58%). Remarkably, almost all of this work was performed in open office work settings (93%). As a consequence, misfits between activity and work setting were a common phenomenon, but only with regard to high-complexity tasks. Specifically, 52% of the measurements concerned high-complexity tasks in open office work settings, and only 1% of the measurements concerned low-complexity tasks in private office work settings. Note that there was a substantial discrepancy between the proportion of private office work settings (12%) and the proportion of reported high-complexity tasks (58%).

Table 4.1 shows descriptive statistics for the three continuous variables: (1) PNP, (2) perceived fit, and (3) satisfaction with the work environment. As expected, a significant positive correlation between perceived fit and satisfaction with the work environment was found. Furthermore, PNP was significantly negatively associated with both perceived fit and satisfaction.

Table 4.1 Means, standard deviations, and correlation coefficients (Study 1).

Variable	Mean	SD	1	2
1. Personal need for privacy (PNP)	2.62	0.85	-	
2. Perceived fit between activity and work setting	4.58	0.86	-.65* [-.77, -.47]	-
3. Satisfaction with the work environment	6.91	1.58	-.60* [-.74, -.41]	.61* [.42, .75]

Note. Average scores are used for perceived fit. Pearson correlation coefficients with 95% confidence intervals; * $p < .01$.

Perceived fit as a function of activity, work setting, and personal need for privacy (PNP)

The results of the ordinal probit regression analysis are presented in Table 4.2. The *p* values indicate that all main effects and interaction effects are significant, except for the interaction effect of activity × PNP. The significant main effects and two-way interaction effects were qualified by the significant three-way interaction effect of activity × work setting × PNP. In line with our research model (see Figure 4.1), follow-up analyses revealed a significant slope difference ($p < .001$) for the high-complexity task condition (see Figure 4.2a). Furthermore, perceived-fit scores for high-complexity tasks were significantly higher in the private office work settings compared with the open office work settings ($p < .001$). A significant negative slope for the open office condition ($p < .001$) indicates that, as expected, perceived fit between high-complexity tasks and open office work settings was particularly low among workers high in PNP.

Table 4.2 *Results of ordinal probit regression analysis for perceived fit (Study 1).*

Source of variation	Coefficient	95% confidence interval		<i>p</i> -value
		Lower	Upper	
Activity	2.938	2.609	3.249	< .001
Work setting	5.388	4.653	6.008	< .001
Personal need for privacy (PNP)	-1.378	-1.816	-0.950	< .001
Activity × work setting	-8.925	-10.377	-7.559	< .001
Activity × PNP	0.168	-0.099	0.431	.221
Work setting × PNP	1.148	0.503	1.754	< .001
Activity × work setting × PNP	-2.250	-3.437	-1.040	< .001

Note. The regression coefficients have no natural interpretation as these are measured on a probit-scale; however, the signs of these coefficients indicate the directions of the relations.

Figure 4.2 Interactive effects of activity, work setting, and personal need for privacy (PNP) on perceived fit with 95% credible bands (Study 1).

Note. On the vertical axis, perceived fit scores ranged from 1 to 6 (the width of the intervals varies as a result of the ordinal probit regression analysis). The horizontal axis shows the PNP scores, ranging from 1 s.d. below to 1 s.d. above average. Slope differences were significant for high-complexity tasks ($p < .001$) and low-complexity tasks ($p = .001$). Scores for private and open office work settings differed significantly for both high-complexity and low-complexity tasks (p -values $< .001$).

We also found a significant slope difference ($p = .001$, see Figure 4.2b) for the low-complexity task condition. As expected, in contrast with the high-complexity tasks, perceived-fit scores for low-complexity tasks were significantly higher in the open office work settings compared with the private office work settings ($p < .001$). The significant slopes ($p < .001$) indicate that, compared with workers low in PNP, workers high in PNP reported significantly lower perceived fit in both open and private office work settings.

Indirect effect on satisfaction with the work environment

Two regression models were compared to test the hypothesized indirect effect on satisfaction with the work environment. The first model included activity, work setting, PNP, perceived fit, and all mutual interactions. The second model resulted after the presumed mediator, perceived fit, was removed from the first model. The model fit of the first model ($R^2 = .60$, $R^2_{Adjusted} = .47$, $F(15, 45) = 4.58$, $p < .001$),

compared with that of the second model ($R^2 = .43$, $R^2_{Adjusted} = .36$, $F(7, 53) = 5.8$, $p < .001$), was significantly better ($\Delta R^2 = .17$, $F(8, 45) = 2.42$, $p = .028$).

Our results meet the four conditions for a mediation effect according to Baron and Kenny (1986): (1) as demonstrated in the previous section, perceived fit is a function of activity, work setting, and PNP, (2) the second model demonstrates a significant total effect on satisfaction, (3) a significant main effect of perceived fit was observed in the first model ($\beta = -20.84$, 95% CI $[-39.66, -2.02]$, $t(45) = -2.23$, $p = .031$), and (4) the three-way interaction effect of activity $\times$ work setting $\times$ PNP was weaker in the first model ($p = .799$) than in the second model ($p = .118$). Hence, activity, work setting, and PNP had a significant interactive indirect effect on satisfaction with the work environment, through perceived fit. The adjusted R^2 value of the second model indicates that 36% of variance in satisfaction can be ascribed to the (interactive effects of the) independent variables.

Discussion Study 1 and Introduction Study 2

The results from Study 1 show that, in line with our research model (see Figure 4.1), perceived fit was a function of activity, work setting, and PNP, with an indirect effect on satisfaction with the work environment. Perceived fit scores for *high-complexity tasks* were higher when a private office work settings were used and, in contrast, perceived scores for *low-complexity tasks* were higher when open office work settings were used. Except when high-complexity tasks were carried out in a private office work setting, workers high in PNP consistently reported lower perceived fit compared with workers low in PNP. After describing the methods and results of Study 2, we will compare and integrate these findings with those of Study 2, which is based on the same research model (with the addition of task performance as an outcome variable).

Study 1 was a field study with a high level of ecological validity but it does not allow causal inferences. Therefore, in Study 2, a laboratory experiment, we relied on VR to simulate the typical working conditions of a private and an open office work setting. Under these controlled conditions, we were able to test the causal relations between activity and work setting (independent variables), PNP (moderator), and satisfaction with the work environment and objectively measured task performance (dependent variables). In other words, in an experimentally controlled virtual reality

studio, we tested the same research model (see Figure 4.1), with task performance as an additional outcome variable.

Methods Study 2

Sample

All participants of the lab experiment in the VR studio were first-year students in a bachelor's program in Facility Management at Hanze University of Applied Sciences in the Netherlands. Of the original 204 participants, 44 were excluded from the dataset for different reasons. Twenty-five students who indicated having dyslexia were excluded as this might have affected their task performance. One student who appeared to be familiar with the Indonesian language was excluded since one of the tests was in that language, to prevent participants from getting distracted by the content. Eighteen other students were excluded because of incomplete data (e.g., due to skipping questions, misinterpretation of task instructions, or errors in time keeping). The remaining 160 participants (59% female) ranged in age from 17 to 29 years ($M = 19.48$, $SD = 2.03$).

An a priori power calculation, using G*Power (Faul et al., 2007), revealed that a medium effect size (Cohen's $f = 0.25$) could be detected at the 80% power level when the sample size is at least 128. With the $n = 160$ participants, a power level of 88% for a medium effect size ($f = 0.25$) is feasible (Faul et al., 2007).

Procedure

The participants were randomly assigned to a one of four conditions in a 2 (Work setting: Private versus Open office) $\times$ 2 (Activity: High- versus Low-complexity task) between-subjects design: (1) private office, high task complexity ($N = 39$), (2) private office, low task complexity ($N = 39$), (3) open office, high task complexity ($N = 41$), (4) open office, low task complexity ($N = 41$). The research procedure was reviewed and approved by the Ethical Committee Psychology of the University of Groningen.

The experiment took place in a VR studio on the university campus. In an adjacent room the participants received a written explanation of the procedure, provided

their informed consent, and filled out the need-for-privacy questionnaire (McKechnie, 1977). For the actual experiment, participants were guided to a workstation (chair and desk with computer screen and mouse) that was placed inside the 'Reality Cube': A half-open cube whose sides were 2.5 m long. Stereo 3D images were projected from outside on to the three vertical sides. Participants wore shutter glasses, which allowed them to see depth in the projected images. Also, they wore a cap with a sensor, which enabled the system to draw the images on screen from the perspective of the participant. This technology creates a highly realistic, 'immersive' experience (Loomis et al., 1999; Smith, 2015).

The private and open office conditions were simulated by putting participants in corresponding parts of a 3D model of an existing ABW environment, i.e., a private room measuring 1.8 m by 3.6 m with one workstation versus an open area with 15 workstations; see Figure 4.3. Animated human figures and recorded office sounds (i.e., primarily babble, some laughing; intelligibility of speech was very low) were added to further enhance the realism of the experience. In the private office condition, human figures could be seen walking by in the adjacent corridor through a semi-transparent part of the wall, and L_{Aeq} was between 25 dB and 30 dB (i.e., simulating sounds in an adjacent room, barely audible through the wall). In the open office condition, some human figures were working at desks and others were walking across the open space or standing at the coffee machine, and L_{Aeq} was between 50 dB and 60 dB. Climate conditions were monitored and kept constant throughout the experiment (i.e., temperature 21 – 23 °C, humidity 30 – 40%, CO₂ level 450 – 500 ppm).

Figure 4.3 Simulated conditions in the 'Reality Cube' (Study 2).

Sitting at the workstation, participants completed either the high- or the low-complexity versions of two different tasks, using a mouse and computer screen. Task 1 was based on the Minnesota Clerical Test (Bubany & Hansen, 2006), and Task 2 was a letter-search task. Both tasks are described in more detail below. After the first task, we assessed perceived task complexity (manipulation check) and perceived fit. After the second task, the same questions were answered as after the first task, followed by questions regarding perceived privacy (manipulation check) and satisfaction with the work environment. The tests were timed at three minutes each; the entire procedure in the VR studio took 12 - 14 minutes per participant. A research assistant was present to receive and to guide the participants, to provide the materials, and to monitor the process.

Measures

Perceived task complexity (manipulation check). The following three items were developed for the current research to check the effectiveness of the activity manipulation (i.e., high versus low task complexity): “The task I just completed...” (1) “was simple” (reversed), (2) “was complex”, (3) “was difficult”. Scores ranged from 1 (*do not agree at all*) to 7 (*very strongly agree*). The average of the two scores (i.e., related to the first and the second task) was used to create one overall perceived-task-complexity score. Cronbach’s alpha was .62 after the first task (3 items), .77 after the second task (3 items), and .74 for the overall score (6 items).

Perceived privacy (manipulation check). The following five items were developed for the current research to check the effectiveness of the work-setting manipulation (i.e., private versus open office): “I carried out tasks at a workplace...” (1) “in a quiet environment”, (2) “that provides a lot of privacy”, (3) “in a noisy environment” (reversed), (4) “where I can concentrate well”, (5) “with a lot of distraction” (reversed). Scores ranged from 1 (*do not agree at all*) to 7 (*very strongly agree*). Cronbach’s alpha was .91.

Personal need for privacy (PNP). As in Study 1, we used five items from the environmental response inventory (Bruni et al., n.d.; McKechnie, 1977) to measure PNP. Cronbach’s alpha was .72.

Perceived fit between activity and work setting. In Study 2, we were able to use a multi-item scale to measure perceived fit. For this purpose, the following five items were developed: "The task that I just carried out..." (1) "was doable at this workplace", (2) "was undoable at this workplace" (reversed), (3) "I would have done better at a different workplace" (reversed), (4) "I could not do well at this workplace" (reversed), (5) "I could do well at this workplace". For one participant who skipped one of these items, we used the remaining four items to calculate the perceived-fit score. Scores ranged from 1 (*do not agree at all*) to 7 (*very strongly agree*). The average of the two scores (i.e., related to the first and the second task) was used to create one overall perceived-fit score. Cronbach's alpha was .86 after the first task (5 items), .89 after the second task (5 items), and .91 for the overall perceived-fit score (10 items).

Satisfaction with the work environment. In Study 2, we were able to use a multi-item scale to measure satisfaction with regard to three aspects of the work environment that were adapted from the WODI (Work Environment Diagnostic Instrument) (Maarleveld et al., 2009): (1) comfort, (2) productivity support, and (3) functionality. A ten-point response scale was used, ranging from 1 (*very dissatisfied*) to 10 (*very satisfied*). Cronbach's alpha was .82.

Task performance. Two different cognitive tasks were used to measure task performance. In the first task, based on the Minnesota Clerical Test (Bubany & Hansen, 2006), two lists of meaningless codes (random combinations of letters and numbers) were presented on the screen. The participants were asked to mark all lines (and only those lines) in which both codes (left and right) were identical. In the low-complexity version, all codes consisted of six characters; in the high-complexity version, all codes consisted of ten characters. Participants could use the mouse to mark lines and to scroll to the next page to continue until the three minutes were over. Scores were determined by summing up the number of correct marks and subtracting the number of incorrect marks.

In the second task, a letter-search task, participants were asked to mark (with the mouse) specific letters in a text presented on the computer screen, e.g., "In the text below, mark all lower-case letters 'd'". Indonesian texts were used to prevent participants from getting distracted by the content (non-familiarity with Indonesian language was checked beforehand). In the high-complexity version, the targets were three different letters that had to be marked simultaneously. In the

low-complexity version, the target was only one letter. Participants could scroll to the next page to continue until the time was up. Test scores were determined by summing up the number of correct marks and subtracting the number of incorrect marks (i.e., wrong letters).

To create one overall task-performance score, the scores on each task were transformed into Z-scores. The average Z-score was used as overall index for participants' task performance.

Statistical analyses

In Study 2, a linear regression model was constructed to analyze perceived fit as a function of activity, work setting, and PNP, including their mutual interactions. Follow-up simple slope analyses (Aiken & West, 1991) were used to interpret interaction effects.

A regression-based approach, developed by Hayes (2017a, 2017b), was used to analyze the indirect effect of activity, work setting, PNP, and their mutual interactions on satisfaction, through perceived fit ('moderated moderated mediation' according to Hayes' Model 12).

Results Study 2

Descriptive statistics

Table 4.3 presents the means, standard deviations, and correlation coefficients of all continuous variables. As expected, perceived fit was significantly positively correlated with satisfaction with the work environment and task performance. The correlation between satisfaction and task performance was not significant.

Table 4.3 Means, standard deviations, and correlation coefficients (Study 2).

Variable	M	SD	1	2	3
1. Personal need for privacy (PNP)	3.01	0.72	-		
2. Perceived fit between activity and work setting	5.46	0.94	-.06 [-.21, .10]	-	
3. Satisfaction with the work environment	6.42	1.30	-.11 [-.26, .05]	.52** [.39, .62]	-
4. Task performance	0.00	1.65	-.06 [-.21, .10]	.19* [.04, .34]	.08 [-.08, .23]

Note. Average scores (Task 1 and Task 2) are used for perceived fit and task performance. Pearson correlation coefficients with 95% confidence intervals; * $p < .05$, ** $p < .01$.

Manipulation checks

Perceived task complexity. A two-sided t-test revealed that compared with the participants in the low-complexity task condition ($M = 2.87$, $SD = 0.84$), the participants in the high-complexity task condition ($M = 3.32$, $SD = 0.91$) scored significantly higher on perceived task complexity (mean difference = -0.45 , 95% CI $[-0.72, -0.18]$, $t(158) = -3.28$, $p = .001$), as intended.

Perceived privacy. A two-sided t-test showed that also the manipulation of the work setting was successful. Compared with the participants exposed to the open office condition ($M = 3.69$, $SD = 1.20$), the participants exposed to the private office condition ($M = 5.46$, $SD = 1.01$) scored higher on perceived privacy (mean difference = 1.77 , 95% CI $[1.42, 2.12]$, $t(158) = 10.07$, $p < .001$).

Perceived fit as a function of activity, work setting, and personal need for privacy (PNP)

As in Study 1, results from the regression analysis show that the significant main and two-way interactions were qualified by the significant three-way interaction effect of activity $\times$ work setting $\times$ PNP (see Table 4.4). Also consistent with Study 1,

follow-up analyses revealed that in the open office condition, perceived fit was negatively related to PNP ($p = .025$, see Figure 4.4a). This indicates that, as expected, perceived fit between high-complexity tasks and open office work settings was particularly low among participants high in PNP. An additional two-sided t-test revealed that, as in Study 1, compared with the participants exposed to the private office condition ($M = 6.01$, $SD = 0.68$), the participants exposed to the open office condition ($M = 4.90$, $SD = 0.94$) were lower in perceived fit (mean difference = -1.12 , 95% CI $[-1.48, -0.75]$, $t(78) = -6.03$, $p < .001$), when performing high-complexity tasks. In Study 2, no significant slopes or differences were found in the low-complexity task condition (Figure 4.4b).

Table 4.4 Results of regression analysis for perceived fit (Study 2).

Source of variation	Coefficient	95% confidence interval		p value
		Lower	Upper	
Activity	1.71	0.01	3.42	.049
Work setting	1.61	0.01	3.22	.049
Personal need for privacy (PNP)	0.21	-0.19	0.62	.298
Activity $\times$ work setting	-1.78	-4.09	0.53	.130
Activity $\times$ PNP	-0.73	-1.30	-0.15	.014
Work setting $\times$ PNP	-0.42	-0.95	0.11	.117
Activity $\times$ work setting $\times$ PNP	0.86	0.11	1.61	.025

Note. Unstandardized regression coefficients are shown.

Figure 4.4 *Interactive effects of activity, work setting, and personal need for privacy (PNP) on perceived fit with 95% confidence bands (Study 2).*

Note. On the vertical axis, perceived fit scores ranged from 1 to 6 (values and upper confidence bands exceeding 6 are a result of using the standard linear regression model, which is unbounded). The horizontal axis shows the PNP scores, ranging from 1 s.d. below to 1 s.d. above average. Slope differences were not significant for the high-complexity and the low-complexity task condition ($p = .103$ and $p = .118$ respectively). Scores for the private and open office condition differed significantly for the high-complexity task condition (mean difference = -1.12 , 95% CI $[-1.48, -0.75]$, $t(78) = 6.03$, $p < .001$), but not for the low-complexity task condition (mean difference = -0.36 , 95% CI $[-0.75, 0.03]$, $t(78) = -1.83$, $p = .071$).

Indirect effect on satisfaction with the work environment

The results showed that the expected indirect effect existed in our sample (index = 0.62 , 95% CI $[0.06, 1.19]$). The positive index value indicates that perceived fit amplifies the interactive indirect effect of activity, work setting, and PNP on satisfaction.

Indirect effect on task performance

The analysis with task performance as dependent variable provided evidence for the expected indirect effect on task performance (index = 0.37 , 95% CI $[0.01, 0.85]$).

The positive index value indicates that perceived fit amplifies the interactive indirect effect of activity, work setting, and PNP on task performance.

General discussion

The results from both Study 1 and Study 2 consistently provide empirical support for our research model (see Figure 4.1). That is, perceived fit between activity and work setting was a function of activity, work setting, and PNP, with an indirect effect on satisfaction with the work environment (Studies 1 and 2) and task performance (Study 2). More specifically, with regard to *high-complexity tasks*, both studies consistently demonstrated that outcomes were more positive for private office work settings than for open office work settings, particularly when workers were high in PNP. With regard to *low-complexity tasks*, the results were less consistent across the studies. In the field study (Study 1), perceived-fit scores were lower in the private office work setting than in the open office work setting, particularly when workers were high in PNP. In contrast, in the lab study (Study 2), no significant differences were found in the low-complexity task condition.

These findings imply that in ABW environments, higher levels of satisfaction and task performance may be achieved if private office work settings are used for high-complexity tasks, rather than open office work settings; this is particularly important for workers high in PNP. Our less consistent findings with regard to low-complexity tasks indicate that further research is needed to examine if, and for whom, the use of open office work settings may be beneficial, relative to the use of private office work settings. We note that the practical relevance of this question seems limited, given the low frequency of low-complexity tasks performed in *private office* work settings (1% of the measurements).

We believe that our findings regarding perceived fit and high-complexity tasks provide an explanation for the mixed outcomes of ABW environments that were reported in previous research (Babapour, 2019; Bodin Danielsson & Bodin, 2009; Brunia et al., 2016; De Been & Beijer, 2014; Engelen et al., 2019; Göçer et al., 2018; Hoendervanger et al., 2018; Leesman, 2017; Van der Voordt, 2004). The use of *open office* work settings for high-complexity tasks was reported frequently in our field study (52% of the measurements, see Study 1). This was probably due to the observed discrepancy between the proportion of high-complexity tasks (58%) and

the proportion of private office work settings (12%). ABW environments typically feature a main area in an open-plan layout where most of the work settings are located (Wohlers & Hertel, 2017), whereas around 50% of the time at the office is typically spent on tasks requiring concentration (Gensler, 2012). As a consequence, a shortage of work settings suitable for high-complexity tasks is likely to be common across organizations adopting ABW environments (see Study 1; cf., Wohlers & Hertel, 2017; Gensler, 2012). Hence, we may assume that the use of open office work settings creates perceived misfits on a wide scale, particularly among workers high in PNP. This may explain the often-reported complaints regarding lack of privacy and concentration (Babapour, 2019; Bodin Danielsson & Bodin, 2009; De Been & Beijer, 2014; Engelen et al., 2019; Van der Voordt, 2004). It may also explain why workers high in PNP were found to be the least satisfied with ABW environments (Hoendervanger et al., 2018).

Strengths and limitations

A strength of our research is that we tested and largely replicated the same research model (see Figure 1) in a field study (Study 1) and under controlled experimental conditions (Study 2). Hence, we were able to combine a high level of ecological validity with the assessment of causal relationships. Consistent results (i.e., with regard to perceived fit and the outcomes of high-complexity tasks) across different methodologies and participants imply considerable generalizability of our findings. Furthermore, the current research was, to the best of our knowledge, the first to use app-based experience sampling and VR simulation in ABW research. We discuss the strengths and limitations of these innovative methods below.

As demonstrated in our field study (Study 1), app-based experience sampling enables the collection of detailed and reliable data on the actual use and perception of work settings by capturing data as it happens or soon afterwards. We believe this is an important strength in the context of ABW research, as it may be difficult for workers to recall (e.g., when completing a survey) which work settings they have been using, for how long, for which activities, and how they perceived the fit at each work setting. In this respect, experience sampling is an alternative to the diary method that was used by Gerdenitsch et al. (2018) to capture similar data. Using a mobile application makes it easy for participants to respond quickly, at any place in the work environment. A potential weakness is the necessity to keep the questions

brief and simple, which rules out the use of multiple-item scales. Furthermore, in Study 1, the respondents had the possibility to answer until midnight. However, as this only happened occasionally (a time gap longer than five hours was registered for 6% of the measurements), recall bias does not seem to be a major issue in the current research. In any case, for future experience-sampling research, we recommend shortening the maximum response time span to one hour.

As demonstrated in Study 2, a strength of VR simulation in a well-equipped studio is that it creates a highly realistic environmental experience, with optimal control of experimental conditions. This enables testing of different work settings which are typically found in ABW environments in relation to different work activities. A weakness of the current study may be the use of tests that were rather short and not directly related to common knowledge workers' activities (e.g., answering e-mails, checking a spreadsheet, or reviewing a contract with different degrees of complexity). For future experimental ABW studies, tests may be developed and utilized that are more akin to such work activities in terms of content and time needed to complete them. Using the same standardized tests in different experimental studies, both in lab and field settings, may increase the comparability and generalizability of findings.

Finally, a strength of our research model (Figure 4.1) is its focus on key variables, but excluding other factors may be perceived as a weakness as well. For example, other psychological needs, including the need for autonomy and relatedness, may also influence workers' perceptions of fit in ABW environments.

Theoretical implications

Our findings are largely in line with the core assumption of PE fit theory that perceived needs-supply fit positively affects outcomes such as satisfaction and performance (Edwards et al., 1998; Kristof-Brown et al., 2005; Vischer, 2007; Wohlers & Hertel, 2017). We extend previous findings by emphasizing that "needs" may be both person-related (i.e., PNP) and task-related (i.e., required level of privacy associated with the complexity of the task), and that "supply" includes the physical work environment. Indeed, P-E fit theory seems to provide a useful framework for improving our understanding of the complex interplay of work activities, work settings, and personal characteristics in work environments. Research in ABW, in

turn, may contribute to the further development of P-E fit theory by acknowledging how specific (perceived) qualities of the ABW environment (e.g., availability, functionality, comfort, and aesthetic quality of different types of work settings) may be instrumental in creating P-E fit.

Practical implications

Our findings demonstrate the importance of creating (perceived) fit between activity, work setting, and personal characteristics for optimizing satisfaction and task performance in ABW environments. At the same time, however, our results indicate that such a fit is far from obvious in practice. Specifically, performing high-complexity tasks in open office work settings seems to be highly prevalent, also among workers high in PNP. We see two major keys to resolving this issue, which we will discuss below: (1) *facilitating* high complexity-tasks by providing sufficient work settings that offer privacy, (2) *stimulating* the use of such work settings for high-complexity tasks by removing social, psychological, and practical barriers.

The supply of work settings that offer privacy may include private office work settings (like the ones included in the current studies), but also other types of work settings like shared 'quiet rooms' where (phone) conversations are not allowed (Haapakangas et al., 2018b). The design of these work settings deserves special attention to ensure optimal (control of) architectural privacy (Sundstrom et al., 1980; i.e., acoustic and visual isolation). To determine how many of these work settings are needed to facilitate a specific work force, the time spent on high-complexity tasks (at the office) needs to be mapped properly first. The proportion of high-complexity tasks appears to be easily underestimated in practice. Typically, this proportion is around 50% (Gensler, 2012) and increasing due to computerization of low-complexity tasks (Duffy & Powell, 1997; Newport, 2016). In contrast, ABW environments typically offer mostly open office work settings (Wohlers & Hertel, 2017) that are not suitable for high-complexity tasks. In addition to time spent on high-complexity tasks, individual differences regarding PNP (i.e., related to psychological need and age) should also be taken into account when determining the supply of work settings that offer privacy.

If sufficient work settings that offer privacy are provided, these may still not be used for performing high-complexity tasks, as workers typically do not frequently switch

between different work settings (Appel-Meulenbroek et al., 2011; Göçer et al., 2018; Hoendervanger et al., 2016), despite the variety of the tasks that they carry out (Rothe, 2015). Important reasons *not* to switch are related to social ties and norms (e.g., staying with colleagues in an open office work setting instead of moving to a work setting that offers more privacy), psychological factors (e.g., place attachment), and practical issues (e.g., necessity to move stuff) (Hoendervanger et al., 2016). Effective measures to remove such barriers may be, for instance, discussing and changing social norms and encouraging conscious experimentation with the use of different work settings. By removing barriers to switching, workers may be stimulated to use work settings that offer privacy when appropriate, while at the same time it may increase the availability of these work settings by discouraging 'implicit ownership' (Babapour, 2019).

In our view, the facilitating approach and the stimulating approach should go hand in hand to achieve optimal fits between activities, work settings, and personal characteristics. This requires a joint effort of various workplace professionals, including designers, facility managers, and human resource managers. As a starting point, we recommend conducting a thorough analysis of relevant job characteristics (e.g., task variety, time spent on high-complexity tasks), personal characteristics (e.g., PNP, place attachment), and organizational characteristics (e.g., social ties and norms).

Conclusions

Our studies confirmed that perceived fit is a function of activity, work setting, and PNP, with indirect effects on satisfaction with the work environment (Studies 1 and 2) and task performance (Study 2). Across both studies, a misfit was perceived particularly among workers high in PNP when performing high-complexity tasks in an open office work setting.

These findings imply that the potential benefits of ABW environments in terms of satisfaction and performance may be achieved only when workers actually experience a fit between activities, work settings, and personal characteristics. Therefore, organizations and workplace professionals should facilitate and stimulate workers to create better fits, particularly among workers high in PNP when performing high-complexity tasks.

CHAPTER 5

Perceived fit and user behavior in activity-based work environments⁹

Abstract

While activity-based working is gaining popularity worldwide, research shows that workers frequently experience a misfit between the task at hand and their work setting. In the current study, experience sampling data were used to examine how perceived fit in activity-based work environments is related to user behavior (i.e., the use of work settings and setting-switching). We found that workers' perceived fit was higher when they used closed rather than open work settings for individual high-concentration work. Furthermore, more frequent setting-switching was related to higher perceived fit. Unexpectedly, however, this relation was observed only among workers low in activity-switching. These findings indicate that user behavior may indeed be relevant to creating fit in activity-based work environments. To optimize workers' perceived fit, it seems to be particularly important to facilitate and stimulate the use of closed work settings for individual high-concentration work.

⁹ This chapter is based on Hoendervanger, J. G., Van Yperen, N. W., Mobach, M. P., & Albers, C. J. (in press). Perceived fit and user behavior in activity-based work environments. *Environment and Behavior*.

Introduction

More and more organizations worldwide are adopting an activity-based work (ABW) environment (Cushman & Wakefield, 2013; Leesman, 2017; Van den Berg et al., 2019; Van Meel, 2019; Wohlers & Hertel, 2017). ABW environments provide workers with a range of non-assigned work settings to choose from, which are designed to support different types of work activities (Becker, 1999; Van Meel, 2019, Veldhoen, 2005). Offering variety and choice with regard to work settings seems to fit well with the diversity of work activities and the flexible work style that are typical of contemporary knowledge work (Davenport, 2005; Davis et al., 2011; Duffy & Powell, 1997; Van Yperen & Wörtler, 2017). At the same time, however, research has shown mixed findings when it comes to actually creating such fit between work and work environment, with striking differences between and within organizations (Brunia et al., 2016; Göçer et al., 2018; Hoendervanger et al., 2018; Leesman, 2017; Rolfö et al., 2019).

The basic rationale underlying ABW is that, through having a choice of different types of work settings, workers are enabled to create fit between their needs and their work settings (Becker, 1999; Gibson, 2003). This implies that the ABW concept assumes specific user behavior, i.e.: (1) use of work settings that suit the activities at hand, (2) switching between these work settings in accordance with the activity pattern. Previous research findings indicate that such user behavior is not obvious. Several studies found a widespread use of work settings that did not suit the activity at hand (Appel-Meulenbroek et al., 2011; Hoendervanger et al., 2019). Furthermore, most workers were found to switch seldom or not at all between work settings (e.g., Appel-Meulenbroek et al., 2011; Hoendervanger et al., 2016; Leesman, 2017). Given these findings, we wondered how previously observed variance in perceived fit in ABW environments (Gerdenitsch et al., 2018; Hoendervanger et al., 2019; Wohlers et al., 2019) may be related to differences in user behavior. Hence, the aim of the current study was to examine how perceived fit in ABW environments is related to the use of work settings and setting-switching. In the next section, we discuss the concept of perceived fit in the context of ABW environments.

Perceived fit in activity-based work (ABW) environments

Person-Environment (P-E) fit theory postulates that a perceived misfit between personal characteristics and characteristics of the work environment causes various psychological strains, which negatively affect organizational outcomes (Edwards et al., 1998; Kristof-Brown & Guay, 2011). Indeed, the extant P-E fit literature has demonstrated that perceived P-E fit is related to outcomes such as job satisfaction, performance, organizational commitment, turnover, and psychological and physical well-being (Edwards et al., 1998; Kristof-Brown et al., 2005).

According to the ABW concept, workers can create fit by using work settings that suit their work activities (Becker, 1999; Gibson, 2003). Drawing on P-E fit theory, Wohlers and Hertel (2017) hypothesized that workers' perceived fit would be higher the more the work setting fulfilled their activity-based needs and that this would, in turn, help them to achieve positive work outcomes. Recent empirical ABW studies demonstrated that perceived fit is indeed positively related to satisfaction with the work environment (Gerdenitsch et al., 2018; Hoendervanger et al., 2019), task performance (Hoendervanger et al., 2019), collaboration (Gerdenitsch et al., 2018), favorable job attitudes, and vitality (Wohlers et al., 2019). Given these links to wider organizational outcomes, we consider perceived fit to be a key variable for assessing and optimizing the effectiveness of ABW environments. In the following sections, we discuss how it may be related to two aspects of user behavior: (1) the use of work settings and (2) setting-switching.

Perceived fit and the use of work settings

In the current study, we examined how the use of specific work settings for specific activities is related to perceived fit. In line with Leesman (2017), we distinguished between individual work (i.e., various types of solo work, mostly desk-bound) and non-individual work (i.e., formal and informal conversations, meetings, and other types of social activities). In contrast to individual work, non-individual work involves oral communication such as face-to-face communication with fellow-workers and remote communication through phone or video connections. With regard to individual work, we made a further distinction between high-concentration (or high-complexity) work (e.g., writing a business case report,

reviewing a complex contract) and low-concentration (or low-complexity) work (e.g., answering simple e-mails, reading newsletters).

With regard to work settings, we distinguished between closed and open spaces. Closed work settings are separated from adjacent work settings and circulation areas by interior walls (from floor to ceiling) and a door (e.g., focus room, phone booth, meeting room, project room). In contrast, open work settings are not physically separated from adjacent work settings and circulation areas (apart from movable interior elements like desk screens, cabinets, and plants: e.g., open plan workstations, open meeting places, company restaurant, lounge area).

When it comes to individual high-concentration work, numerous studies suggest a better fit with closed rather than open work settings (e.g., Compennolle, 2014; De Been & Beijer, 2014; Kaarlela-Tuomaala et al., 2009; Kim & De Dear, 2013; Van den Berg et al., 2019). For example, workers who rated their job as requiring high concentration experienced lower levels of environmental distraction and stress in cell offices compared with open-plan offices (Seddigh et al., 2014). Conversely, other studies showed that, particularly among workers in highly complex jobs, working in open-plan offices was negatively associated with satisfaction, workplace attitudes, withdrawal behaviors, and performance (Block & Stokes, 1989; Maher & Von Hippel, 2005; Sundstrom et al., 1980). In a recent ABW study, Hoendervanger et al. (2019) found that low perceived fit was frequently reported when open work settings were used for individual high-concentration work. Hence, *Hypothesis 1* was that workers performing individual high-concentration work would report higher perceived fit when using a closed work setting rather than an open work setting.

With regard to individual low-concentration work, Compennolle (2014) suggested a good fit with open work settings because “some distraction helps to prevent this work from becoming too boring and increases the performance and feeling of wellbeing” (p. 24). This is in line with the Yerkes-Dodson (1908) Law, which assumes that, to achieve optimal performance, low-complexity tasks require a higher level of arousal, which may result from noise, compared with high-complexity tasks (Yoon, 2013). It is also consistent with the social facilitation hypothesis, which suggests that performance of routine tasks may improve in nonprivate areas (Zajonc, 1965). Based on a literature review, Hockey (1979) indeed concluded that performance improvement from noise exposure is often seen in less complex tasks or those in which boredom is experienced. However, to date, further empirical

findings are scarce and contradictory. For instance, in a laboratory study, workers performed better at routine tasks in a shared office (with three co-workers) compared with a private office (Block & Stokes, 1989). In contrast, Sundstrom et al. (1980) found that private rooms were preferred for all types of work, including routine work. In a recent ABW field study, Hoendervanger et al. (2019) found higher perceived fit when individual low-concentration work was performed in open work settings, albeit that this finding was not replicated in their experimental study. We conclude that, while several scholars have suggested a fit between low-concentration work and open work settings (e.g., Compennolle, 2014; Hockey, 1979; Zajonc, 1965), convincing empirical evidence is lacking. Hence, we tested the hypothesis that workers performing individual low-concentration work would report higher perceived fit when using an open work setting rather than a closed work setting (*Hypothesis 2*).

With regard to the level of enclosure that is suitable for non-individual work, research has shown mixed findings. From a social relations perspective, it has been suggested that an open work environment would facilitate face-to-face communication due to physical proximity, visibility, and lack of physical barriers (Davis et al., 2011). Some early studies indeed showed an increase in face-to-face communication after the implementation of an open work environment (Allen & Gerstberger, 1973; Davis et al., 2011). However, more recent studies showed no difference (Kim & De Dear, 2013) between open and closed work settings, or even less face-to-face communication in open work settings (Brennan et al., 2002; Brill & Weidemann, 2001; Bernstein & Turban, 2018). In this context, Brill and Weidemann (2001) called the idea that open work settings would support social interaction better than closed work settings one of the 'widespread myths' about workplace design. Given these mixed findings, we assume that preferences may be situational (e.g., based on desired privacy for conversation, duration of the session, or the proximity and occupancy of neighboring work settings). Hence, we did not formulate a specific hypothesis with regard to non-individual work.

Perceived fit and setting-switching

According to the ABW concept, workers have to switch between different work settings to be able to create fit with their diverse work activities (Van Koetsveld & Kamperman, 2011). Empirical studies have shown positive relations between

setting-switching and satisfaction with ABW environments (Hoendervanger et al., 2016; Leesman, 2017), productivity, and well-being at work (Haapakangas et al., 2018a). The ABW concept assumes that each switch to a different type of work activity coincides with a switch to a different work setting that is suitable for this type of work activity. This implies the alignment of setting-switching with activity-switching, which is a function of task variety (Derfler-Rozin et al., 2016; Morgeson & Humphrey, 2006). As a consequence, a higher degree of task variety requires more frequent setting-switching to sustain perceived fit. Indeed, a strong positive association between setting-switching and task variety was found in an ABW study (Hoendervanger et al., 2016). Furthermore, Leesman (2017) found that workers high in task variety were the most satisfied with the ABW environment, but only if they had adopted a mobile work pattern (i.e., high setting-switching), and vice versa. Hence, we hypothesized that the more frequently workers switched between activities, the more their setting-switching would be associated with better perceived fit (*Hypothesis 3*).

Method

Sample and Procedure

Table 5.1 presents information about the seven different organizations in which the data were collected in 2015 – 2017. These were Dutch organizations, recruited within the researchers' network, that agreed to cooperate by allowing workers to take part in the research on a voluntary basis. Although the organizations focused on different public and private services, they all mainly employed knowledge workers (Davenport, 2005). In all cases, the work environment, which had been in use for more than two years, was based on the ABW concept, providing different types of work settings (e.g., open-plan workstations, private rooms, meeting rooms, open meeting places, lounge workstations, telephone booths). These work settings were designed for different types of activities and were not assigned to individual workers (free seating). Since there were several differences between the seven organizations (see Table 5.1), we included organizational affiliation as a control variable in our analyses. A total of 232 workers participated in the study (49% male; average age 43.0 years; educational attainment: 43% master's degree or higher).

Table 5.1 Descriptive information about the cases included in the study sample.

Organization	Type	Location	Period	Participants (n)	Measurements	Average age	Male	Master's degree	Individual work		Non-individual work	Average perceived fit
									High- concentration	Low- concentration		
A	Private service	Groningen, NL	January 2015	25	583	39.3	80%	68%	30%	30%	40%	4.98
B	Public, education	Utrecht, NL	February 2015	23	611	42.4	43%	39%	32%	29%	39%	4.94
C	Public service	Assen, NL	February 2015	48	1,222	44.5	50%	35%	34%	30%	36%	4.75
D	Private, trading	Amsterdam, NL	February 2017	32	670	35.9	28%	56%	29%	27%	44%	5.11
E	Private service	Amsterdam, NL	June 2016	26	429	46.4	23%	35%	35%	24%	41%	5.01
F	Financial service	Amsterdam, NL	November 2016	48	628	50.0	73%	25%	23%	34%	43%	5.22
G	Financial service	Amsterdam, NL	November 2016	30	611	38.2	33%	60%	38%	25%	38%	4.57
Total sample				232	4,754	43.0	49%	43%	32%	29%	40%	4.92

Note. Perceived fit was measured on a six-point scale; proportions of activity categories and average perceived fit scores were weighted by numbers of measurements per participant.

As recommended by Davis et al. (2011), we used experience sampling (Larson & Csikszentmihalyi, 1983; Totterdell, 2006) to collect detailed and reliable field data on perceived fit in relation to the use of different work settings for different work activities. About a week before the start of the measurement period, all participants received an e-mail including a link to an online questionnaire, which assessed basic demographic data (i.e., age, gender, and educational attainment). After completing this questionnaire, the participants could install a mobile application on their smartphone or tablet. This tailor-made application was developed to enable experience sampling in the context of ABW environments. We pilot tested and optimized the application before using it for the current study (Hoendervanger et al., 2015). During the measurement period of two weeks (10 working days), at six randomly chosen times during office hours each day, participants received a push notification to answer the experience sampling questions that are presented in the next section. Participants could answer these questions right away or later the same day. Participants were instructed to answer each survey with the original notification moment in mind. Every day at midnight, unanswered surveys of that day were automatically deleted to limit potential recall bias. Our research procedure was reviewed and approved by the Ethical Committee Psychology of our university.

Measures

The experience-sampling questionnaire was kept as short as possible to maintain optimal participation during the measurement period (Robinson, 2009; Totterdell, 2006). Hence, all variables were measured through single-item measures. We believe this is acceptable because we relied on measures that assessed sufficiently narrow and unambiguous constructs (e.g., Nagy, 2002; Wanous et al., 1997). Furthermore, similar single-item measures have been used in previous ABW research (Gerdenitsch et al., 2018; Hoendervanger et al., 2019; Wohlers et al., 2019).

Activity. At each random moment, participants reported their current activity by selecting one out of six pre-defined options: (1) individual high-concentration work, (2) individual low-concentration work, (3) planned face-to-face communication, (4) non-planned face-to-face communication, (5) communication through phone or video, (6) taking a break. Differences between the four types of non-individual work (3 – 6) were not relevant for our analysis of perceived fit in relation to the use of

closed versus open work settings, given our hypotheses. Hence, we used three activity categories for the analysis: (1) individual high-concentration work, (2) individual low-concentration work, (3) non-individual work. In this categorization, non-individual work is different from individual work because it involves (face-to-face or remote) oral communication. Assuming that taking a break (2% of the measurements in our sample) often involves oral communication, we decided to include this activity in the non-individual work category. The number of reported activities per category was divided by the total number of reported activities per participant. These proportions indicate how workers' office time was distributed among the three different categories of activities (Robinson, 2009).

Activity-switching was assessed by systematically comparing the activities recorded at every two consecutive random moments on the same day. We included all six pre-defined activity options (i.e., including the four different types of non-individual work), since switches between all these different activities may provoke setting-switches. Each pair of consecutive measurements that indicated the occurrence of a switch to a different activity was coded as 1. If the same activity was reported at two consecutive moments, this was coded as 0. Activity-switching was calculated by dividing the number of activity switches by the total number of measurement pairs per participant.

Setting. At each random moment, participants indicated which type of work setting they were using by selecting a work setting from a list of pre-defined options. These options were tailored to the specific types and terms used in each organization. For the analysis of perceived fit in relation to the use of work settings, we aggregated the different types work settings into two generic categories: (1) closed work settings (i.e., work settings enclosed by floor-to-ceiling interior walls and a door), (2) open work settings (i.e., work settings not enclosed by floor-to-ceiling interior walls and a door).

Setting-switching was assessed by systematically comparing the work settings recorded at every two consecutive random moments on the same day. Here, all different types of work settings were used (not aggregated into closed vs. open work settings). Each pair of consecutive measurements that indicated the occurrence of a switch to a different work setting was coded as 1. If the same work setting was being used at two consecutive moments, this was coded as 0. Setting-

switching was calculated by dividing the number of setting switches by the total number of measurement pairs per participant.

Perceived fit between activity and setting. At each random moment, participants reported to what extent they agreed with the statement “My current activity fits well with my current work setting” using a six-point scale, ranging from “very strongly disagree” (1) to “very strongly agree” (6). This measure was previously used in an ABW study by Hoendervanger et al. (2019). The use of a direct measure of perceived fit (i.e., asking participants to assess the general compatibility of activity and work setting) is common in P-E fit studies (Kristof-Brown & Guay, 2011). An average perceived fit score was calculated for each participant.

Modeling

Our multivariate data set has a hierarchical structure with three levels: measurements in time for individuals at seven organizations. This might suggest requiring a multilevel model, yet this is not necessary for the current study. The seven organizations are not regarded as representative and were thus treated as a fixed level. The longitudinal dimension was collapsed into single values for proportions of measurement per participant. Thus, the research hypotheses could be modeled with linear regression models (including ANOVA), in which organizational affiliation was included to control for possible differences among organizations.

Results

Descriptive statistics

A total of 4,754 measurements were used in this study (see Table 5.1), after excluding measurements that concerned work outside the office, commuting, and time off. The number of measurements per participant ranged from 1 to 57 ($M = 20.5$; $SD = 12.86$; the theoretical maximum was $10 \text{ days} \times 6 \text{ measurements} = 60$). Rather than excluding participants with a low number of measurements (in which case the threshold would be arbitrary), we used the number of measurements per participant as a weight factor in our analyses to optimize the reliability,

representativeness, and generalizability of our results. The time gap between sending out the questions and receiving the answers was less than one hour in 65% of the cases, and more than five hours in 6% of the cases ($M = 68$ minutes; $SD = 115$ minutes). A very small but significant positive correlation between time gap and perceived fit ($r = .07, p < .001$) indicates that perceived fit scores were slightly higher as surveys were answered later, however the size of this effect may be considered as marginal.

Table 5.2 shows means, standard deviations, and correlations for the variables included in this study. Overall, 60% of the activities concerned individual work, comprising almost equal shares of high- and low-concentration work. The standard deviations indicate that activity patterns, the use of open/closed work settings, activity-switching, and setting-switching differed considerably among participants. Most of the work (72%) was performed in open work settings. The significant positive correlation between activity-switching and setting-switching ($r = .44$) confirms the presupposed interrelationship. However, the means show that activity-switching was more common ($M = 58\%$) than setting-switching ($M = 44\%$).

In Table 5.3, the observed frequencies of different types of activity-switches are split into two categories: (1) the activity-switch coincided with a setting-switch, (2) the activity-switch did *not* coincide with a setting-switch. Overall, most activity-switches (64%) did coincide with a setting-switch. As could be expected, setting-switches *without* coinciding activity-switch were far less common (16% of the total sample). Simultaneous activity- and setting-switching occurred most frequently when workers switched to, or from, non-individual work activities (76% – 81%) and least frequently when they switched from high-concentration to low-concentration individual work (12%) or vice versa (7%). These statistics indicate that setting-switching was linked strongly to non-individual work and weakly to individual work.

Table 5.2 Means, standard deviations, and correlations.

Variable	Mean	SD	1	2	3	4	5	6	7	8
1. Activity: Individual high-concentration work	.32	0.21	-							
2. Activity: Individual low-concentration work	.29	0.19	-.49**	-						
3. Activity: Non-individual work	.40	0.20	-.58**	-.42**	-					
4. Activity-switching	.58	0.17	-.20**	-.04	.24**	-				
5. Setting: Closed work setting	.28	0.21	-.36**	-.27**	.62**	.00	-			
6. Setting: Open work setting	.72	0.21	.36**	.27**	-.62**	.00	-1.00**	-		
7. Setting-switching	.44	0.21	-.38**	-.15*	.54**	.44**	.36**	-.36**	-	
8. Perceived fit	4.92	0.65	-.30**	.17**	.15*	.04	.18**	-.18**	.08	-

Note. All calculations weighted by numbers of measurements per participant; variables 1 – 7 are proportions of the number of measurements per participant; Pearson correlations (two-tailed), ** $p < .01$, * $p < .05$.

Table 5.3 Frequencies of different types of switches between activities and work settings.

Comparison of two subsequent activity measurements				Frequency	Coinciding setting-switch?	
Activity-switch?	From	To	Yes		No	
Yes	Individual high-concentration work	Individual low-concentration work	190	23 (12%)	167 (88%)	
		Non-individual work	363	279 (77%)	84 (23%)	
	Individual low-concentration work	Individual high-concentration work	228	16 (7%)	212 (93%)	
		Non-individual work	353	287 (81%)	66 (19%)	
	Non-individual work	Individual high-concentration work	313	237 (76%)	76 (24%)	
		Individual low-concentration work	312	252 (81%)	60 (19%)	
Different type of non-individual work		294	222 (76%)	72 (24%)		
No	Subtotal with activity-switch		2,053	1,316 (64%)	737 (36%)	
	Individual high-concentration work	Individual high-concentration work	597	32 (5%)	565 (95%)	
	Individual low-concentration work	Individual low-concentration work	406	29 (7%)	377 (93%)	
	Non-individual work	Same type of non-individual work	505	180 (36%)	325 (64%)	
	Subtotal without activity-switch		1,508	241 (16%)	1,267 (84%)	
	Total sample		3,561	1,557 (44%)	2,004 (56%)	

Perceived fit and the use of work settings

We hypothesized that workers performing individual high-concentration work would report higher perceived fit when using a closed work setting rather than an open work setting (Hypothesis 1) and that, in contrast, workers performing individual low-concentration work would report higher perceived fit when using an open work setting rather than a closed work setting (Hypothesis 2). Table 5.4 shows the distribution of the measurements among six different combinations of activity (i.e., individual high-concentration work vs. individual low-concentration work vs. non-individual work) and work setting (i.e., closed vs. open work setting). The most remarkable finding is that individual high-concentration work was far less often performed in closed work settings than in open work settings (4% vs. 28% of the measurements).

Table 5.4 Means, confidence intervals, standard deviations, and distribution of measurements among different combinations of activity and work setting.

Activity category	Setting category	Perceived fit			Number of measurements (n)	Percentage of total sample
		Mean	95% CI	SD		
Individual high-concentration work	Closed work setting	5.43 ^a	[5.32, 5.54]	0.72	167	4%
	Open work setting	4.32 ^c	[4.25, 4.38]	1.22	1,343	28%
Individual low-concentration work	Closed work setting	5.10 ^a	[4.83, 5.37]	0.94	49	1%
	Open work setting	5.16 ^a	[5.12, 5.20]	0.74	1,308	28%
Non-individual work	Closed work setting	5.36 ^a	[5.31, 5.40]	0.75	1,116	23%
	Open work setting	4.79 ^b	[4.71, 4.86]	1.02	771	16%
Total sample		4.92	[4.89, 4.95]	1.04	4,754	100%

Note. ^{a-c} indicate significant mean differences among the six combinations of activity and work setting ($p < .001$; multiple testing corrections were applied, using the Bonferroni method).

To test our hypotheses, we conducted a 3 (Activity: individual high-concentration work vs. individual low-concentration work vs. non-individual work) $\times$ 2 (Setting: closed work setting vs. open work setting) factorial ANOVA with perceived fit as the dependent variable. We included organizational affiliation, and its interactions with activity and setting, to control for differences among the seven organizations. The results showed significant main effects for activity, $F(2, 4,712) = 5.58, p = .004$, and setting, $F(1, 4,712) = 46.69, p < .001$. These main effects were qualified by a significant interaction effect of activity $\times$ setting, $F(2, 4,712) = 10.71, p < .001$.

Follow-up ANOVAs were conducted to close-examine differences among the six different combinations of activity and setting (see Table 5.4). As hypothesized (Hypothesis 1), individual high-concentration work was related to higher perceived fit when performed in closed work settings, compared with open work settings, $F(1, 1,496) = 74.27, p < .001$. For individual low-concentration work, no difference between closed and open work settings was found, which does not provide empirical support for Hypothesis 2. Furthermore, perceived fit for non-individual work was significantly higher in closed work settings, compared with open work settings, $F(1, 1,873) = 206.49, p < .001$. Taken together, the mean differences indicate that using an appropriate (i.e., closed) work setting for the task at hand is particularly important for individual high-concentration work and, to a lesser extent, for non-individual work. The statistics in Table 5.4 indicate that low perceived fit due to the use of open work settings for individual high-concentration work was quite common (28% of our sample).

Perceived fit and setting-switching

We further hypothesized (Hypothesis 3) that the more frequently workers switched between activities, the more their setting-switching would be associated with better perceived fit. To test this hypothesis, we constructed a linear regression model with activity-switching, setting-switching, and their interaction as predictor variables, and perceived fit as the dependent variable. Furthermore, we included organizational affiliation to control for differences among the seven organizations. Results of the analysis show a significant positive main effect of setting-switching ($B = 1.82, 95\% \text{ CI } [0.66, 2.97], p = .002$), which was qualified by a significant interaction effect of activity-switching $\times$ setting-switching ($B = -2.53, 95\% \text{ CI } [-4.28,$

-0.77], $p = .005$). The adjusted R^2 value indicates that the regression model explained 10% of the variance in perceived fit scores.

Follow-up simple slope analyses (Aiken & West, 1991) revealed that slopes representing perceived fit as a function of setting-switching (see Figure 5.1) were significant for all values of activity-switching $< .53$ ($p < .05$) and non-significant for all values of activity-switching $\geq .53$. These results indicate that more frequent setting-switching was related to higher perceived fit. However, contrary to Hypothesis 3, this was only true when activity-switching was *low* (i.e., lower than 53% of a participant’s measurements).

Figure 5.1 Interactive effect of activity-switching and setting-switching on perceived fit with 95% confidence bands.

Note. Low activity-switching represents -1 s.d., high activity-switching represents $+1$ s.d..

Additional explorative analysis of setting-switching

In an attempt to explain the unexpected nature of the interaction effect of activity-switching and setting-switching on perceived fit (see Figure 1), we conducted an additional explorative analysis, comparing two distinct groups of participants: (1) participants who spent an above-average proportion of their office time at individual high-concentration work and a below-average proportion at non-individual work ($n = 69$), (2) participants who spent an above-average proportion of their office time at non-individual work and a below-average proportion at individual high-concentration work ($n = 81$). This distinction was prompted by the correlations presented in Table 5.2, i.e., activity-switching, setting-switching, and perceived fit were correlated negatively with high-concentration work and positively with non-individual work. In line with these correlations, a MANOVA, including organizational affiliation as control variable revealed significant differences between the two groups with regard to activity-switching, $F(1, 136) = 5.68, p = .019$, and setting-switching, $F(1, 136) = 71.10, p < .001$; the groups showed no significant difference with regard to perceived fit. This means that workers who performed predominantly individual high-concentration work switched less between activities and between settings than workers who performed predominantly non-individual work. These differences seem to indicate that individual activity patterns might influence the effect of switching behaviors on perceived fit. However, as this explorative analysis shows no significant difference in terms of perceived fit, the results are non-conclusive at this point.

Discussion

Our findings demonstrate that user behavior is relevant to the creation of perceived fit in ABW environments in two different ways. Firstly, the use of closed versus open work settings appeared to be related to perceived fit. Specifically, workers' perceived fit was higher when they used closed rather than open work settings for individual high-concentration work, and, to a lesser extent, for non-individual work. For individual low-concentration work, we found no difference between closed and open work settings. Secondly, we found that more frequent setting-switching was related to higher perceived fit. Contrary to our expectations, however, this was only true for workers low in activity-switching.

Perceived fit and the use of work settings

Our finding that individual high-concentration work fits better with closed work settings than with open work settings is in line with numerous previous research findings (e.g., Compennolle, 2014; De Been & Beijer, 2014; Hoendervanger et al., 2019; Kim & De Dear, 2013; Maher & Von Hippel, 2005; Seddigh et al., 2014; Van den Berg et al., 2019). Consistent with a similar field study conducted by Hoendervanger et al. (2019), we observed that the use of open work settings for individual high-concentration work (which is associated with low perceived fit) was very common. In the current study, this concerned $(1,343 / (1,343 + 167) =) 89\%$ of the individual high-concentration work. In the Hoendervanger et al. (2019) study, this percentage was 93%. These observations signify a serious issue concerning ABW environments, which may explain typical complaints regarding concentration and privacy (Engelen et al., 2019), particularly among workers high in personal need for privacy (Hoendervanger et al., 2018).

The widespread use of open work settings for individual high-concentration work is probably due to a discrepancy between the office time spent on this type of work and the availability of suitable closed work settings. In the organizations that were included in the current study, 40 – 60% of the individual work required high-concentration, whereas 5 – 25% of the work settings for individual work were classified as closed. These percentages are in line with other research findings on activity patterns (e.g., Brill & Weidemann, 2001; Gensler, 2012; Hoendervanger et al., 2019) and descriptions of the typical layout of ABW environments (e.g., Van den Berg et al., 2020; Wohler & Hertel, 2017).

An additional explanation for the widespread use of open work settings for individual high-concentration work might be the typical reluctance of workers to switch between different work settings (Appel-Meulenbroek et al., 2011; Hoendervanger et al., 2016). In the current study, we found this reluctance (i.e., low setting-switching) particularly among workers who performed predominantly individual high-concentration work. Possibly, these workers kept on working in an open work setting at times when their work activity switched from low- to high-concentration individual work.

With regard to individual low-concentration work, workers' perceived fit did not differ in closed and open work settings, which is consistent with the findings of a

recent lab study (Hoendervanger et al., 2019). This observed pattern calls into question the idea that low-concentration work fits better with open work settings than with closed work settings, as argued by several scholars (e.g., Compennolle, 2014; Hockey, 1979; Zajonc, 1965). It remains unclear if, and in which cases, the use of open rather than closed work settings might be beneficial when doing individual low-concentration work. Further research might reveal specific contingencies in this respect: for instance, task characteristics (i.e., other than level of concentration) or personal characteristics (e.g., task maturity, stimulus screening ability). Possibly, our finding indicates that individual low-concentration or routine office work (similar to data-entry or retyping) no longer exists due to advanced automation, as predicted by Duffy and Powel (1997).

Our finding that non-individual work, on average, fits better with closed rather than open work settings is in line with previous findings that disproved the widespread intuitive assumption that open work settings support face-to-face interaction (Brennan et al., 2002; Brill & Weidemann, 2001; Bernstein & Turban, 2018; Kim & De Dear, 2013). Our finding suggests that privacy (i.e., in terms of both not being overheard and not being disturbed by environmental stimuli) is beneficial for most non-individual work activities. Hence, we agree with Haapakangas et al. (2019) that the typical openness of ABW environments may impair communication due to lack of privacy.

Perceived fit and setting-switching

In a previous study, Leesman (2017) found that workers high in task variety, which is supposed to induce high activity-switching (Derfler-Rozin et al., 2016), were the most satisfied with the ABW environment, but only if they reported high setting-switching. In contrast, we unexpectedly found a positive link between perceived fit and setting-switching only for workers *low* in activity-switching. Apparently, the perceived fit of workers high in activity-switching was not related to their setting-switching frequency.

In an additional explorative analysis, we found that relative to workers who performed predominantly non-individual work, workers who performed predominantly individual high-concentration work showed lower setting-switching and lower activity-switching. Although this analysis showed no significant

difference in perceived fit, these results seem to suggest that the effect of switching behaviors on perceived fit might be different for workers with different activity patterns. The relevance of activity patterns to fit with work environments was recently demonstrated by Soriano et al. (2020).

In line with previous research (Hoendervanger et al., 2016), we observed that setting-switching was linked strongly to non-individual work and weakly to individual work. It seems that switching between different work settings is more natural (e.g., due to scheduled meetings) and more attractive (e.g., due to the availability of suitable work settings) in relation to non-individual work. Furthermore, non-individual work might be more diverse (i.e., including four different types in the current study), requiring more different work settings.

Strengths and weaknesses

We consider the use of app-based experience sampling to be a major strength of the current study. This method enabled participants to easily report their use of work settings, activities, and perceived fit, while they worked. This way, potential bias due to the typical difficulty of recalling one's use and perceptions of different work settings in relation to different activities, was minimized. Hence, our method yielded detailed and reliable data with high ecological validity. Furthermore, the collection of these data across seven different organizations increases confidence in the generalizability of our findings.

Yet, the experience sampling method comes with several limitations. Firstly, the use of multiple-item scales is ruled out, as the questions needed to be brief and simple (Robinson, 2009; Totterdell, 2006). This is a potential weakness; however, in the current study, we assessed three sufficiently narrow and unambiguous constructs (i.e., activity, work setting, and perceived fit; cf. Gerdenitsch et al., 2018; Hoendervanger et al., 2019; Nagy, 2002; Wanous et al., 1997; Wohlers et al., 2019). Secondly, despite some personal feedback and motivational quotes that were built into the application, our data generally show rather low response rates. Yet, this did not necessarily affect our analyses, since we transformed all separate time points into proportions per participant and did not look at longitudinal parameters. More importantly, our sample is unevenly distributed across the participants due to large differences in response rates. Although this is not uncommon for experience

sampling studies, and we used the number of responses per participant as a weighting factor to enhance reliability, it implies compliance bias i.e., more responsive participants have a larger impact on the findings (Van Berkel et al., 2020). However, we have no reason to assume that more responsive participants would differ from less responsive participants in terms of behaviors or perceptions. A further potential weakness of the method used is that participants had the possibility of answering until midnight, which might cause recall bias. However, as we observed that participants used this possibility only occasionally, and the correlation between time gap and perceived fit was very small, this does not seem to be a major issue. Lastly, since the method did not provide any information about activity- and setting-switches that may have occurred between the administered time points, we may have underestimated the switching frequencies.

Perspectives for further research

Following our additional explorative analysis, further research may reveal how different activity patterns may be associated with different activity-switching and setting-switching behaviors, and how this, in turn, may be related to perceived fit with ABW environments. Like the current study, a follow-up study may use experience sampling to collect data on user behavior and perceived fit. Alternatively, a diary method may be used to collect similar data (cf. Gerdenitsch et al., 2018). A large number of participants across different job types is required to enable cluster analysis to identify groups of workers with distinct activity patterns (cf. Soriano et al., 2020), followed by regression analysis including deviation contrasts (see, e.g., Baguley, 2014, Ch. 15).

Further research may test potential solutions for the major problem, as indicated by our current findings, that open work settings are frequently used for individual high-concentration work. Because a typical discrepancy between office time spent on individual high-concentration work and the availability of suitable closed work settings seems to be a key factor, we would be particularly interested to see what would happen if plenty of these work settings were available in an ABW environment. In such a field study, it would be possible to test the hypothesis that, in line with the ABW concept, workers typically use, or switch to, closed work settings when performing individual high-concentration work. Moreover, if a range of closed work settings were offered (e.g., private concentration rooms, group

'library' rooms), with different design characteristics (e.g., with(out) daylight, with (non)transparent interior walls), the study might reveal (different) preferences.

Furthermore, to the extent that workers would still be using open work settings for individual high-concentration work, despite the availability of closed work settings, this proposed field study would enable testing of interventions aimed at changing user behavior. That is, interventions aimed at removing barriers (e.g., routines, social norms, negative perceptions of closed work settings and of setting-switching; Hoendervanger et al., 2016), which may prevent workers from using, or switching to, closed work settings. Eventually, such further research might indicate to what extent solutions can be found within the ABW concept (i.e., by improving the availability of work settings, and changing user behavior), or, alternatively, have to be found outside the ABW concept (e.g., by providing assigned closed work settings to specific types of workers).

Implications for theory

In line with previous ABW studies (Gerdenitsch et al., 2018; Hoendervanger et al., 2018; Hoendervanger et al., 2019; Wohlers et al., 2019), our findings further demonstrate that P-E fit theory provides a useful framework for identifying specific person- and environment-related factors, which, if aligned, may yield perceived fit and related positive outcomes. The current findings reveal that, in addition to workers' psychological needs, job characteristics, task characteristics, and demographic characteristics (Gerdenitsch et al., 2018; Hoendervanger et al., 2018; Hoendervanger et al., 2019; Wohlers et al., 2019), also their behaviors should be compatible with the work environment in order to create fit. In terms of P-E fit theory, we consider user behavior to be an ability that should match related environmental demands (Kristof-Brown & Guay, 2011). Specifically, an ABW environment requires workers to use suitable work settings and to switch between them as needed; their ability to behave accordingly is reflected in their perceived fit. Hence, our findings demonstrate that, in addition to needs-supply fit, also demands-abilities fit is relevant in the context of ABW environments.

Implications for practice

Our findings underline the importance of close alignment of the availability of different work settings with the variety of activities that need to be performed when implementing an ABW environment. In particular, creating sufficient supply of closed work settings for individual high-concentration work and, to a lesser extent, for non-individual work, deserves the attention of workplace professionals. For individual high-concentration work, this may include both private 'concentration rooms' and shared 'library rooms' (i.e., where only working in silence is allowed; Haapakangas et al., 2018b). Alternatively, individual high-concentration work might be facilitated by quiet open work settings; however, it is typically difficult to enforce strict non-speech and non-interruption rules in such work settings (Babapour Chafi & Rolfö, 2019). For non-individual work, in addition to open work settings, different types of closed work settings may be provided for different communicative activities that require privacy (e.g., face-to-face meetings, private conversations, project teamwork, phone and video calls). Based on previous findings, we recommend including job characteristics, psychological needs, and demographic variables, in addition to work activities, in the analysis conducted to inform the design process (Hoendervanger et al., 2018; Hoendervanger et al., 2019).

With regard to job characteristics, the current findings indicate that user behavior and (related) perceived fit may be very different across different job types. Specifically, it seems important to pay special attention to workers in jobs that involve predominantly individual high-concentration work, as they may particularly struggle with a shortage of closed work settings and with the necessity to switch between different work settings. With regard to their user behavior, it may be helpful to identify barriers that may keep them from using, or switching to, available closed work settings. Such barriers may be related to social ties and norms (e.g., staying with colleagues in an open work setting instead of moving to a closed work setting), psychological factors (e.g., place attachment), and practical issues (e.g., necessity to move stuff) (Hoendervanger et al., 2016). Effective measures to remove identified barriers may be, for instance, discussing and changing social norms and encouraging conscious experimentation with the use of different work settings.

Will these recommendations hold, if work practices change structurally due to the current COVID-19 pandemic, as many scholars expect (e.g., Kniffin et al., 2020;

Rudolph et al., 2020)? If workers indeed keep working from home for a larger part of their time than they used to do before the pandemic, the ABW environment will probably be used less for individual work, including high-concentration work. Consequently, this might mitigate the widespread issue concerning lack of privacy for individual high-concentration work to a certain extent. Still, it will remain important to provide the right mix of different work settings, based on a thorough analysis of workers' needs, and to recognize user behavior as a factor which significantly co-determines perceived fit with ABW environments.

In conclusion, our findings indicate that user behavior, in terms of the use of work settings and setting-switching in relation to different activity patterns, deserves attention when implementing an ABW environment. To optimize workers' perceived fit, it seems to be particularly important to facilitate and stimulate the use of closed work settings for individual high-concentration work.

CHAPTER 6

General discussion

Why do some workers experience fit with an ABW environment, while others do not? The current research project was designed to examine how workers' jobs, tasks, behaviors, psychological needs, and demographic characteristics may be related to their perceived fit with ABW environments. This final chapter discusses the main findings and their implications for P-E fit theory, the ABW concept, and ABW practice. Furthermore, the ABW environment of the future is envisioned in the light of expected long-term impact of the current COVID-10 pandemic. Finally, strengths and limitations of the current research and perspectives for further research are discussed.

Between-person differences in perceived fit with activity-based work environments

In line with P-E fit theory, our findings demonstrate that workers who are using the same ABW environment may experience different levels of fit, as a function of individual difference variables, job and task characteristics, and environmental factors (i.e., including their jobs, tasks, and behaviors). In this project, we found relevant variables across all categories that were included; see Table 6.1.

Table 6.1 *Observed relationships with perceived fit with ABW environments.*

<i>Category</i>	<i>Workers perceive better fits with ABW environments when they are:</i>	<i>Chapter</i>
Job characteristics	in jobs characterized by: <ul style="list-style-type: none">- high task variety- high autonomy- high external mobility- high internal mobility- high social interaction	2 3 2 3 3
Task characteristics	performing tasks that are: <ul style="list-style-type: none">- low in complexity- non-individual	4, 5 2, 5
Behaviors	<ul style="list-style-type: none">- using closed work settings for individual high-complexity tasks- using closed work settings for non-individual tasks- switching between different work settings	4, 5 5 2, 5
Psychological needs	<ul style="list-style-type: none">- low in need for privacy- high in need for relatedness	3, 4 3
Demographic characteristics	<ul style="list-style-type: none">- of younger age	3

Job characteristics. Confirming assumptions of Duffy and Powell (1997), we found that ABW environments particularly fit with jobs that involve high autonomy and high social interaction (Chapter 3). We also found a positive link between perceived fit and internal mobility, which may be explained by higher ‘workspace territoriality’ (i.e., preference for an assigned, personalized work station) in workers low in internal mobility (Roskams & Haynes, 2019). Furthermore, our findings that setting-switching is higher for workers in jobs that involve high task variety and high external mobility (Chapter 2), indirectly indicate that these job characteristics are also positively related to perceived fit with ABW environments. In line with the basic ABW rationale, workers high in task variety may particularly benefit from the availability of different types of work settings (Becker, 1999; Van Meel, 2019). The

positive link with external mobility (i.e., causing low presence at the office) may be explained by low place attachment (Chapter 2).

Task characteristics. Our findings indicate that workers experience better fits with ABW environments when they are performing low-complexity tasks (Chapter 4 and 5) and when they are performing non-individual tasks (Chapter 2 and 5). The lower perceived fit with high-complexity tasks is in line with complaints regarding lack of concentration that were found in previous ABW research (Babapour, 2019; Bodin Danielsson & Bodin, 2009; De Been & Beijer, 2014; Engelen et al., 2019; Van der Voordt, 2004). This is probably due to a typical shortage of closed work settings for individual work (Chapter 4 and 5).

Behaviors. Firstly, we found partial support for the basic idea underlying the ABW concept, that different types of work settings should be used to optimally support different types of tasks (Becker, 1999; Van Meel, 2019, Veldhoen, 2005). We particularly found that workers' perceived fit was higher when they used closed rather than open work settings when performing individual high-complexity tasks (Chapter 4 and 5) and, to a lesser extent, when performing non-individual tasks (Chapter 5). With regard to individual low-complexity tasks, we found no evidence supporting the idea that this would better fit with open work settings (cf. Compennolle, 2014; Hockey, 1979; Zajonc, 1965; Chapter 4 and 5).

Secondly, we found a positive link between setting-switching and perceived fit (Chapter 2 and 5). Since setting-switching causes internal mobility, this further explains why jobs high in internal mobility fit with ABW environments. Switching frequencies were generally low (Chapter 2 and 5) and appeared to be positively related to task variety, external mobility (Chapter 2), and non-individual work (Chapter 2 and 5). We did not find a positive interaction between setting-switching and activity-switching as suggested by practical research (Leesman, 2017; Veldhoen + Company, 2020). In contrast, our findings indicate a positive link between perceived fit and setting-switching only for workers *low* in activity-switching (Chapter 5).

Psychological needs. We found high need for privacy to be a strong predictor of low perceived fit with ABW environments (Chapter 3 and 4). This is in line with previous research, which indicates that lack of privacy is a typical source of dissatisfaction with ABW environments (Babapour, 2019; Bodin Danielsson &

Bodin, 2009; De Been & Beijer, 2014; Engelen et al., 2019; Van der Voordt, 2004), probably due to their predominantly open and transparent workspace designs (Chapter 4 and 5; Van den Berg et al., 2020; Wohlers & Hertel, 2017). The same design characteristics may explain why we found workers high in need for relatedness to be (slightly) more satisfied with ABW environments (Chapter 3). Our research did not show differences in perceived fit in relation to need for autonomy and need for structure (Chapter 3).

Demographic characteristics. In line with previous research (Leesman, 2017; Pullen, 2014; Veldhoen + Company, 2020) older workers appeared to be less satisfied with ABW environments (Chapter 3), indicating lower perceived fit. This might be associated with a stronger sensitivity to auditory and visual distractions (Pullen, 2014) and with a higher need for quiet spaces (Myerson et al., 2010). We did not find any gender-related differences (Chapter 3).

Implications for Person-Environment fit theory

In addition to previous research (Gerdenitsch et al., 2018; Haapakangas et al., 2018b; Wohlers et al., 2019; Zamani & Gum, 2019), we found further evidence that perceived fit is a significant predictor of outcomes of ABW environments (i.e., satisfaction with the work environment and task performance). This implies that perceived fit plays a central role in the origin of mixed outcomes of ABW environments (e.g., De Been & Beijer, 2014; Engelen et al., 2019; Van der Voordt, 2004) and that P-E fit theory provides a useful framework for expanding our understanding of underlying factors.

As argued by Vischer (2007, p. 179), P-E fit provides a sounder theoretical basis for work environment research than the traditional focus on user satisfaction, as it acknowledges “the complexities of the transactional nature of the person-environment relationship”. Essentially, P-E fit theory explains that it is the *interplay* of specific personal and environmental attributes that yields positive or negative outcomes. This implies that identifying and aligning these specific attributes is key for optimizing outcomes of (activity-based) work environments.

Our findings support the argument made by Appel-Meulenbroek et al. (2020a) that the physical work environment can play a pivotal role in achieving P-E fit. This role,

as yet, seems to be overlooked in general P-E fit literature (e.g., Kristof-Brown & Guay, 2011). Hence, this research project contributes to filling a significant gap in P-E fit literature.

In the context of ABW environments, it is important to recognize that workers' personal needs and abilities are affected by their jobs and tasks¹⁰. Furthermore, their behaviors affect their fit with the ABW environments. Specifically, an ABW environment requires workers to use suitable work settings and to switch between them when needed. Hence, their ability to behave accordingly is reflected in their perceived fit. This implies that fit with ABW environments is not a static phenomenon, but rather the product of the interaction between person and work environment. It also implies that workers' fit with ABW environments can be conceptualized and measured at two distinct levels: (1) momentary fit, directly related to the use of a specific work setting for a specific task; (2) general fit, based on a substantial use period in which various work settings may have been used for various tasks. In the current research, line with affective events theory (Weiss & Cropanzano, 1996; Ashkanasy et al., 2014), it was assumed that, over time, experiences at the first level create workers' perception of fit at the second level.

Figure 6.1 shows a conceptual model of P-E fit in the context of ABW, adapted from an established P-E fit model (Kristof, 1996). This model distinguishes two routes to perceived fit with an ABW environment: (1) alignment of personal needs and environmental supply (e.g., a need to perform different types of tasks (induced by high task variety) matches with the supply of different work settings); (2) alignment of personal abilities with environmental demands (e.g., freedom to choose where to work (as part of high job autonomy) matches the demand to use a work settings that suits the tasks at hand).

¹⁰ Wohlers and Hertel (2017) introduced the term 'Task-Environment fit' to address this. However, in the current research, job and task characteristics are considered as moderators of workers' needs and abilities (e.g., need for privacy may increase when performing a high-complexity task); see Figure 6.1.

Figure 6.1 *Conceptual P-E fit model, adapted from Kristof (1996), applied to the ABW context.*

In analogy with P-E fit, outcomes of ABW environments may also depend on alignment with organizational characteristics (which might be labeled as ‘Organization-Workspace fit’). Just like some workers experience fit with ABW environments, while others do not, some organizations may be more compatible with ABW environments than others. This may explain major differences across organizations that we observed (Chapter 2, 3, and 5) and that were found in other ABW studies (e.g., Brunia et al., 2016). Examples of relevant organizational characteristics are social ties and norms, which, as parts of an organization’s culture, may prevent workers from switching between work settings (Chapter 2) and organizational policies (e.g., clean desk policy) that may support flexible use of work settings (Babapour & Rolfö, 2019). Conceptually, such organizational characteristics may shape a context that makes it easier or harder for individual workers to create P-E fit with the ABW environment. Furthermore, from a Person-Organization fit perspective, an ABW environment may embody specific organizational values (e.g. self-direction, relations, goal-orientedness) that may (not) match personal values (De Clercq et al., 2008).

Implications for the ABW concept

By explaining why workers (do not) experience fit with ABW environments, our findings are also relevant for evaluating the ABW concept; does it live up to expectations regarding effective support of the workforce (Cushman & Wakefield, 2013; Van Meel, 2019)? Our findings partly support the basic rationale underlying the ABW concept, that it enables workers to use the most appropriate work setting for the task at hand by providing a variety of non-assigned work settings (Becker, 1999; Van Meel, 2019, Van Koetsveld & Kamperman, 2011; Veldhoen, 2005). Using a suitable (i.e., closed rather than open) work setting appeared to be relevant for individual high-complexity and non-individual tasks, but not for individual low-complexity tasks (Chapter 4 and 5). Our findings further revealed that perceived fit is not only dependent on the activity at hand, but also on job characteristics, psychological needs, behaviors, and demographic characteristics. This implies that the basic rationale underlying the ABW concept is incomplete: in conjunction with task characteristics, other factors co-determine which work setting should be considered as suitable. Hence, 'activity-based' should not be taken literally; in fact, 'need-based' would be a more appropriate term.

Furthermore, our findings indicate that the basic ABW rationale is contingent on two (implicit) assumptions that appeared to be far from obvious: (1) the supply of different types of work settings matches the demand of the workforce, (2) workers switch between these work settings in accordance with their activity patterns. In the samples that we studied, we found a clear shortage of closed work settings for individual work (Chapter 4 and 5). While on average 50 – 60% of the individual work required a high level of concentration, only 10 – 15% of the settings for individual work were closed. This is in line with observations that ABW environments typically feature a main area in an open-plan layout where most of the work settings are located (Van den Berg et al., 2020; Wohlers & Hertel, 2017), whereas around 50% of the time at the office is typically spent on tasks requiring concentration (Gensler, 2012). Evidently, this discrepancy hinders the use of appropriate, closed work settings for high-concentration work.

With regard to setting-switching, in line with previous research (Blok et al., 2009; Qu et al., 2010; Appel-Meulenbroek et al., 2011), we found a strong general reluctance, with only 4% of the workers switching multiple times a day (Chapter 2) and only 11% of random moments being linked to a setting-switch (Chapter 5). We

found this reluctance to be related to various job characteristics (i.e., low task diversity, low share of communication work, low external mobility), personal characteristics (i.e., place attachment), organizational characteristics (i.e., social ties and norms), and practical drawbacks of switching (e.g., necessity to move stuff) (Chapter 2). Furthermore, we observed that setting-switching was particularly low among workers who predominantly performed individual high-concentration work (Chapter 5). In a different way than the aforementioned undersupply of appropriate work settings, this may also hinder the use of appropriate work settings for high-concentration work.

In our samples, both assumptions underlying the basic ABW rationale (i.e., that suitable work settings are sufficiently available and that workers switch to a suitable work setting whenever needed) were significantly compromised with respect to high-concentration work. This may well explain why around 90% of the high-concentration work was performed in open work settings (Chapter 4 and 5), and why workers high in need for privacy were the least satisfied with ABW environments (Chapter 3). It may also explain mixed outcomes of ABW environments, and in particular the often-reported lack of privacy, found in previous ABW studies (Babapour, 2019; Bodin Danielsson & Bodin, 2009; De Been & Beijer, 2014; Engelen et al., 2019; Van der Voordt, 2004). Recently, distraction in ABW environments was linked to workers' mental health (Appel-Meulenbroek et al., 2020b). These insights do not directly undermine the basic ABW rationale as such, however they do underline the critical importance of the two aforementioned assumptions.

With regard to setting-switching, Van Meel (2019) argues that the ABW concept is not only about providing a variety of non-assigned work settings, but also involves a flexible way of working that ensures optimal use of these work settings. This behavioral dimension, which implies that workers play an active role in creating fit with their work environment, sets the ABW concept apart from other office concepts.

Our findings confirm the idea that the ABW concept fits with job characteristics that are typical of knowledge work (Davenport, 2005; Duffy & Powell, 1997; Van Yperen & Wörtler, 2017), i.e. high task variety, high external mobility (Chapter 2), high autonomy, high social interaction, and high internal mobility (Chapter 3), notwithstanding the fact that individual high-concentration work is generally not

well supported in current ABW practice¹¹. It should be noted though, that not all workers in ABW environments match the stereotype of the contemporary knowledge worker. Workers whose jobs involve low task variety, low external mobility (Chapter 2), low autonomy, low social interaction, or low internal mobility (Chapter 3) reported lower fit with ABW environments. Some of these workers would possibly be better off when provided an assigned work setting, tailored to their needs. Taken together, our findings indicate that the ABW concept may enable effective support of (a part of) the workforce, but only if it is implemented carefully, acknowledging differing needs and abilities among workers.

Implications for practice

Given the identified factors that influence workers' fit with ABW environments, how can these work environments be improved to optimize outcomes? (How) can ABW environments be aligned with the diverse and variable needs and abilities of all workers? Our most basic recommendation for practice is to start every ABW project with a thorough analysis of the work and the workforce, which not only includes activities (i.e., tasks) but also relevant job characteristics, behavioral patterns, psychological needs, and demographic characteristics (see Table 6.1). It may be practical to elaborate this analysis into a set of user profiles (i.e., groups of workers with similar needs and abilities). In addition to work and workers' characteristics, it is advisable to analyze organizational characteristics that may help or hinder workers to create fit with an ABW environment (e.g., social ties and norms, policies). Integrated findings from the workforce and organization analyses may be used to inform the workspace design process as well as the change process that is needed to create a work culture and work practices that fit with the ABW concept (Becker et al., 1994; Brunia, De Been, & Van der Voordt, 2016; Van der Voordt & Van Meel, 2000; Van Meel, 2019). Our findings, in particular the typical discrepancy between the supply of closed work settings for individual work and the office time spent on individual high-concentration work, seem to indicate that, in current ABW practice, pre-project analyses are often inadequate.

¹¹ The typical undersupply of closed work settings, which seems related to the prevalence of openness and transparency in contemporary workspace design (Van Meel, 2015; 2019), is regarded as a flaw of current ABW practice rather than a drawback that is inherent to the ABW concept.

From a general perspective, we may conclude that the ABW concept fits with key characteristics of knowledge work (Davenport, 2005; Duffy & Powell, 1997), i.e.: high job autonomy and high task variety fit with a range of choice of different work settings. Provided that the ABW environment offers an adequate mix of work settings (including sufficient numbers of closed work settings) and that workers switch between these work settings when needed, effective support of knowledge work may potentially be realized. This potential, combined with the opportunity to save on real estate and facilities costs due to increasing external mobility of workers (Oseland & Webber, 2012; Van Meel, 2019; Van Yperen & Wörtler, 2017), underpins the global trend of ABW adoption (Cushman & Wakefield, 2013; Leesman, 2017; Wohlers & Hertel, 2017; Van Meel, 2019).

Yet, organizations are warned when following the ABW trend. Our findings indicate that organizations typically employ workers with various needs and abilities, some of whom may not match the typical knowledge worker profile. This implies that, even if the ABW concept is well implemented, the work environment may not fit with particular workers, which may negatively impact their work outcomes. For instance, workers low in task variety (i.e., who predominantly perform one specific type of work) and low in external mobility (i.e., who spend their working hours at the office mostly), do not get any benefits from a variety of work settings and may therefore experience the daily search for a suitable work setting merely as a burden. As effective support of the workforce is the main goal, implementing the ABW concept is just one possible solution, which should not turn into a dogma. If the aforementioned pre-project analysis shows that the population includes workers whose needs and abilities do not fit with the ABW concept, and if changing these needs and abilities is not a feasible option, then these workers should be facilitated differently. In many cases, integrating a number of assigned and/or multifunctional work settings in an ABW environment may turn out to be an optimal solution. In these cases, the pre-project analysis may help explain why workers are facilitated differently.

Lack of privacy for high-concentration work appeared to be the single-most important issue in current ABW practice, due to the highly prevalent use of open work settings for this type of work. This particularly affects workers in jobs in which this type of work is central (Chapter 4 and 5), especially when they are high in need for privacy (Chapter 4). A two-fold approach is recommended to resolve this issue: (1) facilitate high-concentration work by providing sufficient work settings that

offer privacy, (2) stimulate the use of such work settings by removing barriers. These work settings may include both private 'concentration rooms' and shared 'quiet rooms' or 'library rooms' where (phone) conversations are not allowed (Haapakangas et al., 2018b). Alternatively, quiet open work settings might be provided; however, it is notoriously difficult to enforce strict non-speech and non-interruption rules in such work settings (Babapour Chafi & Rolfö, 2019). In addition to the obvious requirement of adequate acoustics, other indoor environmental quality (IEQ) aspects (e.g., daylight, ventilation) and ergonomics are also important, as some workers will probably need to use these work settings for most of their time at the office. Besides poor IEQ, barriers that keep workers from using these work settings may be related to social ties and norms (e.g., staying with colleagues in an open work setting instead of moving to a closed work setting), psychological factors (e.g., place attachment), and practical issues (e.g., necessity to move stuff) (Chapter 2). Effective measures to remove identified barriers may be, for instance, discussing and changing social norms and encouraging conscious experimentation with the use of different work settings.

The activity-based work environment of the future

The ABW concept is rooted in the rise and changing nature of knowledge work over the past decades (Van Meel, 2011; Van Meel 2019), but is it also future proof? How will knowledge work practices further change and (how) can ABW environments accommodate these changes? These questions are now particularly relevant in the light of expected major changes following the worldwide COVID-19 pandemic. Specifically, substantial, lasting increases are expected in working from home (WFH) and virtual teamwork (Kniffin et al., 2020; Rudolph et al., 2020). Inevitably, such future expectations are highly speculative at the time of writing (mid-2020), with (1) the virus still spreading and claiming lives in large parts of the world, (2) knowledge gaps with regard to effective infection control, (3) uncertainty about if and when an effective vaccine or medical treatment will be available, and (4) different economic scenario's for the coming years, estimating moderate to severe negative impact on organizations and jobs across several industries. Still, the first empirical studies on recent work experiences consistently indicate that work practices are likely to change structurally in the coming years (Gartner, 2020; Gensler, 2020; Ipsen et al., 2020; Leesman, 2020; Van Veldhoven & Van Gelder, 2020).

As argued by Leesman (2020), the impact of COVID-19 on workplaces for knowledge work seems to unfold in three distinct yet interrelated waves: (1) crisis response; (2) re-entry; (3) future role of the workplace. During the first months of the COVID-19 pandemic, knowledge workers in most countries were forced to WFH on a permanent basis, due to governmental lockdown measures. According to Gartner (2020), approximately one-half of the companies had more than 80% of their employees WFH in April 2020. Remarkably, this unique, massive, unpanned 'WFH experiment' seems to have yielded more positive experiences (e.g., more time-efficient working; better focus; higher autonomy; more contact with family) than negative experiences (e.g., too much screen work; lack of face-to-face interaction; ergonomic issues) (Ipsen et al., 2020; Van Veldhoven & Van Gelder, 2020). Moreover, the overall WFH experience outperformed working at the office; in particular, perceived support of individual high-concentration work and private/confidential conversations was better at home (Leesman, 2020). Yet, large individual differences were also observed, with some workers struggling with WFH, particularly when they had no dedicated work room, which was more often the case for younger workers (Leesman, 2020). From previous WFH research, it is known that other individual factors may also negatively affect WFH experiences, like family status (e.g., combining WFH with child care) and personality (e.g., need for boundaries between work and private life) (Kniffin et al., 2020; Rudolph et al., 2020).

Currently, as part of the second wave of COVID-19 impact, organizations are (preparing for) re-opening their offices. These operations typically include implementing measures to ensure social distancing (e.g., restricted use of elevators; removing desks and meeting chairs), which significantly limit the capacity of the office (Cushman & Wakefield, 2020). Hence, in this phase, structural WFH (i.e., several days a week) remains part of typical knowledge work practices. With regard to ABW, some organizations seem hesitant about shared use of work stations because of possible infection risks. Yet, many organizations continue their shared-desk policy, providing workers with cleaning materials and/or expanding cleaning arrangements to enable cleaning after/before each subsequent use (i.e., the same solution that is used for meeting rooms). The current hesitation may vanish over time, particularly when increased WFH leads to structurally lowered presence at the office.

While it is unknown yet how long this phase will last, a key question arises, as part of the third wave of COVID-19 impact: To what extent will knowledge workers continue to WFH, when social distancing measures are lifted, and how will this affect their use of the office? First estimates indicate that around 50% of office workers are likely to keep WFH structurally; 1 – 5 days a week (De Haas, 2020; Gartner, 2020; Gensler, 2020). The widely expressed expectation that WFH and virtual teamwork will become common work practices seems to be based on: (1) the predominantly positive experiences in the past months (Ipsen et al., 2020; Leesman, 2020; Van Veldhoven & Van Gelder, 2020), (2) possibly trendsetting companies like Twitter and Facebook announcing WFH-promoting policies (The Guardian, 2020), (3) potential cost-savings for employers (Kniffin et al., 2020), and (4) a possible shift towards a results-oriented management culture (Rudolph et al., 2020). From a long-term perspective, the COVID-19 period seems to cause an acceleration of trends that were already underway, including the migration of work to online environments, the expansion of virtual teams (Kniffin et al., 2020), and the adoption of blended working (Van Yperen & Wörtler, 2017). In this context, the exceptional work experiences during the pandemic may work as a catalyst for time-spatial job crafting (Wessels et al., 2019), stimulating workers to consciously evaluate and adjust their work patterns with regard to working hours, places, and locations of work.

As a consequence of expected post-COVID-19 changes, several of the personal attributes that we linked to workers' fit with ABW environments (see Table 6.1) may be affected such that more workers will perceive (better) fit. These attributes are: (1) job autonomy, (2) external mobility, (3) office time spent on high-complexity tasks vs. non-individual tasks, and (4) setting-switching. An increase in time-spatial job crafting (Wessels et al., 2019), enabled by more liberal, results-oriented organizational policies and cultures (The Guardian, 2020; Rudolph et al., 2020), may enhance job autonomy. More blended working, including WFH, implies higher external mobility (i.e., lower presence at the office). Furthermore, workers who structurally WFH will probably go to the office foremost for non-individual work (i.e., face-to-face meetings, informal interactions, collaborative work) and use it less for individual high-concentration work. High external mobility and a focus on non-individual are both associated with more frequent setting-switching (Chapter 2 and 5). Based on these links with our findings, COVID-19 may be expected to promote perceived fit and stimulate further adoption of the ABW concept.

If increased WFH indeed leads to less office time spent on individual high-concentration work, this will help alleviate the widespread problem of lack of privacy for individual high-concentration work in ABW environments. Nevertheless, it may be expected that the need for sufficient adequate (closed) quiet work settings will remain important. The first reason is that high task variety implies that non-individual work often alternates with individual work, including high-concentration work, which typically is the lion's share of the job (Chapter 5). In the words of Peggy Rothe from Leesman (2020): "few jobs include full days of creativity and collaboration". The second reason is that for some workers, structural WFH will be an unfeasible or undesirable option. This may be due to the lack of a dedicated work room (Leesman, 2020), the presence of family members, or personal preference for separating work and private life (Kniffin et al., 2020; Rudolph et al., 2020). Also, for some workers (e.g., workers new to the organization or job; teams with high task interdependence) it may be important to work in close, face-to-face contact with co-workers to ensure optimal collaboration and social learning. Again, this non-individual work will alternate with individual (high-concentration) work. The third reason to offer sufficient closed private work settings is an expected increase in video calls at the office, as part of more common blended working practices, which require a high degree of privacy.

Potentially, the ABW environment of the future may be smaller and hence cheaper, as less work settings are needed when many workers WFH structurally. However, such cost savings will probably not be directly proportional to the increase in WFH. When meeting colleagues face-to-face becomes the number one reason to go to the office for most workers, this will probably increase the tendency towards peak days/moments during the week (e.g., 'everybody goes there on Tuesday, because everybody goes there on Tuesday'). Furthermore, minimizing the supply of work settings may effectively limit the possibilities to use different work settings in accordance with the tasks at hand, and thus remove the key user benefit of the ABW concept. With regard to office space requirements, current measures to ensure social distancing may have a lasting upward effect (i.e., more space per work setting), should these measures remain necessary or preferred. Budget-wise, many organizations will face new investments to facilitate WFH (e.g., ergonomic furniture and tools) and virtual teamwork (e.g., upgrade software, hardware and internet connectivity), which might exceed potential savings on office real estate and facilities.

Combining our findings with predictions for the post-COVID-19 world of work, it may be expected that the ABW concept is here to stay and that the adoption may even accelerate as growing numbers of workers experience fit and the cost-saving argument grows stronger. In the light of expected changes in knowledge work practices and observed shortcomings of current ABW practice, effective future ABW environments may be envisioned which integrate: (1) extensive supply of attractive/inspiring settings for formal and informal face-to-face interactions, (2) sufficient supply of closed work settings to support individual high-concentration work and video calls, (3) state-of-the-art ICT and adequate closed work settings for virtual teamwork, (4) a work culture that fosters time-spatial job crafting, including WFH, use of third places (e.g., co-working space, satellite office, partner office), and optimal use of various work settings at the office.

Strengths, limitations and perspectives for further research

The sizes and diversity of the study samples can be considered as strengths of this research project. Workers from 16 different Dutch organizations (total $N = 3,818$) participated in our surveys and field studies, and a complete cohort of students ($n = 160$) took part in the virtual reality experiment. The combination of these samples supports the generalizability of our findings. Nevertheless, since ABW is a global trend (Cushman & Wakefield, 2013; Leesman, 2017; Van Meel, 2019), the Dutch focus of the current project implies a limitation and it would be interesting to use international samples in future ABW research.

The combination of different research methods contributes to the validity of our findings, since each method has its merits (Mathison, 1988). The surveys that we used in the first studies (Chapter 2 and 3), proved useful for identifying relevant variables. In the later studies, we close-examined these variables, relying on experience sampling (Chapter 4 and 5) and a virtual reality experiment (Chapter 4). In Chapter 4, we used two complementary studies, employing different methods (i.e., a field study and an experimental study) to test the same research model, thus combining a high level of ecological validity with the assessment of causal relationships.

To the best of our knowledge, both experience sampling and virtual reality were novel to ABW research. Based on our experience, app-based experience sampling is

recommended for further ABW research, as it enables the collection of detailed and reliable data on the actual use and perception of work settings. This is an important strength in the context of ABW research, as it may be difficult for workers to recall this information accurately (e.g., when completing a survey). Furthermore, using a mobile application makes it easy for participants to respond quickly, at any place in the work environment. With regard to

virtual reality, we saw that advanced simulation creates a highly realistic experience, with optimal control of experimental conditions. This enables testing of different work settings in relation to different work activities, which is central to the ABW concept.

In the course of this research project, we came across several interesting aspects of ABW environments that were beyond scope, but may be included in further research. Firstly, significant differences between organizations with regard to perceived fit and satisfaction with ABW environments were noticed (Chapter 2, 3, and 5). This calls for comparative case studies, in line with Brunia et al. (2016), that include situational factors such as: organisational culture, workplace policies, implementation process, mix of different work settings, interior design, and occupancy rates

Secondly, since the list of personal attributes relevant to perceived fit with ABW environments (Table 6.1) is by no means complete, further research may for instance focus on: Big Five personality traits (building on: Oseland & Hodsman, 2018; Roskams & Haynes, 2019; Seddigh et al., 2016), stimulus-screening ability (Mehrabian, 1995), place attachment (Lewicka, 2011), task interdependence (Morgeson and Humphrey, 2006), attitude toward time-spatial flexibility (Wessels et al., 2019). Particularly in the light of expected post-COVID-19 changes, the degree of WFH (i.e., 1 – 5 days a week) may be a relevant personal attribute.

Thirdly, in line with our studies that linked perceived fit with the availability of closed work settings (Chapter 4 and 5), further research may reveal more specific attributes of ABW environments which, in alignment with specific personal attributes, may influence perceived fit. Previous research indicates that relevant environmental attributes may include: individual environmental control, aesthetic quality (Roskams & Haynes, 2019), acoustics (Oseland & Hodsman, 2018), communicative work settings (Wohlers et al., 2019), visibility and proximity vs. spatial dispersion (Wohlers & Hertel, 2018).

Fourthly, attributes of ABW environments may be manipulated as part of longitudinal intervention studies (i.e., including pre and post measurements), aimed at providing evidence-based recommendations for optimizing perceived fit. In the light of our findings, it would be particularly interesting to implement an ABW environment with an oversupply (instead of the typical undersupply) of closed work settings for individual work, to test whether this may solve the problem of lack of privacy for high-concentration work – directly, or after a second intervention aimed at stimulating appropriate use/switching (see Chapter 4).

Fifthly, further ABW research may deliver additional evidence for the impact of perceived fit on various work outcomes, by including more outcome variables. In the current project, we demonstrated significant impact on satisfaction with the work environment (Chapter 2, 3, and 4) and task performance (Chapter 4). Further research may examine possible impact on wider organizational outcomes, as suggested by general P-E fit literature, like job satisfaction, organizational commitment, turnover, and psychological and physical well-being (Edwards et al., 2006). Furthermore, findings from previous ABW studies regarding the impact of perceived fit on collaboration (Gerdenitsch et al., 2018; Haapakangas et al., 2018b; Zamani & Gum, 2019), communication and perceived productivity (Zamani & Gum, 2019), and job attitudes and vitality (Wohlers et al., 2019).

Sixthly, since the current studies were all completed before the COVID-19 pandemic, it remains to be seen how this exceptional episode in the evolution of knowledge work will actually affect workers' fit with ABW environments and how it may shape future ABW environments. Expectations in this regard, following from the current research, may serve as hypotheses, to be tested in future ABW research.

General conclusions

The current research project identified and analyzed antecedents of workers' fit with ABW environments. From our findings, a clear profile arises of workers who best fit with ABW environments, i.e.: high task variety, job autonomy, external and internal mobility, social interaction, and need for relatedness; low need for privacy; few high-complexity tasks, many non-individual tasks; appropriately using open and closed work settings; frequently switching between work settings; relatively young. This implies good fit with job characteristics that are typical of knowledge

work, except for high-complexity work. However, it also implies suboptimal fit for workers who not match this profile, some of whom may be better off with an assigned work setting that is tailored to their needs. Furthermore, we found that current ABW environments typically fail to provide sufficient privacy for individual high-concentration work, due to a shortage of closed work settings and reluctance to switch between work settings. Only when these critical issues are effectively resolved, and the design and implementation are carefully tailored to the workers' differing needs and abilities, an ABW environment may effectively support (a part of) the workforce. In the post-COVID-19 world of work, increased adoption of blended working practices and time-spatial job crafting, along with research-based optimization of ABW environments, might enhance perceived fit for growing numbers of workers.

References

- Aarts, H., & Dijksterhuis, A. (2000). Habits as knowledge structures: automaticity in goal-directed behaviour. *Journal of Personality and Social Psychology*, 78(1), 53-63. <https://doi.org/10.1037/0022-3514.78.1.53>
- Aiken, L. S., & West, S. G. (1991). *Multiple regression: Testing and interpreting interactions*. Sage.
- Aiyar, S., Ebeke, C., & Shao, X. (2016). *The Impact of Workforce Aging on European Productivity (IMF Working Paper)*. International Monetary Fund. <https://www.imf.org/external/pubs/ft/wp/2016/wp16238.pdf>
- Allen, T., & Gerstberger, P. (1973). A field experiment to improve communications in a product engineering department: The nonterritorial office. *Human Factors: The Journal of Human Factors and Ergonomics Society*, 15(5), 487-498. <https://psycnet.apa.org/doi/10.1177/001872087301500505>
- Altman, I. (1975). *The environment and social behavior: privacy, personal space, territory and crowding*. Brooks/Cole.
- Appel - Meulenbroek, H., De Vries, B., & Weggeman, M. (2017). Knowledge sharing behavior: The role of spatial design in buildings. *Environment and Behavior*, 49(8), 874-903. <https://doi.org/10.1177%2F0013916516673405>
- Appel-Meulenbroek, R., Groenen, P., & Janssen, I. (2011). An end-user's perspective on activity-based office concepts. *Journal of Corporate Real Estate*, 13(2), 122-135. <https://doi.org/10.1108/14630011111136830>
- Appel-Meulenbroek, R., Le Blanc, P., & De Kort, Y. (2020a). Person-environment fit; Optimizing the physical work environment. In O.B. Ayoko & N.M. Ashkanasy (Eds.), *Organizational Behaviour and the Physical Environment* (pp. 251-267). Routledge.
- Appel-Meulenbroek, R., Van der Voordt, T., Aussems, R., Arentze, T., & Le Blanc, P. (2020b). Impact of activity-based workplaces on burnout and engagement dimensions. *Journal of Corporate Real Estate*, 22(4), 279-296. <https://doi.org/10.1108/JCRE-09-2019-0041>
- Ashkanasy, N. M., Ayoko, O. B., & Jehn, K. A. (2014). Understanding the physical environment of work and employee behavior: An affective events perspective. *Journal of Organizational Behavior*, 35(8), 1169-1184. <https://doi.org/10.1002/job.1973>
- Babapour, M. (2019). *The Quest for the Room of Requirement – Why Some Activity-based Flexible Offices Work While Others Do Not*. PhD thesis, Chalmers University of Technology, Gothenburg, Sweden.
- Babapour Chafi, M., & Rolfö, L. (2019). Policies in activity-based flexible offices -'I am sloppy with clean-desking. We don't really know the rules.' *Ergonomics*, 62(1), 1-20. <https://doi.org/10.1080/00140139.2018.1516805>
- Baguley, T. S. (2012). *Serious Stats, A Guide to Advanced Statistics for the Behavioral Sciences*. Palgrave MacMillan.
- Baron, R., & Kenny, D. (1986). The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology*, 51(6), 1173-1182. <https://doi.org/10.1037/0022-3514.51.6.1173>

- Baumeister, R. F., & Leary, M. R. (1995). The need to belong: Desire for interpersonal attachments as a fundamental human motivation. *Psychological Bulletin*, 117(3), 497-529. <https://psycnet.apa.org/doi/10.1037/0033-2909.117.3.497>
- Becker, F. (1999). Beyond alternative officing: Infrastructure on-demand. *Journal of Corporate Real Estate*, 1(2), 154-168. <https://doi.org/10.1108/14630019910811006>
- Becker, F., Quinn, K. L., Rappaport, A. J., & Sims, W. R. (1994). *Implementing innovative workplaces, organisational implications of different strategies. Workscape 21: The ecology of new ways of working*. Cornell University, State college of Human Ecology. <https://files.eric.ed.gov/fulltext/ED418273.pdf>
- Bedny, G., Karwowski, W., & Bedny, I. (2012). Complexity evaluation of computer-based tasks. *Int. Journal of Human-Computer Interaction*, 28(4), 236-257. <https://doi.org/10.1080/10447318.2011.581895>
- Bernstein, E. S., & Turban, S. (2018). The impact of 'open' workspace on human collaboration. *Philosophical Transactions Royal Society B*, 373(20170239), 1-8. <http://dx.doi.org/10.1098/rstb.2017.0239>
- Block, L., & Stokes, G. (1989). Performance and satisfaction in private versus nonprivate work settings. *Environment and Behavior*, 21(3), 277-297. <https://doi.org/10.1177/0013916589213003>
- Blok, M., De Korte, E., Groenesteijn, L., Formanoy, M., & Vink, P. (2009). The effects of task facilitating working environment on office space use, communication, concentration, collaboration, privacy and distraction. *Proceedings of the 17th World Congress on Ergonomics*. Nova Science. <http://resolver.tudelft.nl/uuid:cec6d1ae-cb56-4241-a961-37f112765932>
- Bodin Danielsson, C., & Bodin, L. (2009). Difference in satisfaction with office environment among employees in different office types. *Journal of Architectural & Planning Research*, 26(3), 241-258. <https://www.jstor.org/stable/43030872>
- Brennan, A., Ghugh, J. S., & Kline, T. (2002). Traditional versus open office design; A longitudinal field study. *Environment and Behavior*, 34(3), 279-299. <https://doi.org/10.1177%2F0013916502034003001>
- Brill, M., & Weidemann, S. (2001). *Disproving widespread myths about workplace design*. Bosti Associates. Kimball International. https://www.researchgate.net/publication/248708306_Disproving_widespread_myths_about_workplace_design
- Bruni, C., Schultz, P., & Saunders, C. (n.d.). *Environmental response inventory*. CONPSYCHMeasures, Measurement Tools for Environmental Practitioners. www.conpsychmeasures.com/conpsychmeasures/measures/ERI/ERI.html
- Brunia, S., De Been, I., & Van der Voordt, T. (2016). Accommodating new ways of working: Lessons from best practices and worst cases. *Journal of Corporate Real Estate*, 18(1), 30-47. <https://doi.org/10.1108/JCRE-10-2015-0028>
- Bubany, S., & Hansen, J. (2006). Minnesota clerical test. In N. Salkind (Ed.), *Encyclopedia of measurement and statistics* (p. 607). Sage Publications
- Carlopio, J. R. (1996). Construct validity of a physical work environment satisfaction questionnaire. *Journal of Occupational Health Psychology*, 1(3), 330-344. <https://doi.apa.org/doi/10.1037/1076-8998.1.3.330>
- Cohen, J. (1992). A power primer. *Psychological Bulletin*, 112(1), 155-159. <https://psycnet.apa.org/doi/10.1037/0033-2909.112.1.155>

- Compernelle, T. (2014). *The open office is naked: The fifth brainchain that ruins your intellectual productivity*. Compuplications.
<https://docs.google.com/a/trivia.nl/viewer?a=v&pid=sites&srcid=ZGVmYXVsdGRvbWFpbnxsaWJlcmF0ZXlvdXJicmFpbnxneDo2M2M4MzRlMDA4ZDI4Zjkx>
- CoreNet Global (2020). COVID-19 and Corporate Real Estate: Key findings from a worldwide member survey; Executive summary.
- Cushman & Wakefield. (2013). *Workplace transformation survey: A global view of workplace change*.
<http://cwedm.com/wp-content/uploads/2015/05/WorkplaceTransformation.pdf>
- Cushman & Wakefield (2020). *Recovery readiness; A how-to guide for reopening your workplace (Version 1.0)*. <https://www.cushmanwakefield.com/en/insights/covid-19/recovery-readiness-a-how-to-guide-for-reopening-your-workplace>
- Davenport, T. (2005). *Thinking for a living: How to get better performance and results from knowledge workers*. Harvard Business School Press.
- Davis, M., Leach, D., & Clegg, C. (2011). The physical environment of the office: Contemporary and emerging issues. In G.P. Hodgkinson & K. Ford (Eds.), *International review of industrial and organizational psychology* (pp. 193-237). John Wiley & Sons Ltd.
<https://doi.org/10.1002/9781119992592.ch6>
- De Been, I., & Beijer, M. (2014). The influence of office type on satisfaction and perceived productivity support. *Journal of Facilities Management*, 12(2), 142-157. <https://doi.org/10.1108/JFM-02-2013-0011>
- De Clercq, S., Fontaine, J. R. J., & Anseel, F. (2008). In Search of a comprehensive value model for assessing supplementary person-organization fit, *The Journal of Psychology*, 142(3), 277-302, <https://doi.org/10.3200/JRLP.142.3.277-302>
- De Haas, M., Hamersma, M., & Faber, R. (2020). *Nieuwe inzichten mobiliteit en de coronacrisis; Vervolgmeting effecten van de coronacrisis op mobiliteitsgedrag en mobiliteitsbeleving*. Kennisinstituut voor Mobiliteitsbeleid (KiM). <https://www.kimnet.nl/publicaties/brochures/2020/07/21/nieuwe-inzichten-mobiliteit-en-de-coronacrisis>
- De Kok, A. (2018). *The new way of working: An empirical assessment of organizational and technological effects*. PhD dissertation, University of Utrecht. <https://dspace.library.uu.nl/handle/1874/360025>
- Derfler-Rozin, R., Moore, C., & Staats, B. R. (2016). Reducing organizational rule breaking through task variety: How task design supports deliberative thinking. *Organization Science*, 27(6), 1043-1573. <https://doi.org/10.1287/orsc.2016.1094>
- Duffy, F., & Powell, K. (1997). *The new office*. Conran Octopus.
- Edwards, J. R., Cable, D.M., Williamson, I. O., Schurer Lambert, L., & Shipp, A. J. (2006). The phenomenology of fit: Linking the person and environment to the subjective experience of person-environment fit. *Journal of Applied Psychology* 91(4), 802-827. <https://doi.org/10.1037/0021-9010.91.4.802>
- Edwards, J. R., Caplan, R. D., & Van Harrison, R. (1998). Person-environment fit theory: Conceptual foundations, empirical evidence, and directions for future research. In C. Cooper (Ed.), *Theories of organizational stress* (pp. 28-67). Oxford University Press.

- Engelen, L., Chau, J., Young, S., Mackey, M., Jeyapalan, D., & Bauman, A. (2019). Is activity-based working impacting health, work performance and perceptions? A systematic review. *Building Research & Information*, 47(4), 468-479. <https://doi.org/10.1080/09613218.2018.1440958>
- Faul, F., Erdfelder, E., Lang, A. G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods*, 39, 175-191. <https://doi.org/10.3758/BF03193146>
- Gartner. (2020). *Gartner HR survey reveals 41% of employees likely to work remotely at least some of the time post coronavirus pandemic*. <https://www.gartner.com/en/newsroom/press-releases/2020-04-14-gartner-hr-survey-reveals-41--of-employees-likely-to->
- Gensler. (2012). *What we've learned about focus in the workplace*. [https://www.gensler.com/uploads/document/306/file/Focus in the Workplace 10 01 2012.pdf](https://www.gensler.com/uploads/document/306/file/Focus%20in%20the%20Workplace%2010%2001%202012.pdf)
- Gensler (2020). *Gensler U.S. work from home survey 2020; Briefing #1: Back to the office*. <https://www.gensler.com/research-insight/workplace-surveys/us-work-from-home-survey/2020>
- Gerdenitsch, C., Korunka, C., & Hertel, G. (2018). Need-supply fit in an activity-based flexible office: A longitudinal study during relocation. *Environment and Behavior*, 50(3), 273-297. <https://doi.org/10.1177/0013916517697766>
- Gerdenitsch, C., Kubicek, B., & Korunka, C. (2015). Control in flexible working arrangements; When freedom becomes duty. *Journal of Personnel Psychology*, 14(2), 61-69. <https://psycnet.apa.org/doi/10.1027/1866-5888/a000121>
- Gibson, V. (2003). Flexible working needs flexible space?; Towards an alternative workplace strategy. *Journal of Property Investment & Finance*, 21(1), 12-22. <https://doi.org/10.1108/14635780310468275>
- Göçer, Ö., Göçer, K., Karahan, E., & Oygür, I. (2018). Exploring mobility & workplace choice in a flexible office through post-occupancy evaluation. *Ergonomics*, 61(2), 226-242. <https://doi.org/10.1080/00140139.2017.1349937>
- Greene, C., & Myerson, J. (2011). Space for thought: designing for knowledge workers. *Facilities* 29(1), 19-30. <https://doi.org/10.1108/02632771111101304>
- Haapakangas, A., Hallman, D. M., Mathiassen, S. E., & Jahncke, H. (2018a). Self-rated productivity and employee well-being in activity-based offices: The role of environmental perceptions and workspace use. *Building and Environment*, 145, 115-124. <https://doi.org/10.1016/j.buildenv.2018.09.017>
- Haapakangas, A., Hallman, D. M., Mathiassen, S. E., & Jahncke, H. (2019). The effects of moving into an activity-based office on communication, social relations and work demands – A controlled intervention with repeated follow-up. *Journal of Environmental Psychology*, 66, 1-8. <https://doi.org/10.1016/j.jenvp.2019.101341>
- Haapakangas, A., Hongisto, V., Varjo, J., & Lahtinen, M. (2018b). Benefits of quiet workspaces in open-plan offices – Evidence from two office relocations. *Journal of Environmental Psychology*, 56, 63-75. <https://doi.org/10.1016/j.jenvp.2018.03.003>
- Hackman, J., & Lawler, E. (1971). Employee reactions to job characteristics. *Journal of Applied Psychology*, 55(3), 259-286. <https://doi.org/10.1037/h0031152>
- Hackman, J. R. & Oldham, G. R. (1980). *Work Redesign*. Addison-Wesley.

- Hadfield, J. (2010). MCMC methods for multi-response generalized linear mixed models: The MCMCglmm R package. *Journal of Statistical Software*, 33(2), 1-22. <https://doi.org/10.18637/jss.v033.i02>
- Harris, R. (2015). The changing nature of the workplace and the future of office space. *Journal of Property Investment & Finance*, 33(5), 424-435. <https://doi.org/10.1108/JPIF-05-2015-0029>
- Hayes, A. F. (2017a). *Introduction to mediation, moderation, and conditional process analysis, second edition: A regression-based approach*. Guilford Publications.
- Hayes, A. F. (2017b). Partial, conditional, and moderated moderated mediation: Quantification, inference, and interpretation. *Communication Monographs*, 85 (1), 4-40. <https://doi.org/10.1080/03637751.2017.1352100>
- Haynes, B. P. (2007). Office productivity: A theoretical framework. *Journal of Corporate Real Estate*, 9(2), 97-110. <https://doi.org/10.1108/14630010710828108>
- Hirst, A. (2011). Settlers, vagrants and mutual indifference: Unintended consequences of hot-desking. *Journal of Organizational Change Management*, 24(6), 767-788. <https://doi.org/10.1108/09534811111175742>
- Hockey, G. R. J. (1979). Stress and the cognitive components of skilled performance. In V. Hamilton & D. M. Warburton (Eds.), *Human stress and cognition: An information processing approach* (pp. 141-177). John Wiley & Sons.
- Hoendervanger, J. G., De Been, I., Van Yperen, N. W., Mobach, M. P., & Albers, C. J. (2016). Flexibility in use: Switching behaviour and satisfaction in activity-based work environments. *Journal of Corporate Real Estate*, 18(1), 48-62. <https://doi.org/10.1108/JCRE-10-2015-0033>
- Hoendervanger, J. G., Ernst, A., Albers, C. J., Van Yperen, N. W., & Mobach, M. P. (2018). Individual differences in satisfaction with activity-based work environments. *PLoS ONE*, 13(3), 1-15. <https://doi.org/10.1371/journal.pone.0193878>
- Hoendervanger, J. G., Le Noble, V., Mobach, M. P., & Van Yperen, N. W. (2015). Tool development for measuring and optimizing workplace utilization in activity-based work environments. In K. Alexander & I. Price (Eds.), *EuroFM Research Papers – Advancing knowledge in FM; People make facilities management* (Section 4.1, pp. 2-10). EuroFM Publications. https://www.eurofm.org/images/Papers/Section_4.1_Space_and_organisation.pdf
- Hoendervanger, J. G., Van Yperen, N. W., Mobach, M. P., & Albers, C. J. (2019). Perceived fit in activity-based work environments and its impact on satisfaction and performance. *Journal of Environmental Psychology*, 65, 1-10. <https://doi.org/10.1016/j.jenvp.2019.101339>
- Hoendervanger, J. G., Van Yperen, N. W., Mobach, M. P., & Albers, C. J. (in press). Perceived fit and user behavior in activity-based work environments. *Environment and Behavior*.
- Horváth, J., Czigler, I., Birkás, E., Winkler, I., & Gervai, J. (2009). Age-related differences in distraction and reorientation in an auditory task. *Neurobiology of Aging*, 30(7), 1157-1172. <https://doi.org/10.1016/j.neurobiolaging.2007.10.003>
- Ipsen, C., Kirchner, K., & Hansen, J. P. (2020). *Experiences of working from home in times of covid-19; International survey conducted the first months of the national lockdowns March-May*. DTU. <https://doi.org/10.11581/dtu:00000085>

- Ipsos. (2016). *Engagement and the global workplace*. Steelcase Inc.
<https://cdn2.hubspot.net/hubfs/1822507/2016-WPR/EN/2016-WPR-PDF-360FullReport-EN .pdf>
- Jones Lang Lasalle (2012), *Activity based working*. <http://www.jll.com.au/australia/en-au/Documents/jll-au-activity-based-working-2012.pdf>.
- Kaarlela-Tuomaala, A., Helenius, R., Keskinen, E., & Hongisto, V. (2009). Effects of acoustic environment on work in private office rooms and open-plan offices: Longitudinal study during relocation. *Ergonomics*, 52(11), 1423-1444. <https://doi.org/10.1080/00140130903154579>
- Kampschroer, K., & Heerwagen, J. H. (2005). The strategic workplace: development and evaluation. *Building Research & Information*, 33(4), 326-337. <https://doi.org/10.1080/09613210500161976>
- Kim, J., & De Dear, R. (2013). Workspace satisfaction: The privacy-communication trade-off in open-plan offices. *Journal of Environmental Psychology*, 36, 18-26. <https://doi.org/10.1016/j.jenvp.2013.06.007>
- Kleijn, M., Appel-Meulenbroek, R., Kemperman, A., & Hendriks, E. (2012). CREM and activities at the modern workplace; a study of the variables influencing the use of workplaces in an activity based office design. *Proceedings of the in 19th Annual Conference of the European Real Estate Society*, 1-17. ERES.
- Kniffin, K. M., Narayanan, J., Anseel, F., Antonakis, J., Ashford, S. P., Bakker, A. B., Bamberger, P., Bapuji, H., Bhawe, D. P., Choi, V. K., Creary, S. J., Demerouti, E., Flynn, F. J., Gelfand, M. J., Greer, L., Johns, G., Kesebir, S., Klein, P. G., Lee, S. Y. (...) Van Vugt, M. (2020). COVID-19 and the workplace: Implications, issues, and insights for future research and action. *American Psychologist*.
<http://dx.doi.org/10.1037/amp0000716>
- Kristof, A. L. (1996). Person-organization fit: An integrative review of its conceptualizations, measurement, and implications. *Personnel Psychology*, 49(1), 1-49. <https://doi.org/10.1111/j.1744-6570.1996.tb01790.x>
- Kristof-Brown, A. L., & Guay, R. (2011). Person-environment fit. In S. Zedeck (Ed.), *Handbook of industrial and organizational psychology* (3, pp. 3-50). American Psychological Association.
- Kristof-Brown, A. L., Zimmerman, R., & Johnson, E. (2005). Consequences of individuals' fit at work: A meta-analysis of person-job, person-organization, person-group and person-supervisor fit. *Personnel Psychology*, 58(2), 281-342. <https://doi.org/10.1111/j.1744-6570.2005.00672.x>
- Kupritz, V. (1998). Privacy in the work place: The impact of building design. *Journal of Environmental Psychology*, 18(4), 341-356. <https://doi.org/10.1006/jevp.1998.0081>
- Larson, R., & Csikszentmihalyi, M. (1983). The Experience Sampling Method. In H. Reis (Ed.), *New Directions for Methodology of Social and Behavioral Sciences* (15, pp. 41-56). Jossey-Bass.
- Leaman, A., & Bordass, B. (2006). Productivity in buildings: the "killer" variables (part three). In D. Clements-Croome (Ed.), *Creating the productive workplace* (pp. 153-180). Taylor & Francis.
- Leesman (2017). *The rise and rise of activity based working*.
<http://www.leesmanindex.com/The Rise and Rise of Activity Based Working Research book.pdf>
- Leesman (2020). *The impact of home working on employee experience*. Presentation shared in a live webinar on 7 July.
- Lewicka, M. (2011), Place attachment: How far have we come in the last 40 years? *Journal of Environmental Psychology*, 31(3), 207-230. <https://doi.org/10.1016/j.jenvp.2010.10.001>

- Li, K., Hasher, L., Jonas, D., Rahhal, T., & May, C. (1998). Distractibility, circadian arousal, and aging: A boundary condition? *Psychology and Aging*, 13(4), 574-583. <https://psycnet.apa.org/doi/10.1037/0882-7974.13.4.574>
- Loomis, J., Blascovich, J., & Beall, A. (1999). Immersive virtual environment technology as a basic research tool in psychology. *Behavior Research Methods, Instruments, & Computers*, 31(4), 557-564. <https://doi.org/10.3758/BF03200735>
- Maarleveld, M., Volker, L., & Van der Voordt, T. (2009). Measuring employee satisfaction in new offices - the WODI toolkit. *Journal of Facilities Management*, 7(3), 181-197. <https://doi.org/10.1108/14725960910971469>
- Maher, A., & Von Hippel, C. (2005). Individual differences in employee reactions to open-plan offices. *Journal of Environmental Psychology*, 25(2), 219-229. <https://doi.org/10.1016/j.jenvp.2005.05.002>
- Mark, G., Gonzales, V., & Harris, J. (2005). No task left behind? Examining the nature of fragmented work. *Proceedings of CHI 2005*, 321-330. <https://doi.org/10.1145/1054972.1055017>
- Mathison, S. (1988). Why Triangulate? *Educational Researcher*, 17(2), 13-17. <https://doi.org/10.3102%2F0013189X017002013>
- McBain, W. (1961). Noise, the "arousal hypothesis", and monotonous work. *Journal of Applied Psychology*, 45(5), 309-317. <https://doi.org/10.1037/h0049015>
- McClelland, D., & Burnham, D. (1976). Power is the great motivator. *Harvard Business Review* (54), 100-110.
- McKechnie, G. (1977). The environmental response inventory in application. *Environment and Behavior*, 9(2), 255 - 276. <https://doi.org/10.1177/001391657792006>
- Mehrabian, A. (1995). Theory and evidence bearing on a scale of trait arousability. *Current Psychology*, 14(1), 3-28. <https://psycnet.apa.org/doi/10.1007/BF02686870>
- Morgeson, F. P., & Humphrey, S. E. (2006). The Work Design Questionnaire (WDQ): Developing and validating a comprehensive measure for assessing job design and the nature of work. *Journal of Applied Psychology*, 91(6), 1321-1339. <https://psycnet.apa.org/doi/10.1037/0021-9010.91.6.1321>
- Myerson, J., Bichard, J., & Erlich, A. (2010). *New demographics, new workspace: Office design for the changing workforce*. Gower Publishing Ltd.
- Nagy, M. S. (2002). Using a single-item approach to measure facet job satisfaction. *Journal of Occupational and Organizational Psychology*, 75(1), 77-86. <https://doi.org/10.1348/096317902167658>
- Newport, C. (2016). *Deep Work*. Grand Central Publishing.
- Oldham, G. (1988). Effects of changes in workspace partitions and spatial density: A quasi-experiment. *Journal of Applied Psychology*, 73(2), 253-258. <https://doi.org/10.1037/0021-9010.73.2.253>
- Oldham, G., & Fried, Y. (1987). Employee reactions to workspace characteristics. *Journal of Applied Psychology*, 72(1), 75-80. <https://psycnet.apa.org/doi/10.1037/0021-9010.72.1.75>
- Oseland, N. (2009). The impact of psychological needs on office design. *Journal of Corporate Real Estate*, 11(4), 244-254. <https://doi.org/10.1108/14630010911006738>
- Oseland, N., & Hodsman, P. (2018). A psychoacoustical approach to resolving office noise distraction. *Journal of Corporate Real Estate*, 20(4), 260-280. <https://doi.org/10.1108/JCRE-08-2017-0021>

- Oseland, N., & Webber, C. (2012). *Flexible working benefits*. Workplace Unlimited. <https://www.workplaceunlimited.com/2012%20WPU-OP-01%20Flexible%20Working%20Benefits.pdf>
- Pullen, W. (2014). Age, office type, job satisfaction and performance. *Work & Place* (September), 9-22. <http://workplaceinsight.net/wp-content/uploads/2014/08/Work+Place4mje.pdf>
- Qu, X., Zhang, X., Izato, T., Munemoto, J., & Matsushita, D. (2010). Behavior concerning choosing workstations in non-territorial offices. *Journal of Asian Architecture and Building Engineering*, 9(1), 95-102. <https://doi.org/10.3130/jaabe.9.95>
- R Core Team. (2015). *R: A language and environment for statistical computing*. R Foundation for Statistical Computing.
- Rashid, M., & Zimring, C. (2008). A review of the empirical literature on the relationships between indoor environment and stress in health care and office settings; Problems and prospects of sharing evidence. *Environment and Behavior*, 40(2), 151-190. <https://doi.org/10.1177%2F0013916507311550>
- Robinson, M. (2009). Work sampling: Methodological advances and new applications. *Human Factors and Ergonomics in Manufacturing & Service Industries*, 20(1), 42-60. <https://doi.org/10.1002/hfm.20186>
- Rolfö L., Jahncke H., Järnholm L. S., Öhrn M., & Babapour M. (2019) Predictors of preference for the activity-based flexible office. *Advances in Intelligent Systems and Computing*, 876, 547-553. https://doi.org/10.1007/978-3-030-02053-8_83
- Roskams, M., & Haynes, B. (2019). Employee-workplace alignment: Employee characteristics and perceived workplace requirements. *Facilities*, 38(3/4), 282-297. <https://doi.org/10.1108/F-09-2018-0105>
- Rothe, P. (2015). Flexibility and variety hold the key as employees' activity profiles become more complex. *Leesman Review* (18). <https://www.leesmanindex.com/wp-content/uploads/Leesman-Review-Issue-18.pdf>
- Rudolph, C. W., Allan, B., Clark, M., Hertel, G., Hirschi, A., Kunze, F., Shockley, K., Shoss, M., Sonnentag, S., & Zacher, H. (2020). Pandemics: Implications for research and practice in industrial and organizational psychology. *Industrial and Organizational Psychology: Perspectives on Science and Practice*. <https://doi.org/10.31234/osf.io/k8us2>
- Schwartz, G. (1978). Estimating the Dimension of a Model. *The Annals of Statistics*, 6(2), 461-464. <http://www.jstor.org/stable/2958889>
- Seddigh, A. (2015). Office type, performance and well-being; A study of how personality and work tasks interact with contemporary office environments and ways of working. PhD thesis, Stockholm University, Department of Psychology. <https://www.diva-portal.org/smash/get/diva2:840700/FULLTEXT02.pdf>
- Seddigh, A., Berntson, E., Bodin Danielson, C., & Westerlund, H. (2014). Concentration requirements modify the effect of office type on indicators of health and performance. *Journal of Environmental Psychology* (38), 167-174. <https://doi.org/10.1016/j.jenvp.2014.01.009>
- Seddigh, A., Berntson, E., Platts, L. G., & Westerlund, H. (2016). Does personality have a different impact on self-rated distraction, job satisfaction, and job performance in different office types?. *PLoS ONE*, 11(5), 1-14. <https://doi.org/10.1371/journal.pone.0155295>

- Shiffman, S., Stone, A., & Hufford, M. (2008). Ecological momentary assessment. *Annual Review of Clinical Psychology*, 4, 1-32. <https://doi.org/10.1146/annurev.clinpsy.3.022806.091415>
- Slijkhuis, J. M. (2012). A structured approach to need for structure at work. PhD thesis, University of Groningen. https://www.rug.nl/research/portal/files/10438897/Dissertatie_Marjetta_Slijkhuis_1.pdf
- Smith, J. (2015). Immersive virtual environment technology to supplement environmental perception, preference and behavior research: A review with applications. *International Journal of Environmental Research and Public Health*, 12(9), 11486-11505. <https://doi.org/10.3390/ijerph120911486>
- Soriano, A., Kozusznik, M. W., Peiró, J. M., & Mateo, C. (2020). The role of employees' work patterns and office type fit (and misfit) in the relationships between employee well-being and performance. *Environment and Behavior*, 52(2), 111-138. <https://doi.org/10.1177%2F0013916518794260>
- Staal, M.A. (2004). *Stress, cognition, and human performance: A literature review and conceptual framework*. NASA Ames Research Center. <https://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20060017835.pdf>
- Stone, P., & Luchetti, R. (1985). Your office is where you are. *Harvard Business Review*, 63(2), 102-117.
- Sundstrom, E., Burt, R., & Kamp, D. (1980). Privacy at work: Architectural correlates of job satisfaction and job performance. *Academy of Management Journal*, 23(1), 101-117. <https://doi.org/10.2307/255498>
- The Guardian (2020). *Facebook expects half of employees to work remotely over next five to 10 years*. <https://www.theguardian.com/technology/2020/may/21/facebook-coronavirus-remote-working-policy-extended-years>
- Thompson, M. M., Naccarato, M. E., Parker, K. C. H., & Moskowitz, G. B. (2001). The personal need for structure and personal fear of invalidity measures: Historical perspectives, current applications, and future directions. In: Moskowitz, G. B. (Ed.). *Cognitive social psychology: The Princeton symposium on the legacy and future of social cognition* (pp. 19-39). Lawrence Erlbaum.
- Totterdell, P. (2006). Longitudinal research/experience sampling technique. In G. Rogelberg (Ed.), *Encyclopedia of industrial and organizational psychology* (pp. 462-465). EBSCO Publishing / Sage Publications.
- Van Berkel, N., Goncalves, J., Hosio, S., Sarsenbayeva, Z., Velloso, E., & Kostakos, V. (2020). Overcoming compliance bias in self-report studies: A cross-study analysis. *International Journal of Human-Computer Studies*, 134, 1-12. <https://doi.org/10.1016/j.ijhcs.2019.10.003>
- Van den Berg, J., Appel-Meulenbroek, R., Kemperman, A., & Sotthewes, M. (2020). Knowledge workers' stated preferences for important characteristics of activity-based workspaces. *Building Research & Information*, 48(7), 1466-4321. <https://doi.org/10.1080/09613218.2020.1726169>
- Van den Broeck, A., Vansteenkiste, M., De Witte, H., Soenens, B., & Lens, W. (2010). Capturing autonomy, competence, and relatedness at work: Construction and initial validation of the work-related basic need satisfaction scale. *Journal of Occupational and Organizational Psychology*, 83(4), 981 - 1002. <https://doi.org/10.1348/096317909X481382>
- Van der Voordt, T. (2004). Productivity and employee satisfaction in flexible workplaces. *Journal of Corporate Real Estate*, 6(2), 133-148. <https://doi.org/10.1108/14630010410812306>
- Van der Voordt, T., & Van Meel, J. (2000). Lessons from innovations. In G. Dewulf, P. Krumm, & H. De Jonge (Eds.), *Successful Corporate Real Estate Strategies* (pp. 51-64). Arko Publishers

- Van Koetsveld, R., & Kamperman, L. (2011). How flexible workplace strategies can be made successful at the operational level. *Corporate Real Estate Journal*, 1(4), 303-319.
<https://www.veldhoencompany.com/wp-content/uploads/2016/11/How-flexible-strategies-can-be-made-on-operational-level.pdf>
- Van Meel, J. (2011). The origins of new ways of working; Office concepts in the 1970s. *Facilities*, 29(9/10), 357-367. <http://dx.doi.org/10.1108/02632771111146297>
- Van Meel, J. (2015). *Workplaces today*. ICOP / Center for Facilities Management.
- Van Meel, J. (2019). *Activity-based working; The Purennet practice guide*. Purennet. http://www.purennet.org/images/Annual_Conference_2019/ABW_practice_guide_public.pdf
- Van Veldhoven, M., & Van Gelder, M. (2020). *Ervaringen met thuiswerken tijdens COVID-19: Europees vragenlijstonderzoek onder 5000 kenniswerkers gedurende de eerste weken van de lockdown*. Tilburg University / Veldhoen + Company.
https://www.researchgate.net/publication/342010967_Ervaringen_met_thuiswerken_tijdens_COVID-19_Europees_vragenlijstonderzoek_under_5000_kenniswerkers_gedurende_de_eerste_weken_van_de_lockdown_-_Rapportage_Nederland
- Van Yperen, N. W., Rietzschel, E. F., & De Jonge, K. M. M. (2014). Blended working: For whom it may (not) work. *PLOS ONE*, 9(7), 1-8. <https://doi.org/10.1371/journal.pone.0102921>
- Van Yperen, N. W., & Wörtler, B. (2017). Blended working. In G. Hertel, D. Stone, R. Johnson, & J. Passmore (Eds.), *The Wiley-Blackwell handbook of the psychology of the internet at work* (pp. 157-174). Wiley-Blackwell.
- Veitch, J. A., Charles, K. E., Farley, K. M. J., & Newsham, G. R. (2007). A model of satisfaction with open-plan office conditions: COPE field findings. *Journal of Environmental Psychology*, 27(3), 177-189.
<https://doi.org/10.1016/j.jenvp.2007.04.002>
- Veldhoen, E. (2005). *The art of working*. Academic Service.
- Veldhoen + Company (2020). *Activity based working: A research on measurable outcomes and key differentiators*. <https://www.veldhoencompany.com/en/impact-of-activity-based-working-white-paper-download/>
- Vischer, J. C. (2007). The effects of the physical environment on job performance: Towards a theoretical model of workplace stress. *Stress and Health*, 23(3), 175-184. <https://doi.org/10.1002/smi.1134>
- Volker, L., & Van der Voordt, T. (2005). An integral tool for the diagnostic evaluation of non-territorial offices. *Designing Social Innovation, Planning, Building, Evaluating*, 241-250.
http://pure.tudelft.nl/ws/portalfiles/portal/39307596/2005_Designing_Social_Innovation_Volker_Van_derVoordt_IntegralTool_NonterritorialOffices.pdf
- Vos, P., & Van der Voordt, T. (2001). Tomorrow's offices through today's eyes; Effects of office innovation in working environments. *Journal of Corporate Real Estate*, 4(1), 48-65.
<https://doi.org/10.1108/14630010210811778>
- Wanous, J., Reichers, A., & Hurdy, M. (1997). Overall job satisfaction: How good are single-item measures? *Journal of Applied Psychology*, 82(2), 247-252. <https://doi.org/10.1037//0021-9010.82.2.247>

- Weiss, H. M., & Cropanzano, R. (1996). Affective events theory: A theoretical discussion of the structure, causes, and consequences of affective experiences at work. In B. M. Staw & L. L. Cummings (Eds.), *Research in organizational behavior* (18, pp. 1–74). JAI Press.
- Wells, M. (2000). Office clutter or meaningful personal displays: The role of office personalization on employee and organizational well-being. *Journal of Environmental Psychology*, 20(3), 239–255. <https://doi.org/10.1006/jevp.1999.0166>
- Wessels, C., Schippers, M. C., Stegmann, Bakker, A. B., Van Baalen, P. J., & Proper, K. I. (2019). Fostering flexibility in the new world of work: A model of time-spatial job crafting. *Frontiers in Psychology*, 10(505), 1–13. <https://doi.org/10.3389/fpsyg.2019.00505>
- Wohlers, C., Hartner-Tiefenthaler, M., & Hertel, G. (2019). The relation between activity-based work environments and office workers' job attitudes and vitality. *Environment and Behavior*, 51(2), 167–198. <https://doi.org/10.1177/0013916517738078>
- Wohlers, C., & Hertel, G. (2017). Choosing where to work at work: Towards a theoretical model of benefits and risks of activity-based flexible offices. *Ergonomics*, 60(4), 467–486. <https://doi.org/10.1080/00140139.2016.1188220>
- Wohlers, C., & Hertel, G. (2018). Longitudinaleffects of activity-based flexible office design on teamwork. *Frontiers in Psychology*, 9(2016). <https://doi.org/10.3389/fpsyg.2018.02016>
- Yerkes, R. M., & Dodson, J. D. (1908). The relationship of strength of stimulus to rapidity of habit formation. *Journal of Comparative Neurology and Psychology*, 18(5), 459–482. <https://doi.org/10.1002/cne.920180503>
- Yoon, H. (2013). Performance of office workers under office sounds and various enclosure conditions in open workplaces. *Architectural Research*, 15(1), 9–15. <https://doi.org/10.5659/AIKAR.2013.15.1.9>
- Zajonc, R. B. (1965). Social facilitation. *Science*, 149(3681), 269–274. www.jstor.org/stable/1715944
- Zamani, Z., & Gum, D. (2019). Exploring the fit between physical environment qualities and user needs impacting satisfaction, communication, collaboration and productivity. *Journal of Corporate Real Estate*, 21(3), 234–253. <https://doi.org/10.1108/JCRE-08-2018-0028>
- Zumbrun, J. (2016). The rise of knowledge workers is accelerating despite the threat of automation. *The Wall Street Journal*, May 4. <https://blogs.wsj.com/economics/2016/05/04/the-rise-of-knowledge-workers-is-accelerating-despite-the-threat-of-automation/>

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Dan zijn er mensen die op verschillende manieren hebben meegewerkt aan het onderzoek. Voor de prettige samenwerking bij het schrijven van eerste en het tweede artikel wil ik respectievelijk Iris de Been en Anja Ernst hartelijk bedanken. Top was ook de samenwerking met Vincent le Noble en zijn collega's van Measuremen bij het ontwikkelen van de experience sampling app. Alle contactpersonen en onderzoeksdeelnemers van de organisaties waar ik data mocht verzamelen, ben ik zeer dankbaar voor hun medewerking. Dat geldt ook voor Wim Pullen en Theo van der Voordt, die zorgden dat ik de database van het Center for People and Buildings kon gebruiken voor het eerste artikel. Voor de lab studie heb ik dankbaar gebruik gemaakt van de VR studio van de RuG, met onmisbare ondersteuning van het team van Frans van Hoesel en student-assistenten Daniël Koning, Aniek Elliot en Simone Doornbos, plus de medewerking van een volledige lichting eerstejaars FM studenten van de Hanzehogeschool (cohort 2016/2017). Bedankt allemaal!

In de geest van ABW heb ik op verschillende plekken aan het promotieonderzoek gewerkt. Op elk van die plekken vond ik steun en inspiratie waar ik de betrokkenen graag voor wil bedanken. Het grootste deel van het concentratiewerk voerde ik thuis in Groningen uit. Daar leefden Renate, Jaco en Robbe altijd mee als ik weer eens tevreden of juist teleurgesteld was over de feedback van een reviewer of een begeleider. En ze lieten me met rust als er weer eens iets 'af moest'. Soms trok ik me terug in ons vakantiehuisje in Lauwersoog, de boel in Groningen de boel latend... Een enkele keer ben ik uitgeweken naar een andere concentratieplek, zoals een zolderkamer bij Het Paleis. In het Heymansgebouw van de RuG kon ik enige tijd beschikken over een heuse eigen werkplek (!).

Gelukkig bleek het promotietraject niet alleen een kwestie te zijn van eenzaam buffelen aan een bureau; sociale interactie was minstens zo belangrijk. Bij het Instituut voor Bedrijfskunde en het Kenniscentrum NoorderRuimte van de Hanzehogeschool werkte ik zelden direct aan het onderzoek, maar ik trof er wel vaak geïnteresseerde collega's en mede promovendi, die me stimuleerden om door te gaan. Dat geldt zeker ook voor de collega's van de kenniskring van het lectoraat Facility Management. Bij de onderzoeksgroep Organisatiepsychologie van de RuG voelde ik me, als buiten-promovendus, altijd welkom, ook tijdens de lab meetings waar ik veel leerde van ervaren onderzoekers en andere promovendi.

Tot slot waren er diverse plekken – van Groningen tot Delft en van Tampere tot Glasgow – waar ik vele 'vakbroeders en -zusters' heb ontmoet tijdens congressen en andere bijeenkomsten. Die contacten versterkten mijn gevoel dat kennisontwikkeling een continue, gezamenlijke opgave is, waar we allemaal – vanuit verschillende achtergronden en invalshoeken – steentjes aan bijdragen. Ik haalde er veel inspiratie uit en het heeft me geholpen om te blijven focussen op vragen die relevant zijn in de praktijk. Laten we samen blijven werken aan betere werkomgevingen!

About the author

Throughout his professional career, Jan Gerard Hoendervanger (1968) has been focusing on work environments for new ways of working. In the 1990s, when 'office innovation' started in Dutch practice, he got involved as a management consultant. Later, he switched to education and research at the Hanze University of Applied Sciences. Alongside courses and projects in the fields of Corporate Real Estate Management and Healthy Workplace, he worked on his PhD research. Currently, Jan Gerard is working as an independent workplace strategist, helping organizations to put research insights into practice while preparing for the post- COVID-19 world of work.

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