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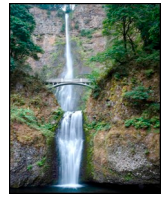
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The effects of moving into an activity-based office on communication, social relations and work demands – A controlled intervention with repeated follow-up



Annu Haapakangas^{a,b,*}, David M. Hallman^a, Svend Erik Mathiassen^a, Helena Jahncke^a

^a Centre for Musculoskeletal Research, Department of Occupational and Public Health Sciences, University of Gävle, SE-801 76, Gävle, Sweden

^b Turku University of Applied Sciences, Faculty of Health and Well-being, Joukahaisenkatu 3, FI-20520, Turku, Finland

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ABSTRACT

When organizations adopt activity-based workplaces (ABWs), improved interaction is a common goal. Yet, few controlled longitudinal studies have been conducted on the effects of ABWs on interaction, social relations and work demands. The aim of this natural intervention study was to investigate the effects of moving into an ABW on satisfaction with communication, on social relations (i.e., social support and social community) and on work demands (i.e., quantitative demands, emotional demands and work pace) 3 months and 12 months after the relocation. The study included four offices which relocated into an ABW and one control office that did not. Questionnaire data from 408 respondents were analyzed with linear mixed models. Satisfaction with communication and the sense of belonging to a community had decreased 3 and 12 months after the relocation. Work pace was not affected while small, mostly short-term, negative effects on social support, quantitative demands and emotional demands were only observed among employees who had moved to ABWs from private offices. Differences between office sites were also observed. The results suggest that, to avoid negative outcomes, organizations moving to ABWs should focus on solving difficulties in locating colleagues at the office and on supporting particularly workers from private offices in adopting activity-based working.

1. Introduction

Office design is shaped by the emergence of new technologies, business needs, management theories and conceptions about the nature of work (Danielsson, 2005; Davis, Leach, & Clegg, 2011). In today's society, the emergence of activity-based workplace (ABW) designs reflects the growth in knowledge work which, due to technological development, has become increasingly flexible in terms of when and where work is performed (Blok, Groenesteijn, Schelvis, & Vink, 2012; Harris, 2016). The key idea in ABWs is to provide various work spaces adapted to different tasks contained in knowledge work, such as different forms of collaboration, tasks requiring high concentration, phone calls, and routine work. The employees are supposed to select among these spaces based on their activities and needs (Appel-Meulenbroek, Groenen, & Janssen, 2011). Hence, there are no dedicated desks in ABWs. ABWs are generally expected to promote knowledge-sharing and collaboration (van Koetsveld & Kamperman, 2011) which are considered key factors for organizational productivity in knowledge work

(Sveiby & Simons, 2002).

Surprisingly, the scientific evidence concerning the claimed positive effects of ABWs on communication is not particularly strong. The main reason for this is the lack of high-quality studies. For example, a systematic literature review by Engelen et al. (2018) found support for the positive effects of ABWs, but their conclusion was largely based on cross-sectional and descriptive studies, many of which lacked comparisons with other office types. Furthermore, several of the cross-sectional studies which have found ABWs superior to other office types in regard to interaction or collaboration (e.g., Bodin Danielsson and Bodin 2009; Candido et al., 2016; Kim, Candido, Thomas, & de Dear, 2016) have compared office types in terms of how much communication is *perceived to be supported* by the office design. In effect, these studies only show that employees in ABWs, more than employees in private or open-plan offices, tend to perceive that their office spaces support interaction. These are subjective assessments of the effects of ABWs and they do not measure whether the perceived amount or quality of communication actually differs between these office types. In fact, differences between

* Corresponding author. Turku University of Applied Sciences, Faculty of Health and Well-being, Joukahaisenkatu 3, FI-20520, Turku, Finland.

E-mail addresses: annu.haapakangas@turkuamk.fi (A. Haapakangas), david.hallman@hig.se (D.M. Hallman), svenderik.mathiassen@hig.se (S.E. Mathiassen), helena.jahncke@hig.se (H. Jahncke).

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ABWs and office rooms have not been observed when employees have been asked about general satisfaction with communication (De Been & Beijer, 2014) and quality of cooperation (Danielsson & Bodin, 2008), without linking these experiences to the perception of office spaces.

Longitudinal studies of the effects of moving to ABWs from other office types are better suited for answering the question about the effects of ABWs on communication. They are, however, rare. Some studies comparing communication or social relations before and after a relocation to an ABW have observed improvements (Blok, de Korte, Groenesteijn, Formanoy, & Vink, 2009; Gerdenitsch et al., 2018; Robertson, Huang, O'Neill, & Schleifer, 2008), while Arundell et al. (2018) did not find any changes, and Blok et al. (2012) and Berthelsen, Muhonen, and Toivanen (2018) observed negative effects. To our knowledge, only two studies have included a control group that did not move to an ABW (Arundell et al., 2018; Robertson et al., 2008) which is needed to attribute any observed effect to the office change *per se* with more certainty.

In addition, previous relocation studies have not considered whether the effects of the ABW differ depending on the previous office type. Most relocation studies on communication concern employees who have moved to an ABW from open-plan offices (Arundell, personal communication; Arundell et al., 2018; Blok et al., 2009, 2012; Robertson et al., 2008). However, satisfaction with different factors in the physical office environment is typically higher in private offices compared with shared or open-plan offices (Bodin Danielsson and Bodin, 2009; Kim & de Dear, 2013). Thus, it may be important to distinguish whether a relocation to an ABW affects employees differently, depending on whether they move from private offices or from some type of shared offices.

Moving into an ABW can be expected to have different short-term and long-term consequences (Wohlert & Hertel, 2017). Habituating to an environmental change and adopting new ways of working is a process which takes time and develops differently between individuals (Babapour, Karlsson, & Osvalder, 2018; Blok et al., 2012). Such a transition is a potential source of stress which could manifest itself, for example, as an increase in perceived work demands (cf. Demerouti, Bakker, Nachreiner, & Schaufeli, 2001). Changes with time in the effects of office relocations have not received much attention in the literature. Still, it could be expected that a possible initial negative effect of relocation may decline over time as the employees accommodate to their new office. Better accommodation with time was observed by Meijer, Frings-Dresen, and Sluiter (2009), reporting that work performance was impaired 6 months after an ABW implementation while, at the 15-month follow-up, the situation had normalized and even improved compared with that before the move. Among longitudinal studies on communication in ABWs, only Gerdenitsch et al. (2018) and Robertson et al. (2008) had two follow-up measurements, showing that improvements in communication remained stable between the first and second follow-up. However, the follow-up periods only extended over six (Robertson et al., 2008) and eight months (Gerdenitsch et al., 2018).

The aim of this study among office workers from a large Swedish government agency is to investigate the effects of moving into an ABW on satisfaction with communication, on social relations (i.e., social support and social community) and on work demands (i.e., quantitative demands, emotional demands, and work pace) 3 months and 12 months after the relocation. The study is a controlled natural intervention, including four office sites which relocated into an ABW and a control office site where no relocation took place.

The following research questions were addressed:

RQ1. Among office employees, to what extent does moving into an ABW (i.e., an office relocation) affect satisfaction with communication, social relations and work demands compared with a control group who does not move?

RQ2. To what extent are the effects of an office relocation stable from 3 to 12 months follow-up?

RQ3. To what extent do the effects of an office relocation depend on the baseline office type (private offices vs shared/open-plan offices)?

Based on previous literature, we expect that moving into an ABW will affect satisfaction with communication, social relations and work demands, but that the effects may differ depending on follow-up time and the baseline office type.

2. Methods

2.1. Design

This study followed a natural intervention in a large Swedish Government agency (i.e. the Swedish Transport Administration), including four office sites at different geographical locations. A controlled trial design was applied, including an intervention group (four offices, A to D) moving from traditional offices (private offices, shared rooms of 2–3 employees, and open-plan offices) to an ABW, and a control group (one office, E) that did not move. Random allocation of participants was not feasible. Data were collected between May 2015 and January 2017, at three time points: (i) prior to relocating to new offices (baseline), (ii) three months after the relocation, and (iii) 12 months after the relocation.

The intervention was planned, initiated and implemented by the organization without interference from the researchers. The control group worked at their traditional offices (private, shared and open-plan offices) throughout the study period. However, between the 3-month and 12-month follow-ups, the organization informed the control group that they might also be moving to an ABW in the near future. The study was approved by the Regional Ethical Review Board in Uppsala, Sweden (Dnr.2015/118) and all respondents provided their written informed consent prior to participation.

2.2. Offices

At Offices A and D all employees were included in the study; at Office C employees from one department were included (the only one moving to an ABW); and at Office B workers from only one floor out of six were included as baseline data could not be collected on the other floors. Offices A and D were relocated to another building while Offices B and C were re-designed and renovated as ABWs.

At baseline, most employees worked in private offices (Table 1). The

Table 1
The number of included employees in different waves of the data collection, and descriptive data for the study population at baseline.

	Total	Intervention group	Control group
N			
Baseline	408	284	124
3 months	369	252	117
12 months	331	235	96
Baseline population			
Women, %	42.6	42.6	42.7
Age (years), mean (SD)	47.8 (9.3)	47.5 (9.6)	48.5 (8.6)
Education, %			
Public school	2.2	1.9	3.2
High school	25.5	23.9	29.0
Vocational	10.5	10.9	9.7
University	61.8	63.4	58.1
Managerial position, %	15.9	16.9	13.7
Full-time employment, %	90.2	89.1	92.7
Office type, %			
Private office	62.1	58.8	70.2
Shared room	8.4	2.5	21.8
Open-plan office	27.4	36.2	6.5
Other	2.2	2.5	1.6

open-plan offices, where each employee had their own desk, varied somewhat in size and workstation design both within and between offices sites (for examples, see Supplementary material 1). However, a typical workstation had partial-height partitions (screens or cabinets) on one or two sides of the workstation.

The four ABWs differed in size and spatial design (see details in Supplementary material 2). The total area of the ABWs ranged from 775 to 14,714 m², and the calculated area per employee ranged from 12 to 22 m². The ABWs included large open-plan rooms accommodating 24 workers or more, quiet rooms/zones, project rooms, touchdown tables, conversation rooms, meeting rooms, web-meeting rooms, conference rooms, and a lounge area. Some ABWs also included single rooms for phone calls and prioritized workstations in open-plan or private rooms giving priority to employees with special needs. Photographs illustrating the different office sites, including the control office, are provided in Supplementary material 1 and may also be found in another publication addressing the ABWs (Haapakangas, Hallman, Mathiasen, & Jahncke, 2018).

2.3. Participants

At baseline, 901 employees were approached with a web-based questionnaire (Fig. 1) which measured various factors of the physical and psychosocial work environment, well-being, and productivity. At the first follow-up 3 months after the relocation, the same questionnaire was sent again to those employees responding to the baseline questionnaire ($n = 493$). The second follow-up questionnaire was sent to all employees working in ABWs 12 months after the relocation as well as to the control group (in total $n = 803$). Baseline response rates were 53%, 56%, 75%, 60%, and 65% at Offices A, B, C, D and E, respectively; 3-

month follow-up rates were 85% (A), 84% (B), and 88% (C, D and E); and 12-months response rates were 60% (A), 64% (B), 76% (C), 66% (D), and 62% (E). Descriptive information for the study population is shown in Table 1.

The criterion for including employees in the study population was employment at any of five selected office sites. Exclusion criteria were sick leave, maternal leave, not moving to the ABW (for the intervention groups), reporting in advance that a major job change or retirement would take place during the study period, and having a priority desk in a private room at the ABW. Furthermore, employees were only included in the study if they had responded to the baseline questionnaire and at least one of the follow-up questionnaires (Fig. 1).

2.4. Measures

Satisfaction with communication was rated on a 7-point scale (1: Very dissatisfied, 7: Very satisfied) using three items from Haapakangas, Hallman, et al. (2018). The items concerned information exchange and oral communication with the closest colleagues, including work-related and social interaction, and the possibilities to contact colleagues quickly face-to-face or over the phone for short matters. Answers to these items were averaged to form a scale with Cronbach's alphas of 0.85–0.87 across different time points.

Social support from colleagues and *social community at work* were measured using the 3-item indices in the middle-length questionnaire of the second version of the Copenhagen Psychosocial Questionnaire (COPSOQ II; Pejtersen, Kristensen, Borg, & Bjorner, 2010) translated into Swedish (Berthelsen, Westerlund, & Søndergård Kristensen, 2014).

Work demands were assessed using 2-item indices from the short COPSOQ II (Berthelsen et al., 2014; Pejtersen et al., 2010) for

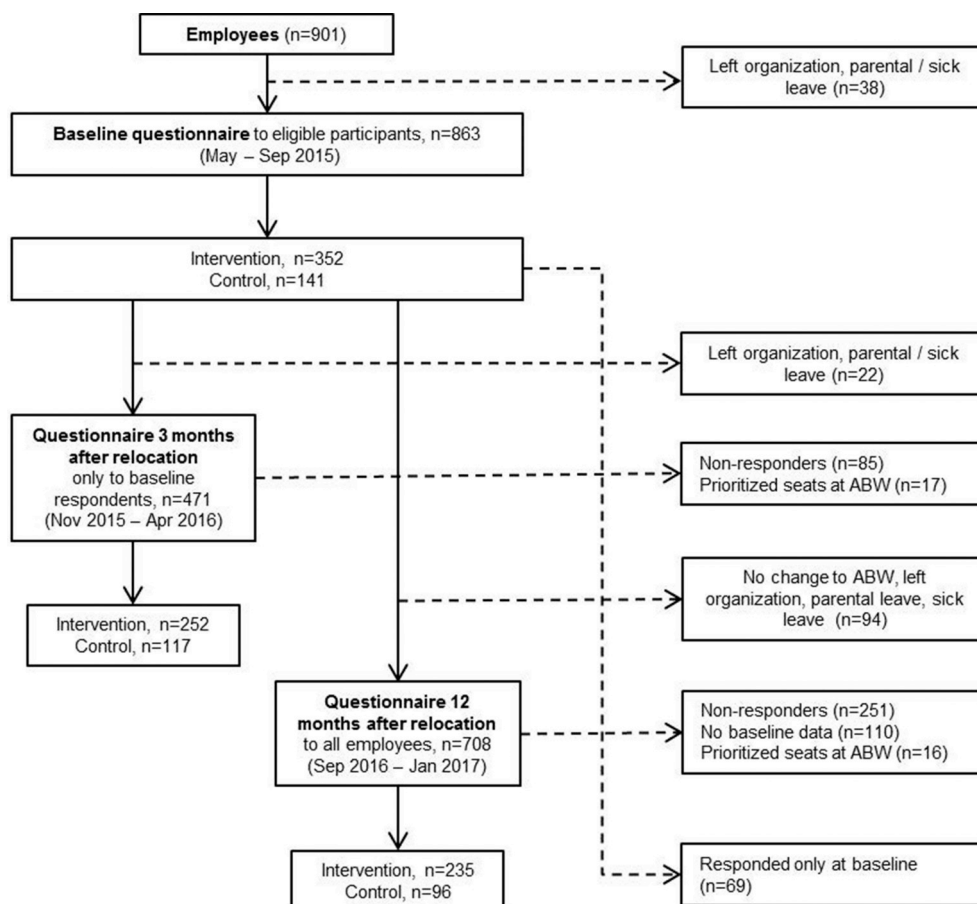


Fig. 1. Participant flow and inclusion in this study.

quantitative demands, emotional demands and work pace. All COPSOQ II questions were assessed on a 5-point scale (0: Never, 4: Always) and averages across items were calculated for each dimension. The individual items included in each index are reported in Supplementary material 3.

2.5. Statistical methods

Statistical analyses were conducted using IBM SPSS Statistics 24 (Armonk, NY: IBM Corp). Baseline differences between the intervention and control groups were determined using t-tests for continuous variables and χ^2 tests for proportions. Effects of the relocation on outcomes were determined using linear mixed models. The models for RQ1 (the effects of intervention) and RQ2 (time-dependent differences) were constructed with *group* (two levels: intervention, control), *time* (three levels: baseline as reference, 3 months, 12 months), and their interaction (*group* \times *time*) as fixed factors. The models for RQ3 (effects of baseline office type) were constructed with the intervention group divided by baseline office type, and included *group* (three levels: private office at baseline, shared/open-plan office at baseline, control group), *time* (three levels: baseline as reference, 3 months, 12 months) and their interaction (*group* \times *time*) as fixed factors. More detailed analyses were conducted to check the extent to which effects differed between four intervention office sites, and to check whether individual questionnaire items within indices gave different results. Worker and intercept were included in all models as random factors while time was included as a fixed factor. A random effect was not included as it did not improve model fit. A first-order autoregressive (AR1) covariance structure with homogenous variances was applied to account for correlations between repeated measurements. For each model, estimates (B) of the interaction effect were determined with 95% confidence intervals (CI). The level of statistical significance was set at 0.05.

3. Results

Of the 863 employees receiving the initial questionnaire, 408 provided valid data at baseline and were included in the statistical analyses (Fig. 1). Among employees included in the final data set, the dropout rate was 9.6% at the 3-month follow-up and 18.9% at the 12-month follow-up, compared with baseline. Two hundred ninety-two employees participated in all three waves.

The intervention and control groups did not differ in demographic characteristics at baseline, except for the proportions of employees in different office types ($p < 0.001$; Table 1). No baseline differences were observed in the outcome variables between the intervention and control groups.

Employees dropping out did not differ from those included in the analyses on most demographic characteristics. However, employees dropping out at the 3-month follow-up had a slightly lower education level and employees dropping out at 12 months were younger than the general study population.

3.1. Overall and time-dependent effects of office relocation (RQ1, RQ2)

Estimates of the effect of office relocation (*group* \times *time* interaction) on the outcomes are presented in Table 2. Satisfaction with communication had clearly decreased 3 months and 12 months after relocation in the intervention group, compared with the control group. Social support showed a small decrease at 3 months while a similar-size decrease in social community was not statistically significant. At 12 months, social support no longer differed from the baseline and the decrease in social community was still small and statistically non-significant.

Quantitative and emotional demands had increased 3 months after the office relocation, although the effects appeared small. Emotional demands remained increased at 12 months while the increase in

quantitative demands had become smaller and statistically non-significant. Work pace did not change in the intervention group compared with the controls.

3.2. Baseline office type

Most intervention effects differed depending on the baseline office type (Table 2, Fig. 2). Satisfaction with communication generally decreased in the intervention group at the 3-month follow-up, but the effect was stronger among employees moving from private offices. These employees also continued to be less satisfied with communication 12 months after relocation, while the decrease in satisfaction with communication was no longer statistically significant for employees from shared and open-plan offices. We found small negative effects on social support, quantitative demands and emotional demands among employees moving from private offices at the 3-month follow-up, and on social community, quantitative demands and emotional demands at the 12-month follow-up. We did not observe such effects among employees moving from shared or open-plan offices. As in the main analyses, work pace was not affected by the intervention.

3.3. Detailed analyses of office sites and individual items

Site-specific effects were found among four intervention offices. As the number of employees differed considerably between offices, site-specific effects were compared in terms of effect sizes, relying less on p -values. Satisfaction with communication had decreased compared with the control group at three out of four office sites 3 months after the relocation (range in estimates of B -0.81 to -1.45 ; all $p < 0.001$) and 12 months after the relocation (B -estimates -0.61 to -0.99 ; all $p < 0.001$). Office C was not affected (3 months: $B = -0.08$, $p = 0.77$; 12 months: $B = -0.03$, $p = 0.92$). For the other outcomes, negative effects at the 3-month follow-up mostly occurred at two sites (Offices A and D), as suggested by the estimates of B from -0.12 to -0.20 for social relations, and the estimates of 0.17 – 0.27 for quantitative and emotional demands. A similar estimate ($B = -0.16$) was also observed for social community at Office B, making Office C the only site where social community was not affected at the 3-month follow-up. At the 12-months follow-up, emotional demands were still increased at Office D ($B = 0.31$).

Analyses of individual items within the indices provided additional information on some of the observed effects. For satisfaction with communication, all items of the index decreased 3 and 12 months after the relocation among employees moving from private offices (range in B -estimates -0.94 to -1.39 ; all $p < 0.001$). Among employees from open-plan offices, work-related information exchange had decreased at 3 months ($B = -0.49$, 95% CI $[-0.89; -0.09]$, $p = 0.015$) whereas satisfaction with possibilities to contact colleagues quickly had decreased both 3 months ($B = -0.59$, 95% CI $[-1.02; -0.16]$, $p = 0.007$) and 12 months ($B = -0.67$, 95% CI $[-1.17; -0.16]$, $p = 0.01$) after the relocation. Satisfaction with oral communication in general was not affected among employees from open-plan offices. For the social community index, the feeling of belonging to a community had decreased regardless of the baseline office type 3 months after the relocation (private offices: $B = -0.36$, 95% CI $[-0.59; -0.14]$, $p = 0.001$; shared/open-plan offices: $B = -0.26$, 95% CI $[-0.51; -0.01]$, $p = 0.039$). After 12 months, the average decrease was of a similar size, but was statistically significant only for employees from private offices (private offices: $B = -0.44$, 95% CI $[-0.70; -0.19]$, $p = 0.001$; shared/open-plan offices: $B = -0.23$, 95% CI $[-0.52; 0.04]$, $p = 0.11$). The other items within social community, measuring good co-operation and atmosphere, were not affected by the relocation. The analyses for other indices (social support, quantitative demands, emotional demands and work pace) did not reveal any clear differences between individual items.

Table 2

Effects of relocation to ABWs on communication, social relations and work demands 3 and 12 months after the relocation, compared with baseline. Effects (B) compared with those in the control group are shown for the whole intervention group as well as for the baseline office type. Unstandardized estimates with 95% confidence intervals (CI) and p-values are shown.

Outcome	3-month follow-up				12-month follow-up			
	B	95% CI		p	B	95% CI		p
		Lower	Upper			Lower	Upper	
Satisfaction with communication								
Whole intervention group	−0.94	−1.23	−0.66	< 0.001	−0.77	−1.13	−0.41	< 0.001
Private offices	−1.28	−1.60	−0.97	< 0.001	−1.13	−1.52	−0.74	< 0.001
Shared/open-plan offices	−0.41	−0.75	−0.06	0.021	−0.28	−0.70	0.15	0.21
Social support								
Whole intervention group	−0.15	−0.29	−0.02	0.030	0.02	−0.14	0.17	0.82
Private offices	−0.16	−0.31	−0.01	0.040	0.01	−0.17	0.18	0.93
Shared/open-plan offices	−0.14	−0.31	0.03	0.095	0.01	−0.18	0.20	0.89
Social community								
Whole intervention group	−0.12	−0.25	0.01	0.075	−0.10	−0.26	0.05	0.19
Private offices	−0.14	−0.29	0.00	0.057	−0.17	−0.34	0.00	0.050
Shared/open-plan offices	−0.10	−0.26	0.06	0.22	−0.03	−0.21	0.16	0.79
Quantitative demands								
Whole intervention group	0.19	0.05	0.34	0.010	0.13	−0.05	0.31	0.17
Private offices	0.32	0.16	0.48	< 0.001	0.20	0.01	0.40	0.042
Shared/open-plan offices	0.03	−0.14	0.21	0.70	0.03	−0.18	0.25	0.76
Emotional demands								
Whole intervention group	0.18	0.03	0.33	0.020	0.20	0.03	0.37	0.020
Private offices	0.24	0.07	0.40	0.006	0.29	0.11	0.48	0.002
Shared/open-plan offices	0.09	−0.10	0.27	0.37	0.06	−0.14	0.27	0.53
Work pace								
Whole intervention group	0.04	−0.08	0.17	0.50	−0.01	−0.16	0.14	0.89
Private offices	0.06	−0.08	0.19	0.43	−0.05	−0.21	0.11	0.57
Shared/open-plan offices	0.01	−0.14	0.17	0.86	0.02	−0.16	0.20	0.84

4. Discussion

This study examined the effects of moving into an ABW on satisfaction with communication, on social relations and on work demands 3 and 12 months after the relocation. The study is one of few controlled field studies to this date on the effects of ABWs on communication (Arundell et al., 2018; Robertson et al., 2008), and the first to consider the influence of baseline office type. The results suggested that moving into an ABW had negative effects particularly on satisfaction with communication, but also on social relations, quantitative demands and emotional demands (RQ1). Work pace was not affected. Most of the negative effects were short-term, but satisfaction with communication and emotional demands remained impaired 12 months after the relocation (RQ2). The effects depended on the baseline office type as most of the negative findings only concerned employees moving from private offices (RQ3). These employees also experienced small, mostly short-term, impairments in quantitative and emotional demands and social support. Negative effects on satisfaction with communication were observed at three out of four offices while other negative effects only occurred at half of the office sites. Overall, the results contradict the claimed benefits of adopting an ABW on communication (van Koetsveld & Kamperman, 2011), and demonstrate that the effects of relocations are not universal, but depend on follow-up time and preceding office type and differ between individual offices.

The long-term deterioration of satisfaction with communication at the ABW was the most pronounced result of our study (Table 2, Fig. 2). This effect was observed at three out of four office sites, suggesting that it did not result from conditions specific to any single office. The result clearly contradicts the conclusions about positive effects made in the systematic literature review by Engelen et al. (2018), as well as the positive findings of several individual studies (Bodin Danielsson and Bodin 2009; Candido et al., 2016; Kim et al., 2016; Blok et al., 2009; Gerdenitsch et al., 2018; Robertson et al., 2008). Compared with other longitudinal studies including a control group, our findings contradict both Arundell et al. (2018), observing no effects, and Robertson et al. (2008), reporting improvements in communication. However, similar findings on social relations have been reported by Berthelsen et al.

(2018) who, unlike other relocation studies on communication, studied a population mainly comprising employees who moved to an ABW from private offices.

The disagreements with previous studies may be partly explained by methodological differences. Positive results regarding communication in ABWs appear more common when employees are explicitly asked how well the office design supports interaction or collaboration (e.g., Bodin Danielsson and Bodin 2009; Candido et al., 2016; Kim et al., 2016; Robertson et al., 2008). We used general questions about communication and social relations without linking them to the perception of office spaces (see Section 2.4). Such questions have resulted in fewer differences between office types in cross-sectional comparisons (e.g., De Been & Beijer, 2014; Danielsson & Bodin, 2008). Due to the type of questions that we used and the controlled study design, we claim that our evidence on the effects of ABWs on communication is stronger than conclusions based on the subjective assessments of environmental effects in some other studies.

Another methodological strength of our study was the attention to the office type preceding the relocation to an ABW. This issue has not been addressed in previous relocation studies on communication. Our results suggest that employees working in private offices are more likely to have negative short- and long-term reactions to moving to an ABW than employees coming from shared or open-plan offices in terms of perceived communication, social relations and work demands. The issue of whether the reactions to ABWs depend on which office type ABWs are compared with was not considered in the systematic literature review by Engelen et al. (2018). Thus, their conclusions on the positive effects of ABWs on interaction may not be valid irrespective of the preceding office type. The possibility that effects of moving to ABWs depend on the preceding office type should also be considered in future relocation studies on other outcomes, such as well-being and productivity.

Considering that ABWs are intended to foster interaction, our findings on decreased satisfaction with communication may be surprising. In our study, difficulties in finding colleagues appeared to be a common denominator for the perceived problems in exchanging information, being able to contact colleagues quickly, and feeling part of

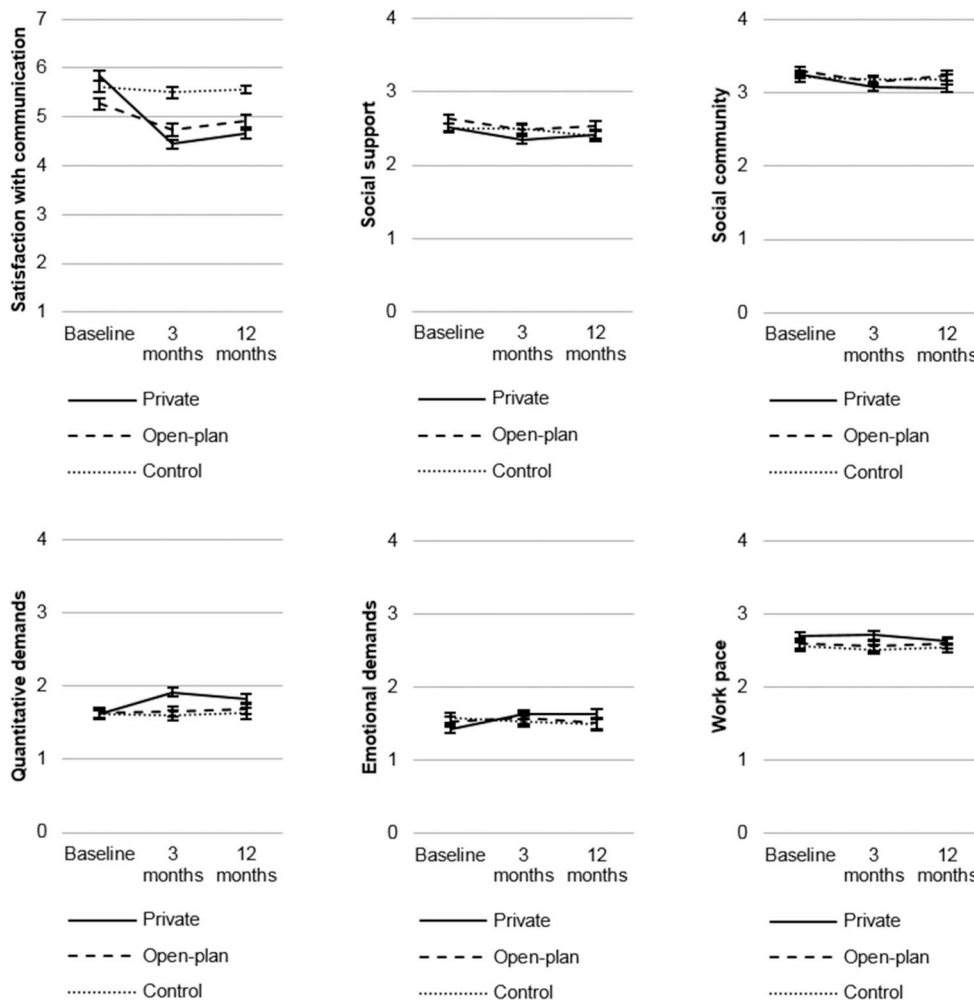


Fig. 2. Estimated marginal means with standard errors for the effects of office relocation in relation to the baseline office type and control group. Shared offices were included in the same category with open-plan offices.

a community. This difficulty is a common complaint in non-territorial office environments (e.g., Arundell et al., 2018; Kim et al., 2016; van der Voordt, 2004) and has been associated with decreased team identification (Millward, Haslam, & Postmes, 2007). The theoretical model of ABWs described by Wohlers and Hertel (2017) suggests that ABWs decrease intra-team communication due to less visibility and proximity to team members, leading to less access to them and fewer unplanned encounters. Our results fit well with this proposition since our questions focused on communication with the closest colleagues. ABWs may, however, be more effective in creating opportunities to interact with non-team colleagues than with team members (Gerdenitsch et al., 2018; Wohlers & Hertel, 2017).

However, difficulties in finding colleagues may not sufficiently explain the negative effects on communication and social relations among employees previously working in private offices. Decreased privacy in the ABWs is one possible explanation since private offices differ from ABWs particularly in this respect (Candido et al., 2016; De Been & Beijer, 2014). The ABWs in our study were not rated high in terms of perceived privacy (Haapakangas, Hallman, et al., 2018). Perceived privacy reflects satisfaction with one's ability to control the level of social contact (Altman, 1975; Laurence, Fried, & Slowik, 2013), and thus, inadequate privacy may lead to negative perceptions of interpersonal relations (Haapakangas, Hongisto, Varjo, & Lahtinen, 2018). Consequently, open workspaces, which are characteristic of ABWs, may impair rather than improve communication and interpersonal relations (e.g., Bernstein & Turban, 2018; Bodin Danielsson, Bodin, Wulff, &

Theorell, 2015; De Croon et al., 2005; Kim & de Dear, 2013). Our results fit well with this line of evidence since satisfaction with communication was higher in private offices than in the shared office types included in our study (i.e., shared offices, open-plan offices and ABWs, Fig. 2). As satisfaction with interaction is typically high in private offices (e.g., Haapakangas, Helenius, Keskinen, & Hongisto, 2008; Kim & de Dear, 2013), improving communication should not be the only motive for redesigning such offices as ABWs.

Decreased privacy might also explain the small increase in perceived work demands among employees moving to the ABW from private offices. Lack of privacy is a stress factor associated with decreased work ability and well-being (Herbig, Schneider, & Nowak, 2016). Office environments with low privacy tend to involve acoustic distractions (Sundstrom, Burt, & Kamp, 1980), such as other people's conversations (Haapakangas et al., 2018; Pierrette, Parizet, Chevret, & Chatillon, 2015) which impair performance in many cognitive tasks (Haapakangas, Hongisto, Hyönä, Kokko, & Keränen, 2014; Jahncke, Hongisto, & Virjonen, 2013; Keus van de Poll, Ljung, Odelius, & Sörqvist, 2014). Such acoustic problems also increase perceived task demands (Haapakangas et al., 2011; Keus van de Poll et al., 2015). However, the effect sizes for work demands, as well as for social relations, were small in our study (Table 2, Fig. 2), and these effects only occurred at half of the investigated office sites. Thus, these findings may be of less importance in practice than those concerning satisfaction with communication.

It is important to note that, unlike open-plan offices, the ABW

concept aims at addressing privacy needs. The measures taken to support collaboration are also more sophisticated in ABWs, including open work areas, specific spaces for different forms of communication, non-territorial working and, typically, the active use of communication technology. However, the ABW is a general design concept while the dispersion in office designs as well as work practices is likely large between offices. The extent to which the disadvantages of the ABW design, such as hygiene concerns due to shared desks and time spent searching for colleagues and workspaces (Kim et al., 2016), are solved might also influence communication, social relations and work demands at an ABW. The ABWs of our study differed in their design (e.g., the amount of rooms and zones for communication or quiet work, see Supplementary material 2), in the existence of a code of behavior regarding office use, and probably in some other aspects of the physical and psychosocial environment, both at baseline and at the ABWs. The lack of positive effects among employees moving from shared and open-plan offices in our study may suggest that the design or implementation of the ABWs they moved to was not optimal, since previous studies show positive effects among such employees (Blok et al., 2009; Robertson et al., 2008). In fact, the results of our research project led to further improvements of the ABW design and use at two of the studied office sites (Offices B and D). Thus, in addition to comparing ABWs with other office types, future studies should also focus on identifying specific aspects of office design and implementation processes that are important for promoting positive effects of ABWs on communication, social relations, work demands, and other outcomes (e.g., productivity and well-being).

4.1. Strengths and limitations

Our study offers new information on the effects of ABW relocations on communication and work demands. The design of our study was of high quality, including a comparable relocation group even from the same organization which is rare in office relocation studies. Unlike any previous study on communication in ABWs, we included several intervention offices and specified the role of the preceding office types. The ratings of social community and work demands at baseline were similar to reference scores from other Swedish organizations (COPSOQ Sverige website), while social support was rated slightly higher. These findings support the generalizability of these findings to other organizations, at least in Nordic countries. On the other hand, only one Swedish organization was investigated, implying that the results may be generalized to ABWs implemented in other organizations only with due caution.

Some of the offices in our study had quite few employees which may have compromised statistical power in the site-specific analyses. For the same reason, we were not able to include the interaction between the site and baseline office type in the statistical models. The distribution of office types differed between office sites at baseline (see Supplementary material 2). Thus, we cannot exclude the possibility that the effects attributed to the baseline office type might instead be explained by an unknown site-specific variable. However, it seems unlikely for such a coincidence to occur across several office sites as the relocation effects appear to be strongly related to the proportion of private offices at baseline at three out of four offices (see Supplementary material 2).

In addition, our study was not designed to investigate other moderators that may play a role in the perception of ABWs, such as task-related factors and personality (Wohlers & Hertel, 2017) or the degree to which the physical environment actually supports activity-based working. It is also important to note that a change from traditional offices to ABWs always occurs in a broader context of physical and psychosocial workplace factors which may also directly or indirectly affect the investigated outcomes. Our study did not control other physical factors (e.g., building characteristics, furniture, views and natural light) that might have also changed during the relocation, nor psychosocial factors (e.g., leadership style, Bergsten, Haapakangas, Larsson, Jahncke, & Hallman, 2019) that could have moderated the

investigated effects. Future studies are needed to identify specific factors in the physical office design and psychosocial work environment that explain different reactions to ABWs.

4.2. Practical implications

Our results suggest that ABWs may not lead to better communication among employees than other office types, particularly if satisfaction with communication is already high before moving to the ABW. Thus, organizations implementing ABWs likely need to actively facilitate effective communication and address the imminent negative effects of the ABWs. In particular, organizations should be prepared to solve possible difficulties in locating colleagues at the ABW, for example, with the help of modern technology. Employees should also be supported in coping with the initial adaptation period, during which the perceived workload may be increased particularly among those previously working in private offices. This might be achieved, for example, by employee participation when the ABW is designed, and by training programs in adopting activity-based working.

5. Conclusions

Our study showed that moving into an ABW can have negative effects on satisfaction with communication and the sense of community even a year after the relocation. This was related, at least partly, to difficulties in locating colleagues at the ABW. Work pace was not affected by the relocation while small, mostly short-term, negative effects on social support, quantitative demands and emotional demands were only observed among employees who moved to ABWs from private offices. One to two out of four offices was not affected by a relocation to an ABW, depending on which outcome is considered. Future studies should focus on identifying specific design features and practices that facilitate positive outcomes in ABWs.

Author contributions

A.H. contributed to the research questions and data processing, conducted the statistical analyses, and drafted, and revised the manuscript. D.H. contributed to planning and designing the study, gave advice on the statistical analyses, and critically revised the manuscript. S.E.M. contributed to planning and designing the study, and critically revised the manuscript. H.J. initiated the project and received funding, designed and planned the study, coordinated data collection, took part in decisions concerning statistical analyses, and critically revised the manuscript.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jenvp.2019.101341>.

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