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ABSTRACT

Many companies move from open-plan offices (OPO) to activity-based workplaces (ABWs). However, few studies examine the benefits and drawbacks following such a change. The aim of this study was to explore how physical conditions, office use, communication, privacy, territoriality, satisfaction and perceived performance change following a company's relocation from an OPO to an ABW. A mixed methods approach included pre- and post-relocation questionnaires and post-relocation focus groups, individual interviews and observations. The questionnaires enabled comparisons over time ($n = 34$) and broader analyses based on retrospective ratings of perceived change ($n = 66$). Results showed that satisfaction with auditory privacy, background noise, air quality, outdoor view and aesthetics increased significantly after relocation. Negative outcomes, such as lack of communication within teams, were perceived as being due to the high people-to-workstation ratio and lack of rules. Overall satisfaction with the physical work environment increased in the ABW compared to the OPO. Perceived performance did not change significantly.

Practitioner Summary: Activity-based workplaces (ABWs) are commonly implemented although their effects on performance and well-being are unclear. This case study gives advice to stakeholders involved in office planning. Despite shortcomings with the people-to-workstation ratio and rules, employees showed improved satisfaction with auditory privacy and aesthetics in the ABW compared with the previous open-plan office.

1. Introduction

In recent years, there has been an increase in open-plan offices (OPO) and activity-based offices (ABWs) (Appel-Meulenbroek, Groenen, and Janssen 2011; Appel-Meulenbroek et al. 2015; Seddigh et al. 2014; Vos and van der Voordt 2002). The reasons for implementing new office concepts include reducing overhead costs, saving space and increasing flexibility in office use (Appel-Meulenbroek, Groenen, and Janssen 2011; de Been and Beijer 2014; Brunnberg 2000). However, while rental costs account for approximately 9% of businesses' operating costs, staff costs account for approximately 90% (Alker et al. 2015; Brill, Weidemann, and Associates 2001). Therefore, it becomes increasingly important to focus on the employees and to determine whether ABWs and OPOs promote performance and work satisfaction, and in turn, long-term productivity.

Research has shown that performance and work satisfaction are not only affected by physical office features such as temperature, lighting, air quality, office layout and furniture (Brill, Weidemann, and Associates 2001; Sundstrom and Sundstrom 1986), but also by the provision of communication, privacy and territoriality (de Croon et al. 2005). For example, as compared with cell offices, the OPO has shown reduced satisfaction and performance (i.e. concentration, memory and learning). The reasons included reduced auditory privacy (de Croon et al. 2005; Jahncke and Halin 2012; Jahncke, Hongisto, and Virjonen 2013; Kaarlela-Tuomaala et al. 2009; Kim and de Dear 2013; Sundstrom, Burt, and Kamp 1980; Sundstrom et al. 1994), and reduced confidentiality during communication (Brennan, Chugh, and Kline 2002). Further studies have shown reduced visual privacy (i.e. more visual distractions and unwanted observation) and lower informative privacy (shared knowledge about oneself) in OPOs (Brennan, Chugh, and Kline 2002; Sundstrom, Burt, and Kamp 1980; Vischer 2007).

However, research is sparse regarding performance and satisfaction in ABWs. Similar to OPOs, which consist

of rooms occupied by four people or more (Danielsson and Bodin 2008), ABWs commonly involve open-plan settings (Wohlers and Hertel 2016). Thus similar disadvantages of privacy may arise for the ABW as for the OPO. However, unlike the OPO, the aim of the ABW is to provide a diversity of settings which may ameliorate the negative effects (dissatisfaction and reduced performance). For example dissatisfaction regarding auditory privacy may be reduced by switching to a quiet setting. A study using self-rated performance by Seddigh et al. (2014) found that there are fewer distractions in activity-based offices compared to OPOs. The variety of settings is claimed to support privacy, autonomy and communication (van der Voordt 2004), although there is a lack of studies addressing this.

A clear difference between OPOs and ABWs is office use. The OPO applies assigned workstations while the ABW applies a non-territorial workplace concept with flexi-desking (van der Voordt 2004). An active choice of workstations is promoted. In fact, the ABW often has more employees than workstations, since it is commonly dimensioned for 70% of the workforce (Danielsson and Bodin 2008). Thus employees should clear the desk before leaving the workstation. Research has shown positive work condition consequences associated with flexi-desking, including good accessibility and co-location of team members, which can increase teamwork quality (Hoegl and Proserpio 2004) and communication (de Croon et al. 2005). However, these results are limited. Some of the negative work condition consequences that have emerged concern the lack of territoriality, along with time loss from finding suitable workplaces, adjusting the workplace, getting acclimatised to the new environment and finding colleagues (Brunnberg 2000; van der Voordt 2004; Wolfeld 2010).

In summary, the unassigned workplace concept and variety of settings in ABWs are expected to increase individual/group performance and employee satisfaction. However, few studies have examined whether this concept actually promotes these positive work condition consequences (van der Voordt 2004) and the results are inconsistent (de Been and Beijer 2014; Gorgievski et al. 2010; Nijp et al. 2016). Furthermore, there is a lack of longitudinal case studies following relocation from OPOs to ABWs with pre- and post-measures of work conditions, satisfaction and performance (Wohlers and Hertel 2016). Despite this, many companies implement ABWs (Appel-Meulenbroek, Groenen, and Janssen 2011; Brunia, de Been, and van der Voordt 2016; van Koetsveld and Kamperman 2011; Toivanen 2015; Vos and van der Voordt 2002). The aim of this paper is to explore how office features, work condition consequences and overall satisfaction and performance change after relocation from an OPO to an activity-based office. More specifically, the research question is:

How are 1) physical work conditions and office use, 2) communication, 3) auditory, visual and informative privacy, 4) territoriality, 5) self-rated performance and 6) satisfaction changed and perceived when employees relocate from an OPO to an ABW?

2. Method

2.1. Setting

This explorative case study was conducted at a large Swedish insurance company that relocated two departments from an OPO to an ABW. Case studies are designed to collect detailed information of a case (Merriam 2009), by using multiple sources of data (Creswell and Poth 2017) and are a preferred strategy for research with explanatory and exploratory focus in a real-life context (Yin 1984).

The motivation for changing office type was to prevent the company from growing out of its premises, change and modernise the way of working, encourage interaction and increase flexibility. The workstation occupancy ratio, measured in May 2014, twice/day for 7 working days, was 47% with a range of 25–75%. A total of 15 employees participated in a reference group that worked for 12 h with architects on needs and concerns during the 9-month planning of the new ABW. All employees could give input through a 'question box' and via the intranet, and it was mandatory to participate in the company's own 3-h workshop on behaviours and how to use the areas in the ABW. No rules were decided. The organisation's motivation for changing office type as well as planning process was similar to other organisations (Davis, Leach, and Clegg 2011; Toivanen 2015; Van Meel, Martens, and van Ree 2010).

In December 2014 the company relocated 100 workers from the OPOs on the 3rd and 4th floors to the 7th floor of the building, which had been rebuilt into an ABW (see Figure 1). The ABW included 64 equipped workstations and common areas:

- A: 48 fully equipped workstations (two screens, keyboard, mouse and intranet connection) in open-plan areas with 8 or 12 stations grouped together.
- B: 4 workstations with one screen, keyboard, mouse and intranet connection in the open-plan area.
- C: 2 glass-windowed rooms with 6 fully equipped workstations in each.
- D: 6 back-up rooms with one fully equipped workstation in each.
- E: 8 meeting rooms for 4 people, with one screen, keyboard and mouse.
- F: 1 meeting room for 6 people, with one screen, keyboard and mouse.
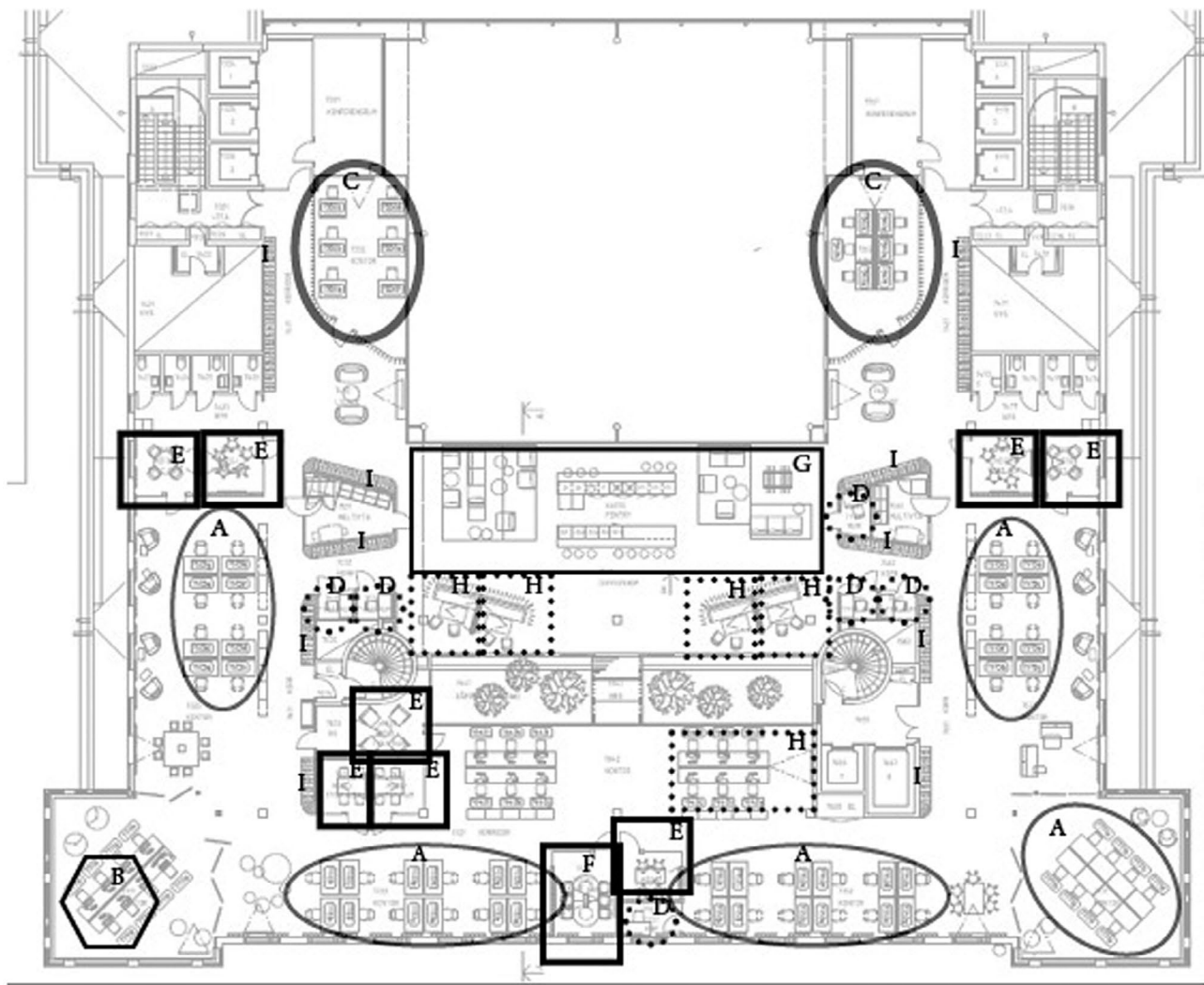- G: 1 lounge

Figure 1. Blueprint of the activity-based office.

- H: 4 team areas in open-plan area with one screen, keyboard and mouse.
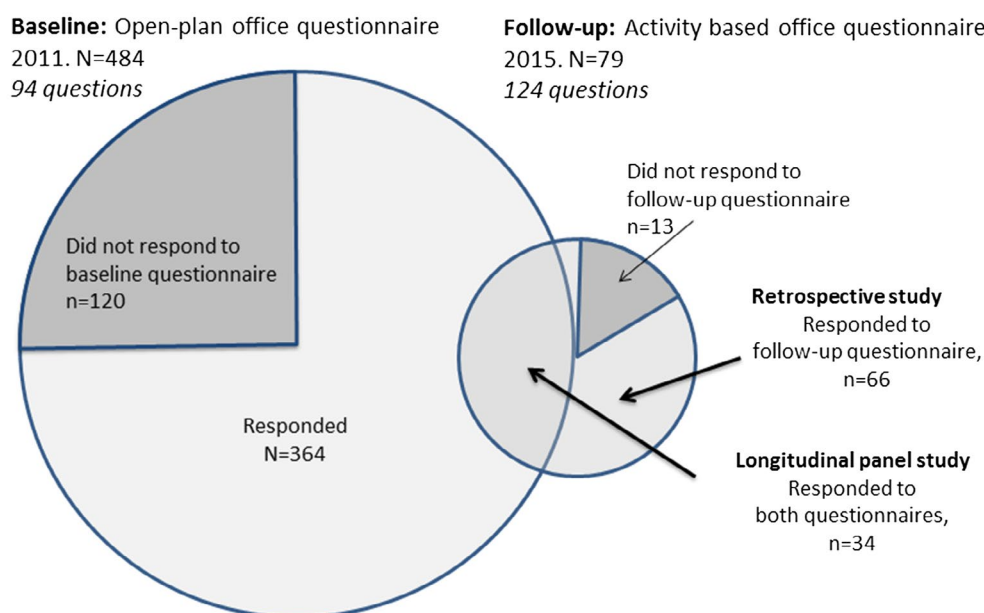- I: 100 lockers.

2.2. Study procedure

A mixed method approach consisting of questionnaires, interviews and observations was used to collect and triangulate data. Ethical approval was granted before the data was collected by the Regional Ethical Board in Uppsala (No: 2008/77) and Stockholm (No: 2014/1180-31). First, quantitative data was collected on two occasions. A baseline web-based questionnaire concerning the OPO layout was distributed to all employees at one of the company's office buildings in 2011, three years before discussions of activity-based office implementations were started. The follow-up (post-relocation) questionnaire was distributed in spring 2015, three months after relocation of the target departments. Second, explorative focus group interviews were conducted. Third, observations were made within the ABW and fourth, individual in-depth interviews were conducted to address issues that emerged as problems in the earlier stages. Each method is described in further detail below.

2.2.1. Questionnaires

An overview of participants in the two questionnaires is illustrated in Figure 2 and further background information is shown in Table 1. The baseline web-based questionnaire invited all 484 employees in the company's major office in Stockholm to participate. In total, 364 participants answered and 317 worked in an OPO. The web-based follow-up questionnaire (post-relocation questionnaire) invited all 79 permanently employed workers who had relocated to the ABW to participate (i.e. some of them were not employed at the baseline measurement). Consultants were excluded. Management informed the

Baseline: Open-plan office questionnaire
2011. N=484
94 questions

Follow-up: Activity based office questionnaire
2015. N=79
124 questions

Did not respond to
baseline questionnaire
n=120

Responded
N=364

Did not respond to
follow-up questionnaire
n=13

Retrospective study
Responded to
follow-up questionnaire,
n=66

Longitudinal panel study
Responded to
both questionnaires,
n=34

Figure 2. Overview of participants for the baseline and follow-up questionnaire.

Table 1. Background information and response rate of the participants who took part in the questionnaire and interviews.

	N	Female/male %	Median age	Response rate %	Mean years at company
Baseline:					
Questionnaire	364	65/35	46.4 (22–64)	75	N/A
Follow-up:					
Questionnaire	66	49/51	41–45* (26–65)	84	N/A
Focus Group interviews	20	42/58	46–50* (31–65)	24	10
Individual Interviews	26	38/62	41–45* (31–60)	33	10
Baseline and follow-up:					
Questionnaire**	34	51/49	44 (26–61)	86***	N/A

*Responses were given on a scale with five-year intervals.
**Only participants who answered both the baseline and follow-up questionnaire were included in the statistical analysis of responses over time.
***Percentage of participants who answered the follow-up questionnaire out of all participants who had filled in the baseline questionnaire and relocated to the ABW.

employees about the questionnaire before the email invitations were sent out. Participation was voluntary and confidential treatment of data was guaranteed in the invitation. Questionnaire responses were electronically sent directly to the researchers. The follow-up questionnaire was answered by 66 employees. The gender division was even (49/51) and the median age was 41–45 years old. In total, 75% had a university degree. Of the respondents 29% worked within the business department and 71% within the IT department. Of the 13 non-respondents 7 were females. In total there were 34 employees who answered both questionnaires (i.e. who had also worked in the OPO at the baseline measurement).

Two study designs were applied: a longitudinal panel study and a retrospective study.

Longitudinal panel study: The panel study sample consisted of the 34 employees who answered both

questionnaires (baseline and follow-up). The panel study addressed 25 questions which concerned perceptions of physical work conditions, office use, communication, privacy, territoriality, perceived satisfaction and performance (see Table 2). The answers were given on a 7-point scale ranging from −3 (very dissatisfied) to 3 (very satisfied). Repeated measures analysis (General Linear Model) was conducted in SPSS version 19.0. The long time span between the questionnaires (three years) meant an additional personnel turnover, limiting the response rate and suggesting a possible selection bias. However, the time span also avoided employees trying to influence the implementation of an ABW and all employees occupying the ABW were included in the retrospective study.

Retrospective study: The retrospective study sample consisted of the 66 employees who answered the follow-up questionnaire. This study included 11 retrospective

Table 2. Main themes investigated in the questionnaire studies.

Study Type	Scale points	Parameter	Question
Physical work conditions			
			How satisfied are you with …
Panel	7	Background noise	… the amount of background noise (not speech) you can hear from your work station?
Panel	7	Air quality	…the airflow?
Panel	7	Temperature	…the temperature?
Panel	7	Visual comfort	…the visual comfort (glare, reflections, shadows etc.)?
Panel	7	Amount of light	…the amount of light at your work station?
Panel	7	Outdoor view	…the possibility to view the outdoors?
Panel	7	Aesthetics	…aesthetics of the work place?
Panel	7	Visitor space	…the size of your work place in the aspect of receiving visitors?
Panel	7	Adjustability of furniture	…the possibility to adjust the interior to meet your individual needs (chairs, tables, drawers …)?
Office use			
Cross-section	5	Consecutive days	How often do you sit at the same workstation on consecutive days?
Cross-section	35	Finding workplace	How many minutes do you spend per day on finding a suitable workplace?
Job resource: communication			
			In comparison to before relocation …
Retro	5	Competence exchange	… does the information exchange with your closest colleagues work better or worse?
Retro	5	Verbal communication	…. does the verbal communication with your closest colleagues work better or worse?
Retro	5	Cooperation	… does cooperation (coordination, problem-solving, decision-making etc.) with your closest colleagues work better or worse?
Retro	5	Information exchange	… does information exchange with your closest colleagues work better or worse?
Retro	5	Ease of gathering colleagues	… is it easier or more difficult to gather together colleagues if needed?
Retro	5	Ease of getting hold of co-worker	… is it easier or more difficult to quickly get hold of one of your closer colleagues for a shorter errand?
			How satisfied are you with ….
Panel	7	Ease of interaction	… ease of interaction with colleagues?
Job resource: privacy			
Panel	7	Distance to colleagues	… distance between you and your colleagues?
Panel	7	Workspace separation	… the degree of privacy with walls, separation panels and furnishings around your work place?
Panel	7	Informative privacy	… the possibility to retreat to private areas for conversations, phone calls or quiet, concentrated work?
Panel	7	Acoustic privacy	… the acoustic privacy at your work desk (possibility to make conversation without neighbours hearing)?
Panel	7	Speech level	… the speech volume level you can hear from your workstation?
Panel	7	Visual privacy	… the visual privacy at your work station (to not be observed)?
Panel	7	Personalisation	… the possibility to adjust your work station (e.g. with flowers, pictures)?
Perceived performance			
			In comparison to before relocation …
Retro	5	Individual efficiency	… do you work more or less efficiently?
Retro	5	Group efficiency	… do you and your colleagues together work more or less efficiently?
Cross-section	5	Productivity	How often do you manage to be productive at your work station?
Cross-section	5	Ability to work in office	Does working in the new office function better or worse?
Satisfaction			
Cross-section	4	Overall satisfaction	How satisfied are you with your physical work environment?
Cross-section	7	Office type preference	Which office type do you prefer?

questions that were answered on a five-point ordinal scale, and evaluated by frequency analysis and one sample Wilcoxon signed rank test in SPSS. These questions concerned perceived change regarding communication and performance (see Table 2) from their previous office to the present office.

The follow-up questionnaire also included questions that only concerned aspects relevant for office use in the ABW (see Table 2). These additional questions were treated as cross-sectional data. Overall satisfaction with the physical work environment was evaluated by Wilcoxon signed rank test in SPSS. Comments were optional for every question.

2.2.2. Focus group interviews and individual in-depth interviews

Interviews were conducted to further explore changes in office use, communication, privacy, territoriality, job

satisfaction and performance. All permanent employees who had relocated to the ABW were invited to focus group interviews and individual in-depth interviews. Signing up for participation in an interview was voluntary and made through a list located in the office lounge. The aim of the semi-structured focus groups was to scan circulating opinions and issues in the activity-based office, for instance regarding satisfaction with the layout, problems and ease of performing work tasks in offered settings. Individual interviews followed up on identified problems, such as nesting and adjustment of work equipment. The interview guides are shown in Appendix 1. The individual interviews were audio-recorded, transcribed verbatim, anonymised and each question was analysed by categorisation in QSR Nvivo.

In total, 20 employees participated on the three focus group occasions (one hour each), and 26 participated in the individual interviews (15–25 min). The gender division of the individual interviewees was 38/62 females and males, respectively, and the median age was 41–45 years old (31–60). Furthermore, 10 employees participated in both interview types.

2.2.3. Observations

Observations were conducted in the morning, around lunchtime and in the afternoon in order to focus on complaints regarding the availability of workstations captured by the questionnaire and focus group interviews. A protocol (see Appendix 1) was completed by counting the number of occupied, reserved and available workstations over a period of two days.

3. Results

Figure 3 shows that most satisfaction ratings improved from baseline (OPO) to the follow-up (ABW) questionnaire.

3.1. Change in physical work conditions and office use

The General Linear Model analysis confirmed that some ratings of the physical work conditions had significantly improved after relocation to the ABW (see Figure 3 and Table 3): background noise, aesthetics, visitor space, outdoor view and air quality.

Interviewees were predominantly positive regarding the new physical work conditions. Improvements in aesthetics, freshness and brightness were mentioned most frequently: 'It's always fun with a new and fresh environment' (I-10).

Relocation to the new office concept meant a change in office use from fixed workstations to desk sharing. Nonetheless, 28% reported in the follow-up questionnaire that they often or always occupy the same workstation for consecutive days. Moreover, the interviewees reported on general trends among the employees concerning workstation nesting, for both whole days and consecutive days: 'I've received comments that we always occupy the same workstations' (I-18).

3.2. Change in communication

The GLM-analysis of the questionnaire data (baseline vs. follow-up) showed no significant change in ease
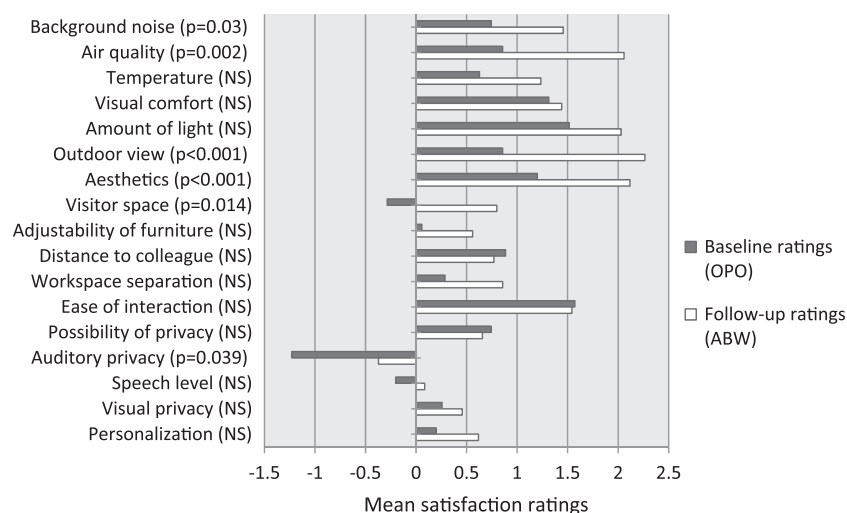

Figure 3. Mean satisfaction ratings, ranging from −3 (very dissatisfied) to 3 (very satisfied), regarding environmental and psychosocial prerequisites, at baseline in the open-plan office and follow-up in the ABW (*n* = 34).

Table 3. Significantly improved satisfaction ratings of the physical conditions.

	F	MSE	p	η_p^2
Background noise	$F\,(1, 34) = 4.63$	1.93	0.03	0.12
Aesthetics	$F\,(1, 33) = 16.44$	0.86	<0.001	0.33
Visitor space	$F\,(1, 34) = 6.66$	3.10	0.014	0.16
Outdoor view	$F\,(1, 33) = 16.33$	1.91	<0.001	0.33
Air quality	$F\,(1, 33) = 11.33$	1.97	0.002	0.26

of interaction, ($F\,(1, 34)=0.01$, MSE $= 1.34$, $p = 0.92$, $\eta_p^2 < 0.00$). The Wilcoxon signed rank test (see Figure 4) showed no significant change in communication except that employees felt significantly less satisfied about getting hold of co-workers after relocation ($p = 0.014$). Additional comments in the follow-up questionnaire indicated, for example, that 'one never finds anyone', 'a lot of time is spent searching' and 'it is more difficult to find people since they are spread out'.

These findings were further emphasised by the interviewees. Searching for people, and not knowing their placement, were the main reasons for dissatisfaction according to the individual interviewees (42% commented on this). Interviewees spontaneously commented that the decline in ease of interaction and possibility of getting hold of co-workers was due to the large amount of time spent on teamwork in combination with lack of team areas. Interviewees (and questionnaire respondents) expressed lack of team areas through comments such as 'my activity is to solve tasks together with my team, but the team can never sit together' (I-16), and 'we often change and search for a workstation in the hope that someone has relocated' (I-24).

In the questionnaire the employees reported spending an average of 10.5 h/week in small groups and 6.3 h/week in bigger groups. Team sizes varied between 3 and 20 people according to the focus groups.
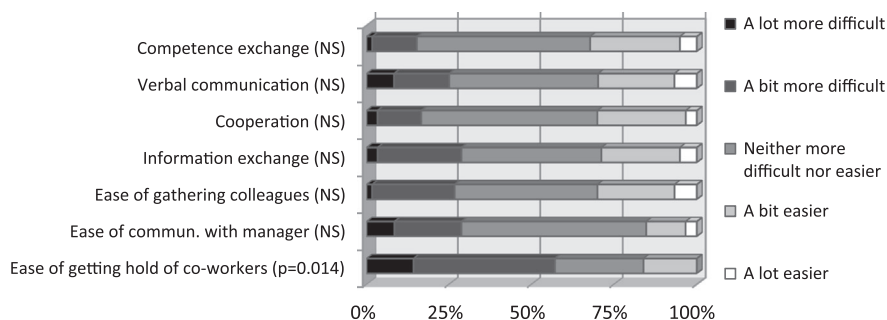
3.3. Change in privacy

3.3.1. Auditory privacy

The GLM-analysis of the questionnaire data (baseline vs. follow-up) showed a significant positive change in satisfaction concerning auditory privacy $F\,(1, 34)=8.55$ MSE $= 1.50$ $p < 0, 01$, $\eta_p^2 = 0.20$; and the background noise $F\,(1, 34) = 8.82$, MSE $= 2.59$, $p < 0.05$, $\eta_p^2 = 0.21$ after the employees relocated to the ABW. Despite these improvements, satisfaction with acoustic privacy and speech level were still lowest rated of all physical work conditions in the follow-up questionnaire (see Figure 3). Some interviewees expressed that they were 'missing quiet zones' (I-23) and that 'the enclosed rooms with 6 workstations (author note: see blueprint Figure 1, section C) that were supposed to be quiet, are not quiet' (I-08).

According to the interviewees, some areas in the OPO setting of the ABW were perceived as noisier than others. According to both interviews and observations daily team meetings commonly took place in the OPO setting: 'At a certain hour there are empty workplaces in that area, due to the adjacent daily meetings. Then nobody endures sitting there' (I-04).

Second, interviewees expressed that some groups were perceived as noisier than others, and that they nested in some specific parts of the OPO area. Consequently, some interviewees wished 'to use mobile walls to enclose the teams, to eliminate the noise from other teams' (I-18), or in other words, wished to increase auditory privacy.

3.3.2. Visual and informative privacy

Satisfaction with visual privacy ($F\,(1, 34) = 0.48$, MSE $= 1.47$, $p = 0.49$, $\eta_p^2 = 0.014$) and with the possibility to withdraw to private areas for conversations, phone calls and quiet concentrated work ($F\,(1, 34) = 0.049$, MSE $= 2.6$, $p = 0.825$, $\eta_p^2 = 0.001$) did not change significantly from

Figure 4. Retrospective ratings from the follow-up questionnaire of perceived change in different communication parameters, after relocation from an open-plan office to an ABW.
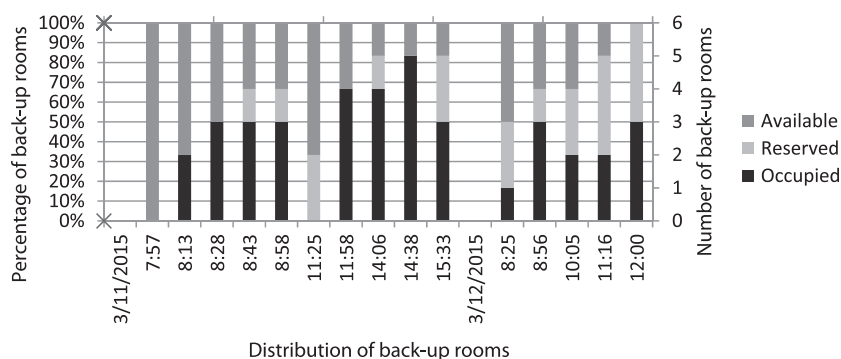
Figure 5. Distribution of occupied, reserved or available back-up rooms during two days of observations.

baseline to follow-up (see Figure 3), according to the GLM-analysis.

The interviewees reported no complaints about the possibility of having confidential conversations. Instead, interviewees expressed a general lack of availability of, and injustice, concerning the back-up rooms in the ABW; 'The back-up rooms are often occupied by the same people' (I-26) and 'the back-up rooms are often occupied for a longer period of time' (I-12). The observations showed that the back-up rooms were frequently occupied (see Figure 5).

3.4. Change in territoriality

None of the indicators of territoriality (i.e. satisfaction with distance to colleagues, and satisfaction with workspace separation) changed significantly in the ratings from baseline to follow-up, according to the GLM-analysis, all $F < 3.5$, all $p > 0.07$.

However, interviewees reported on nesting tendencies and a perceived change in satisfaction with territoriality. New time-consuming activities such as adjusting furniture, tidying up items, cleaning the desk, and carrying and installing ergonomic aids, were reported and used as a justification for nesting. The majority (53%) of the interviewees reported on adjusting their workstation, although with difficulty: 'I don't want to spend four hours adjusting the chair' (I-17).

According to the follow-up questionnaire, the average time spent on finding an appropriate workplace in the ABW was 7.84 min/person/day, varying between 0 and 45 min. A follow-up questionnaire respondent reported that 'the time thief is not to find a workstation, but rather the time it takes to collect all the accessories for the daily work and later clearing the desk. Without doubt, 10 min a day are spent on this'. An interviewee stressed the relationship between the installation time and productivity: 'changing and adjusting a new workstation is an excessive operation that is not conducive to productivity' (I-17).

Another reported reason for nesting was assurance in acquiring a workstation. Interviewees reported a high people-to-workstation ratio: 'the good ones who always clean their desks before meetings and before lunch may, at times, have problems finding a workstation afterwards' (I-04). The high people-to-workstation ratio made the employees choose workplaces unsuitable for their tasks: 'Now I'm occupying a quiet room, as there are no other workstations available' (I-03). Interviewees reported that their work could not be performed on laptops and therefore 'they left things on the tables to mark' (I-02) a workstation.
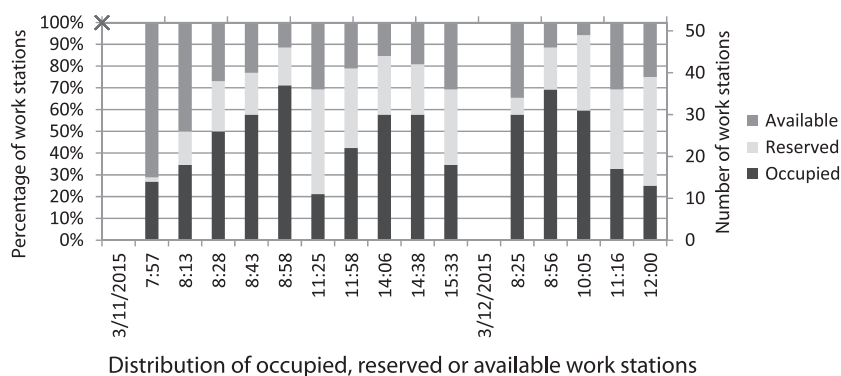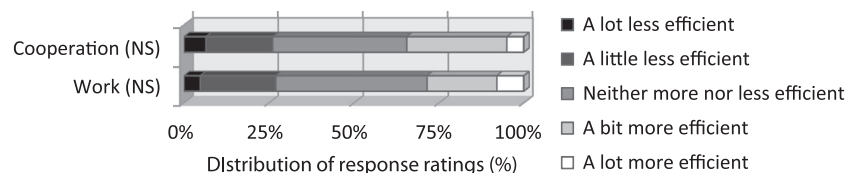

Figure 6. Distribution of occupied, reserved or available 'Fully Equipped Workstations' during two days of observation.

The observations conducted in the office showed that there were always workstations available (see Figure 6). However these were, according to the individual interviewees, located 'in another team's area' (I-12) or were 'too noisy' (I-12). Nesting was therefore not only about keeping a workstation; nesting also ensured acquisition of a workstation close to the team. One interviewee stated that 'you usually get a spot, but that is not where you actually need to sit on that day. You need to sit with your team' (I-07). The workstation arrangement was criticised: 'The workstation arrangement is too big for one team and too small for two teams.' (I-02). Teamwork was used by employees as a justification for nesting. For example nesting simplified continuation of joint work after meetings and 'it is productive to know approximately where people are seated so I can search for them' (I-17). Some teams nested in the enclosed rooms with 6 workstations (see Figure 1, section C). However, these were quiet rooms according to some interviewees who were frustrated by the continuous talking. The employees also nested for a sense of safety and belonging. The interviews revealed that: 'it is more comfortable to sit close to my colleagues' (I-26).

Opposers of nesting argued that only early arrivers 'get the best spots' (I-25) and that 'it is supposed to be an activity-based office, where we are supposed to move around, so it is wrong to occupy the same workstation' (I-25).

3.6. Change in self-rated performance

The Wilcoxon signed rank test on the retrospective ratings showed no significant change in individual and group efficiency after relocation to the ABW (see Figure 7). Most employees (86%) reported in the follow-up questionnaire that they often or always were productive at their workstation in the ABW, and 74% perceived that their ability to work in the ABW was fairly or very good. Only 10.5% indicated that their ability to work in the ABW was fairly bad, or very bad. Only a few questionnaire respondents reported that individual efficiency either strongly improved (8%) or strongly deteriorated (5%) after relocation to the ABW.
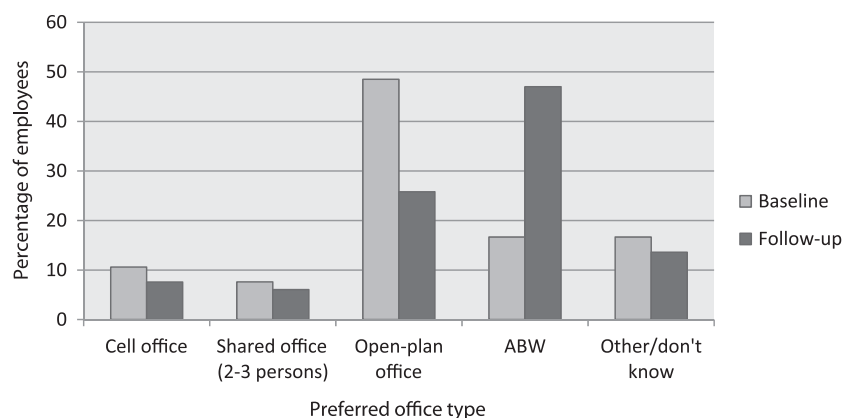
3.7. Change in satisfaction

According to the Wilcoxon signed rank test of the follow-up questionnaire, the scores for satisfaction with the physical work environment in the ABW were significantly more positive than the neutral value ($p = 0.013$). Moreover, now almost half (47%) preferred the ABW to other office concepts (see Figure 8), compared to 16% before they relocated (retrospective ratings). Furthermore, preference for the OPO had dropped from almost half (49%) to a quarter (26%) after the employees had relocated (retrospective ratings).

Satisfaction concerning the physical work environment in the ABW was further emphasised by interviewees ($N = 26$) who compared their current workplace with their previous one. A major reason for their general satisfaction, spontaneously mentioned by 35% of the interviewees, was decision latitude in choosing between different work settings. In addition, 35% mentioned aesthetics and freshness as improvements. The interviewees also mentioned general advantages such as ease for communication, either within the team (35%) or outside the team (23%), and the office as being brighter (27%) in the ABW. Five interviewees were generally negative to the ABW concept and commonly mentioned difficulty in finding workstations, as well as noise levels.

4. Discussion

The aim of this study was to explore changes in office features, work condition consequences, satisfaction and perceived performance in an activity-based office following relocation from an open-plan. The ABW aims at providing a diversity of work settings and applying flexi-desking in order to match employees' activities and personal preferences, and at offering privacy and communication. These variables are assumed to improve performance and satisfaction. This study showed that satisfaction increased but perceived performance did not. Only some positive work conditions were provided in the ABW. Workstation shortage, nesting, lack of auditory privacy, and difficulties

Figure 7. Retrospective (follow-up relocation) ratings of perceived change in efficiency of cooperation, and efficiency of work, after relocation from an open-plan office to an ABW.

Figure 8. Ratings of preferred office type describing relocation from an open-plan office (retrospective baseline rating) to an ABW (post-relocation rating).

in finding colleagues appeared to be related to high people-to-workstation ratio, inappropriate workstation arrangement, and lack of rules.

4.1. Physical work conditions and office use

The current study showed that a high people-to-work-station ratio was a likely source of team members being scattered in the office, increasing the need to search for colleagues and inhibiting communication. Moreover, employees could be left without a workstation or had to work in areas unsuitable for their current work task (for example using back-up rooms when they needed collaboration, or working in another team's noisy area when doing quiet, concentrated work. To avoid these problems employees nested, which exacerbated the problem of finding available and suitable workstations. The fact that a high people-to-workstation ratio lowers support for work processes and reduces satisfaction and performance is in line with the findings of Wohlers and Hertel (2016) and Appel-Meulenbroek et al. (2015).

An inappropriate workstation arrangement was another contributor to collaboration difficulties. The arrangement of the workstations caused a mismatch in team sizes. This mismatch caused unnecessary movement and searches of colleagues, which decreased the communication benefits, perceived performance and satisfaction. van der Voordt (2004) has emphasised the importance of allocating workstations properly to avoid a mix of colleagues with jobs that have little in common.

Rule ambiguity was yet another source of dissatisfaction. The speech policy was ambiguous in the enclosed rooms with 6 workstations. This resulted in (1) irritation towards colleagues who talked in the supposedly quiet zones and (2) shortage of zones supporting quiet concentrated work. According to Brill's study (2001), having enough environments that support concentrated work

is important for productive work. Rule ambiguity also related to the permitted period of use of back-up rooms; some people occupied them for shorter periods, such as for making telephone calls, while others occupied them throughout the day to obtain auditory privacy. A third ambiguity was the duration of workstation non-attendance. Interviewees who cleared their desks when being absent expressed annoyance with colleagues who reserved workstations.

4.2. Communication, privacy and territoriality

The change in communication moving from an OPO to an ABW showed mixed results. The interviewees perceived support for communication when the team succeeded in locating themselves together, and when intra-team collaboration was needed. In contrast, on occasions when the team had to split up communication was inhibited.

The significant improvement in auditory privacy and background noise ratings was likely due to the provision of back-up rooms and the autonomy to choose workstations further away from the noisy areas. Nevertheless, the shortage of quiet zones may explain the complaints and the negative mean satisfaction score of the auditory privacy.

A need for territoriality and a preference for having fixed workplaces were indicated by the high self-reported nesting rate (28%) and that 25% preferred an OPO rather than an ABW. This supports the results by Gorgievski et al. (2010) which showed that 10–20% of employees in non-territorial offices dislike having non-assigned desks. Nesting tendencies have also been found by Brunia and Hartjes-Gosselink (2009). Among the reasons to nest, as identified by Vos and van der Voordt (2002), were the desire to work in quiet areas, get a special view, be close to colleagues, or have a protected backing wall. In the current study an additional reason was mentioned: fear of being left without a workstation.

4.3. Perceived performance

The questionnaire analyses showed no significant changes in perceived performance, communication (i.e. different parameters), individual efficiency and group efficiency. The results from the interviews showed that communication was both supported by autonomy to choose workplace, i.e. to sit with the team, and inhibited through an insufficient number of workstations and inappropriate workstation arrangement.

The ABW did not provide variety in acoustic workplace settings, leading to low incentive to change workplace. The positive work condition consequences, claimed to increase performance in ABWs compared with OPOs (Brill, Weidemann, and Associates 2001; Brunia, de Been, and van der Voordt 2016) were thereby limited. However, the significant improvements in perceived auditory privacy and background noise implied that the ABW supported concentrated work better than did their previous OPO.

Research has shown that auditory privacy and background noise are the strongest dissatisfiers in office settings (Danielsson 2005; Rolfö and Eklund 2015). The presence of background noise can result in 2–12% drops in performance (Jahncke, Hongisto, and Virjonen 2013), and up to 66% decrease in productivity (Banbury and Berry 1998).

Time loss due to additional activities related to hot-desking was found to decrease employees' perceived performance and is in line with findings from de Been, Beijer, and den Hollander (2015) and Wohlers and Hertel (2016).

In conclusion, there were mixed results which indicated that the ABW concept did not improve communication and teamwork, as claimed by other studies (Brunia, de Been, and van der Voordt (2016), de Been, Beijer, and den Hollander (2015). However, auditory variables important to performance were perceived as more positive in the ABW compared to the OPO. These inconclusive results are consistent with other studies (Meijer, Frings-Dresen, and Sluiter 2009; Wolfeld 2010), illustrating the need for further research to measure change in actual performance.

4.4. Satisfaction

This study, in accordance with several other studies (Danielsson and Bodin 2008; Gorgievski et al. 2010; Lansdale et al. 2011; Vos and van der Voordt 2002) showed that overall satisfaction increased in the ABW. The ABW is the most preferred office type (i.e. 47% of all employees) after implementation and received high overall satisfaction ratings for the physical work conditions.

The significant increase in satisfaction regarding auditory privacy and background noise is likely a strong contributor to the high satisfaction ratings. The most prominent

satisfaction contributors according to interviewees were aesthetics and autonomy to choose workplace, which is in line with the findings of de Been and Beijer (2014), and de Been, Beijer, and den Hollander (2015). The improved satisfaction rating on outdoor view was probably due to upward relocation within the building, rather than the ABW concept. However, having unassigned workstations may contribute to increased satisfaction as it gives all the employees the opportunity to sit near windows.

The reasons for dissatisfaction were high workstation occupancy ratio, teams being split up, difficulties in finding colleagues and perceived injustice due to nesting. Appel-Meulenbroek, Groenen, and Janssen (2011) and Lansdale et al. (2011) found a relationship between lowered satisfaction and lack of personal territory. However, while the ABW did not support all work processes and activities, the employees were still very satisfied, especially with the aesthetics, autonomy and auditory privacy in the ABW.

4.5. Implications of results

The findings from this study have practical implications for office planning. For example it is important to investigate work activities. Difficulties in working on laptops were disregarded in this case, indicating inadequate work analysis in the planning process. Moreover, if teamwork is a prominent activity, allocation of team zones should be discussed (Wohlers and Hertel 2016) and, especially in large organizations, solutions on how to find colleagues should be addressed. A sufficient number of workstations should be provided (beware of work tasks and teleworking) and should be arranged properly to support different work activities and employee rotation. Moreover, the people-to-workstation ratio should be followed up after implementation. In addition, the ABW relocation should focus on leadership and organisational changes, in addition to physical layout.

Furthermore employee involvement in the planning process should be facilitated. User involvement decreases misuse of the workplace (cf. Appel-Meulenbroek, Groenen, and Janssen 2011) and supports shared understanding of why it is necessary to implement a change (Nielsen and Randall 2013). For example, the desk-sharing concept and expected switching frequency needs to be discussed by employees. Moreover, speech policies should be addressed and agreed on by employees to provide a diversity of acoustic work environments, including areas for quiet, concentrated work. In this case speech policies should have been discussed, especially for the enclosed rooms for six employees. Dedicating these areas to quiet concentrated work would have attracted employees who used the back-up rooms for longer periods, freeing the back-up rooms.

4.6. Methodological considerations

The strength of a case study is that it provides insights of wider value (Taber, 2010). The generalisability of the case study is analytical in nature, where particular results are generalised to broader theory (Yin 1984). A methodological strength of this study was the mixed method approach whereby the observations and individual in-depth interviews were based on the results from the questionnaires and focus group interviews. Moreover, the study included a large number of interviewees, had a high response rate (84%) regarding the questionnaires and a long time span between the questionnaires. Consequently, some relevant issues for office concepts with unassigned workstations were not queried in the baseline questionnaire. The longitudinal data was combined with the retrospective data in order to ask specifically about perceived change, the area of investigation. Relative ratings (as used in the retrospective study) have been shown to be easier to estimate than absolute ratings (Borg 1998), although retrospective ratings are based on memory and therefore the results should be interpreted with caution.

Only 41 of the employees who relocated to the ABW worked at the company when the baseline questionnaire was sent out. This limits the generalisability of the results. Further, the absence of interviews and observations in the baseline study did not allow comparisons with these methods. Additionally, productivity and performance are difficult to measure (Hongisto 2005; Vos and van der Voordt 2002). However, self-assessed measures are reasonable indicators of productivity, according to Vos and van der Voordt (2002) and Haynes (2008). The follow-up study was performed 3 months after relocation. Therefore the employees may not have been fully acclimatised to the new context. It would be of interest to undertake additional measurements (for instance 1–2 years after relocation) in order to better see the long-term effects of relocation to an ABW.

5. Conclusion

This explorative study of employees relocating from an OPO to an activity-based office (an office concept with unassigned workstations intended to provide a variety of areas for different activities) showed a significant improvement in perceived physical conditions such as background noise, air quality, outdoor view and aesthetics.

However, the employees regarded the high people-to-workstation ratio, unsuitable arrangement of workstations and the absence of rules as problematic. There was low diversity of acoustic environments and inappropriate office use, such as nesting, occupying workstations unsuitable for the activity at hand, and teams being split up.

The success or failure of the ABW in supporting communication varied according to the interviews, depending on whether or not the team managed to sit together. According to the questionnaires, auditory privacy was significantly better in the activity-based office compared to the OPO; however, noise and distraction complaints still occurred. The reasons for this could be that the ABW only provided six back-up rooms and no other quiet areas which could support concentrated work. In addition, the employees complained about the time spent on individual additional activities (such as clearing their desks).

Perceived performance did not change in the new office. Communication performance was supported when employees had the opportunity to sit together with the team or other collaborators, but was inhibited by the insufficient amount/arrangement of workstations.

Despite some dissatisfiers, the activity-based office was preferred in relation to the OPO. Satisfaction ratings with the physical environment increased after relocation to the ABW compared to the previous OPO. Thus, while the ABW did not always support some work processes and activities (i.e. team work collaboration), these shortcomings seemed to be compensated by improved physical conditions such as aesthetics and better auditory privacy. Although these positive aspects were achieved in the activity-based office concept, other aspects still required improvements such as formulating rules and arranging and allocating workstations correctly for the number of employees and variety of work activities.

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No potential conflict of interest was reported by the authors.

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References

Alker, J., M. Malanca, C. Pottage, R. O'Brien, D. Akhras, B. Ambrose, and J. Wong. 2015. "Health, Wellbeing and Productivity in Offices." In *World Green Building Council*. http://www.worldgbc.org/activities/health-wellbeing-productivity-offices/research.

Appel-Meulenbroek, R., Peter Groenen, and Ingrid Janssen. 2011. "An End-user's Perspective on Activity-based Office Concepts." *Journal of Corporate Real Estate* 13 (2): 122–135.

Appel-Meulenbroek, R., A. Kemperman, M. Kleijn, and E. Hendrikss. 2015. "To Use or Not to Use: Which Type of Property Should You Choose?" *Journal of Property Investment & Finance* 33 (4): 320.

Banbury, S., and D. C. Berry. 1998. "Disruption of Office-Related Tasks by Speech and Office Noise." *British Journal of Psychology* 89 (3): 499–517.

de Been, Iris, and Marion Beijer. 2014. "The Influence of Office Type on Satisfaction and Perceived Productivity Support." *Journal of Facilities Management* 12 (2): 142–157. doi:10.1108/JFM-02-2013-0011.

de Been, Iris, Marion Beijer, and Dorieke den Hollander. 2015. "How to Cope with Dilemmas in Activity Based Work Environments: Results from User-centred research." In conference paper 14th Euro FM Research Symposium. Euro FM research papers.

Borg, Gunnar. 1998. *Borg's Perceived Exertion and Pain Scales.* Champaign, IL: Human Kinetics.

Brennan, Aoife, Jasdeep S. Chugh, and Theresa Kline. 2002. "Traditional versus Open Office Design: A Longitudinal Field Study." *Environment and Behavior* 34 (3): 279–299. doi:10.1177/0013916502034003001.

Brill, Michael, Sue Weidemann, and Bosti Associates. 2001. *Disproving Widespread Myths about Workplace Design.* Buffalo, NY: Kimball International.

Brunia, Sandra, and Anca Hartjes-Gosselink. 2009. "Personalization in Non-territorial Offices: A Study of a Human Need." *Journal of Corporate Real Estate* 11 (3): 169–182. doi:10.1108/14630010910985922.

Brunia, Sandra, Iris de Been, and Theo J. M. van der Voordt. 2016. "Accommodating New Ways of Working: Lessons from Best Practices and Worst Cases." *Journal of Corporate Real Estate* 18 (1): 30–47.

Brunnberg, H. 2000. "Evaluation of Flexible Offices." *Proceedings of the Human Factors and Ergonomics Society Annual Meeting* 44 (6): 667–670. doi:10.1177/154193120004400634.

Creswell, John W., and Cheryl N. Poth. 2017. *Qualitative Inquiry and Research Design: Choosing Among Five Approaches.* Thousand Oaks, CA: Sage.

de Croon, E. M., J. K. Sluiter, P. P. Kuijer, and M. H. Frings-Dresen. 2005. "The Effect of Office Concepts on Worker Health and Performance: A Systematic Review of the Literature." *Ergonomics* 48 (2): 119–134. doi:10.1080/00140130512331319409.

Danielsson, Christina. 2005. "Office Environment, Health and Job Satisfaction: An Explorative Study of Office Design's Influence." Doctoral disseratation, KTH.

Danielsson, Christina Bodin, and Lennart Bodin. 2008. "Office Type in Relation to Health, Well-being, and Job Satisfaction Among Employees." *Environment and Behavior* 40 (5): 636–668. doi:10.1177/0013916507307459.

Davis, Matthew C., Desmond Leach, and Chris W. Clegg. 2011. "The Physical Environment of the Office: Contemporary and Emerging Issues." In International Review of Industrial and Organizational Psychology, edited by P. Gerard Hodgkinson and J. Kevin Ford, 195–237. Wiley.

Gorgievski, Marjan J., Theo J. M. van der Voordt, Sanne G. A. van Herpen, and Sophie van Akkeren. 2010. "After the Fire: New Ways of Working in an Academic Setting." *Facilities* 28 (3/4): 206–224.

Haynes, Barry P. 2008. "The Impact of Office Layout on Productivity." *Journal of Facilities Management* 6 (3): 189–201. doi:10.1108/14725960810885961.

Hoegl, Martin, and Luigi Proserpio. 2004. "Team Member Proximity and Teamwork in Innovative Projects." *Research Policy* 33 (8): 1153–1165. doi:10.1016/j.respol.2004.06.005.

Hongisto, Valtteri. 2005. "A Model Predicting the Effect of Speech of Varying Intelligibility on Work Performance." *Indoor Air* 15 (6): 458–468.

Jahncke, Helena, and Niklas Halin. 2012. "Performance, Fatigue and Stress in Open-plan Offices: The Effects of Noise and Restoration on Hearing Impaired and Normal Hearing Individuals." *Noise Health* 14 (60): 260–272. doi:10.4103/1463-1741.102966.

Jahncke, Helena, Valtteri Hongisto, and Petra Virjonen. 2013. "Cognitive Performance During Irrelevant Speech: Effects of Speech Intelligibility and Office-task Characteristics." *Applied Acoustics* 74 (3): 307–316. doi:10.1016/j.apacoust.2012.08.007.

Kaarlela-Tuomaala, A., R. Helenius, E. Keskinen, and V. Hongisto. 2009. "Effects of Acoustic Environment on Work in Private Office Rooms and Open-plan Offices – Longitudinal Study During Relocation." *Ergonomics* 52 (11): 1423–1444. doi:10.1080/00140130903154579.

Kim, Jungsoo, and Richard de Dear. 2013. "Workspace Satisfaction: The Privacy-communication Trade-off in Open-plan Offices." *Journal of Environmental Psychology* 36: 18–26. doi:10.1016/j.jenvp.2013.06.007.

van Koetsveld, Rogier, and Luc Kamperman. 2011. "How Flexible Workplace Strategies Can Be Made Successful at the Operational Level." *Corporate Real Estate Journal* 1 (4): 303–319.

Lansdale, Mark, Jennifer Parkin, Simon Austin, and Thom Baguley. 2011. "Designing for Interaction in Research Environments: A Case Study." *Journal of Environmental Psychology* 31 (4): 407–420. doi:10.1016/j.jenvp.2011.05.006.

Meijer, Eline M., Monique H. W. Frings-Dresen, and Judith K. Sluiter. 2009. "Effects of Office Innovation on Office Workers' Health and Performance." *Ergonomics* 52 (9): 1027–1038. doi:10.1080/00140130902842752.

Merriam, Sharan B. 2009. *Qualitative Research – A Guide to Design and Implementation.* San Francisco, CA: Jossey-Bass.

Nielsen, Karina, and Randall Reymond. 2013. "Opening the black box: Presenting a model for evaluating organizational-level interventions." European Journal of Work and Organizational Psychology. 22 (5): 601–617. doi:10.1080/1359432X.2012.690556

Nijp, H. H., D. G. Beckers, K. van de Voorde, S. A. Geurts, and M. A. Kompier. 2016. "Effects of New Ways of Working on Work Hours and Work Location, Health and Job-related Outcomes." *Chronobiology International* 33 (6): 604–618. doi:10.3109/07420528.2016.1167731.

Rolfö, Linda, and Jörgen Eklund. 2015. "Examining Office Type Preference." Paper presented at the Nordic Ergonomics Society 47th Annual Conference, Lillehammer, Norway.

Seddigh, Aram, Erik Berntson, Christina Bodin Danielson, and Hugo Westerlund. 2014. "Concentration Requirements Modify the Effect of Office Type on Indicators of Health and Performance." *Journal of Environmental Psychology* 38: 167–174. doi:10.1016/j.jenvp.2014.01.009.

Sundstrom, Eric, and Mary Graehl Sundstrom. 1986. *Work Places: The Psychology of the Physical Environment in Offices and Factories*. Cambridge: CUP Archive.

Sundstrom, Eric, Robert E. Burt, and Douglas Kamp. 1980. "Privacy at Work: Architectural Correlates of Job Satisfaction and Job Performance." *The Academy of Management Journal* 23 (1): 101–117. doi:10.2307/255498.

Sundstrom, Eric, Jerri P. Town, Robert W. Rice, David P. Osborn, and Michael Brill. 1994. "Office Noise, Satisfaction, and Performance." *Environment and Behavior* 26 (2): 195–222. doi:10.1177/001391659402600204.

Taber, Keith S. 2010. "Case Studies and Generalizability: Grounded Theory and Research in Science Education." *International Journal of Science Education* 22 (5): 469–487.

Toivanen, Susanna. 2015. *Framtidens arbetsplatser, Att utveckla hållbara och friska kontor*. Stockholm: Ponsarcus.

Van Meel, Juriaan, Yuri Martens, and Hermen Jan van Ree. 2010. *Planning Office Spaces. A Practical Guide for Managers and Designers*. London: Laurence King.

Vischer, Jacqueline C. 2007. "The Effects of the Physical Environment on Job Performance: Towards a Theoretical Model of Workspace Stress." *Stress and Health* 23 (3): 175–184. doi:10.1002/smi.1134.

van der Voordt, Theo J. M. 2004. "Productivity and Employee Satisfaction in Flexible Workplaces." *Journal of Corporate Real Estate* 6 (2): 133–148.

Vos, Paul, and Theo van der Voordt. 2002. "Tomorrow's Offices through Today's Eyes: Effects of Innovation in the Working Environment." *Journal of Corporate Real Estate* 4 (1): 48–65.

Wohlers, Christina, and Guido Hertel. 2016. "Choosing Where to Work at Work – Towards a Theoretical Model of Benefits and Risks of Activity-based Flexible Offices." *Ergonomics* 3: 1–20. doi:10.1080/00140139.2016.1188220.

Wolfeld, Leah R. 2010. "Effects of Office Layout on Job Satisfaction, Productivity and Organizational Commitment as Transmitted Through Face-to-face Interactions." *Colonial Academic Alliance Undergraduate Research Journal* 1 (1): 8.

Yin, Robert K. 1989. *Case Study Research: Design and Methods*, revised edition. Applied Social Research Methods Series, 5. Thousand Oaks: SAGE Publications.

Appendix 1

Focus group interview guide

(1) Briefly describe your position: years in the business, whether you work in a team, and how often you change desk?
(2) Is everyone at the office at the same time? Is the space adequately designed in order for you to perform your work tasks and feel satisfied?
(3) Which work tasks can easily be performed in the new office? Which work tasks work less well?
(4) Do you have a need for a good working atmosphere? Do you feel this is available?
(5) What was the biggest problem in the previous open-plan office?
(6) Is it important for you to have your own work space and silence?
(7) Do you feel productive?
(8) Are there any problems?
(9) Is there something else you would like to address concerning your work environment? Is there something about the physical environment you would like to improve?
(10) Would you recommend the ABW to other departments?

Individual interview guide

(1) In what way does the activity-based office promote your work tasks, which the open-plan office did not?
(2) In what way does the ABW inhibit your work tasks?
(3) Does the ABW satisfy all your office space needs?
(4) Are there any unspoken rules?
(5) Some people believe nesting occurs. Is this right or wrong according to you?
(6) How many times a day do you switch workplaces?
(7) Do people show consideration? How?
(8) What is your experience regarding sharing of work places?
(9) Would you dare ask a person to switch workplaces with you?
(10) Are there any conflicts/sources of irritation at the workplace at the moment?
(11) Do you use headphones? How do you feel about this?
(12) How has the ABW affected cohesion in the teams?
(13) Do you feel you work more ergonomically or less ergonomically today?
(14) Do you adjust your workplace equipment?
(15) What would you wish for to secure the best office work environment?
(16) Would you recommend the ABW to other departments?
(17) Is there something else you would like to address that is affected by the office layout and work environment?

Observation protocol

Office area	Occupied	Reserved	Available	Total no. of work stations
Work stations in open areas				52
2 glass-panelled rooms				12
Back-up rooms				6
Meeting rooms				9