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Ergonomics

ISSN: 0014-0139 (Print) 1366-5847 (Online) Journal homepage: www.tandfonline.com/journals/terg20

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To cite this article: Melina Forooraghi, Annemarie Hultberg, Ingibjörg H. Jonsdottir & Maral Babapour Chafi (2025) Exploring alignments between design principles and work unit needs in activity-based flexible offices: a case study, Ergonomics, 68:9, 1472-1490, DOI: 10.1080/00140139.2025.2475350

To link to this article: https://doi.org/10.1080/00140139.2025.2475350

Published online: 25 Mar 2025.

ERGONOMICS
2025, VOL. 68, NO. 9, 1472–1490
https://doi.org/10.1080/00140139.2025.2475350

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RESEARCH ARTICLE

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Exploring alignments between design principles and work unit needs in activity-based flexible offices: a case study

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ABSTRACT

Activity-based flexible offices (AFOs) offer employees a variety of workspaces based on their activities and needs. This study examines employees' perceptions of the workplace design across five work units in a public service organisation in Sweden, before and after relocation to AFOs. Data collection involved pre- and post-occupancy surveys (T1 = 345, T2 = 388) and interviews (T2 = 75). Explorative and descriptive data analysis was applied. The findings reveal a negative trend in perceptions of workplace design. The uniform application of design principles posed challenges. First, predominantly open zones did not support units with high concentration or confidential tasks. Second, limitations for personalisation did not fit units with creative tasks. Third, clean-desk policy introduced challenges in maintaining team cohesion and colocation did not improve within or between unit cooperations. The study suggests a balanced approach, combining customised and uniform principles to better align office design with diverse needs of different units within organisations.

Practitioner Summary: This study shows that the typical design principles of Activity-based Flexible Offices (AFO) did not align with the task characteristics of all work units within a large organisation. Therefore, organisations, designers, and architects should strive to find a balance between customised and standard design solutions when planning of AFOs.

ARTICLE HISTORY
Received 1 December 2023
Accepted 7 October 2024

KEYWORDS
Workspace design; flexible office; task characteristics; work environment; perceived performance

Introduction

Activity-based flexible offices (AFOs) are designed to provide a variety of workspaces for employees to choose from depending on their activities and needs (Appel-Meulenbroek, Groenen, and Janssen 2011). The assumption is that AFO as a workplace concept can support different tasks and types of work units in large organisations. However, studies show discrepant results about how well AFOs support different tasks (Engelen et al. 2019; Marzban et al. 2023). This discrepancy prompts a closer examination of how AFO design supports various tasks of employees.

AFOs are typically designed based on principles guiding the accommodation of a variety of work tasks. The typical design principles include zoning, that is to create open, semi-open, and enclosed areas tailored for various activities (van Meel 2020). Open work zones are strategically larger than quiet and semi-quiet zones with the purpose of promoting teamwork and informal interactions among employees (Hoendervanger et al. 2019; Wohlers and Hertel 2017). To enable sharing and ensure availability of workspaces for all individuals, a clean desk policy is often integrated in AFOs and personalisation is discouraged (Babapour Chafi and Rolfö 2019). Additionally, the emphasis on digitisation leads to reduced physical work material, often resulting in limited storage space for employees. While these principles are widely adopted in AFOs, they may not always align with the organisational needs and the diverse tasks of different work units. To the best of our knowledge, there is no previous research about how well AFOs support unit-specific needs within large organisations.

Research on the effectiveness of AFOs in supporting employees' tasks offers mixed results. Some studies show that AFOs are associated with improved communication and collaboration (Bodin Danielsson and Bodin 2008; Brunia, De Been, and van der Voordt 2016; ten Brummelhuis et al. 2012). On the other hand, other studies report negative outcomes in terms of visual and acoustic privacy for tasks that require concentration and confidentiality (De Been and Beijer 2014; De Been, Beijer, and Den Hollander 2015; Haapakangas et al. 2018; Radun and Hongisto 2023; Öhrn et al.

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2021). These conflicting findings may be due to the diversity of work tasks in different organisations and the extent to which AFOs support these tasks in different work units. Another reason may be differences in design characteristics of the AFOs that have been overlooked in previous research (exceptions are Forooraghi et al., 2023). This is particularly relevant as AFOs spatial definition is not strict, i.e., "open layout with environments for individual work, phone calls, and meetings" (Bodin Danielsson et al. 2015). Thus, assuming similarity – in terms of size, shape, layout, or zone distribution – in different AFOs might contribute to the identified conflicting findings. Limited documentation of design characteristics in investigated AFOs might be another reason, explaining different findings in previous literature.

From a Human Factors/Ergonomics perspective, workplaces should be designed to promote employee wellbeing and performance, by supporting employees in their different tasks and work activities and by meeting different task demands and needs that arise within the workplace. Office tasks in workplace studies are typically characterised based on two main dimensions: task complexity and interactivity (Bäcklander and Richter 2022; Hoendervanger et al. 2019; Soriano et al. 2020). The level of alignment between needs and office workplaces plays a crucial role in achieving positive employee outcomes (Appel-Meulenbroek, Colenberg, and Danivska 2021). For instance, a longitudinal study by Gerdenitsch, Korunka, and Hertel (2018) showed that those who perceived a better alignment (need–supply fit) reported an increase in workplace satisfaction and interaction across teams. Conversely, suboptimal alignment, such as exposure to task-irrelevant speech, can lead to strain, which is manifested in high noise annoyance, high workload, and fatigue (Radun et al., 2021). However, it is important to note that these studies primarily focus on alignment on individual level, while alignment at unit level has not been investigated. It is therefore important to identify the needs that different tasks pose to better understand how workplace design should be aligned with units' tasks and needs.

The relationship between AFO design and the diverse needs of different work units in large organisations continues to be a knowledge gap. This study aims to address this gap by examining employees' perceptions of workplace design before and after relocation to AFOs, with a particular focus on work units with different types of tasks. One unique contribution of this study is its detailed description and analysis of the design principles of the AFOs which are often underexplored in existing literature on user experience in activity-based offices.

Materials and methods

This study is based on data from pre- and post-occupancy evaluations of Activity-based Flexible Offices (AFOs) in a public service organisation in West Sweden. Relocation raises employee awareness of otherwise ordinary aspects of workspaces and therefore presents an opportunity for the study of perceptions of the work environment. The public sector was chosen based on the observation of Engelen et al. (2019) that this sector is underexposed in activity-based office research. The study was reviewed and approved by the Swedish Ethical Review Authority (Dnr. 768-18).

In order to examine perceptions of the workplace design before and after relocation to AFOs, a mixed methods approach was devised. This approach not only allows for quantitative results to be obtained, but it also facilitates the acquisition of in-depth and detailed explanations of the mechanisms behind quantitative trends from the participants' perspective (Miles, Huberman, and Saldana 2020). Survey data were collected on two occasions: **(T1)** a baseline survey collected two months prior to the relocation, and **(T2)** a post-relocation survey collected six months after the move. The qualitative data collection involved focus group interviews, which were conducted one year after relocation. All data were collected prior to the outbreak of the COVID-19 pandemic.

AFO design principles

The relocation was planned, initiated, and implemented with the overall goal of bringing together different units, optimising administrative workspaces, and reducing facility costs. The design of AFOs was guided by specifications provided by the organisation, emphasising that the workplace design (extending to digital systems) should be suitable for all employees without unit-specific customisations. Therefore, employee participation in the design process was limited. The organisation and architects drew from recommendations for activity-based offices set by architectural or consultancy firms: (i) AFO design was envisioned as an open floor divided into three zones according to van Meel (2020); (ii) a particular emphasis was on open zones. approximately 90–95% of the floor area; and (iii) an intended/planned occupancy of 50% of employees sharing non-assigned workstations, falling within the 0.4–0.8 sharing ratio according to van Meel (2020). Codes of conduct for the intended use of the different work zones were communicated with the employees via brochures, emails, and signs posted in different spaces. Table 1 summarises design principles that were

Table 1. Design principles used for all units in the activity-based flexible offices.

AFO design principles	Design goals
Uniform zone types and proportions: primarily open-plan spaces with a limited number of enclosed back-up spaces	• Support collaborative work by open-plan workspaces and meeting rooms occupying approximately 55–60% of the floor area • Support individual non-concentrative or collaborative work by semi-quiet open-plan workspaces accounting for 30–35% of the floor area • Support concentration-demanding tasks and phone calls by enclosed quiet zones or single rooms (5–10% of the floor area)
One-size personal lockers	Provide storage in proximity to a designated anchor point for each unit
Adjustable workstations for individual work and different types of furniture for collaborative work	Provide workstations intended for sharing among all units
Identical colour schemes, artworks, and greenery	Maintain a neutral environment intended for sharing among all units
Non-assigned desks with clean desk policy	Ensure availability and cleanliness of workspaces for the next user. Exceptions were made for a few employees with particular needs.
Co-location with other units and access to all floors	Foster collaboration and ease of movement within the facilities
Restricted access for external collaborators and visitors	Maintain security for employees

Figure 1. Examples of the standard workspaces provided by the AFOs.

used for all units, and Figure 1 illustrates typical workspaces and detailed design information can be found in a previous study Forooraghi et al., (2023).

Case study and population

The study took place in a public organisation responsible for healthcare, culture, and transportation services in one of the 21 provinces in Sweden. The case organisation had launched AFOs in two new buildings with central locations in two cities. The relocation brought together approximately 2,000 employees from a total of 15 units who worked from 20 locations. Five units were selected for analysis in this paper. This selection enables the authors to describe and compare task characteristics, an analysis that is more feasible in relatively smaller work units. Therefore, our study includes units that met the following criteria: (a) medium-sized units comprising between 80 and 250 employees, with (b) floor plans that followed the organisation's principles for AFO design (Figure 2).

The five work units had between 82 and 229 employees (T2) located in the Activity-based offices. The average response rate was 65% at T1 and 60% at T2. The distribution of respondents in terms of age, gender, and position (managerial) approximately reflects the broader composition of the organisation (Table 2). This is particularly evident as the organisation predominantly provides public services, where

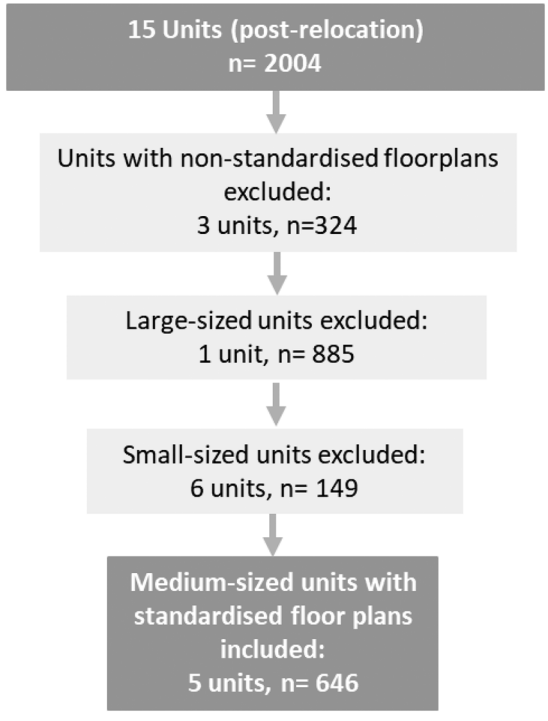


Figure 2. Inclusion and exclusion criteria for data analysis.

Table 2. The study population and participants' demographic data.

Units	Unit 1. Healthcare administration		Unit 2. Healthcare administration		Unit 3. Creative production		Unit 4. Service administration		Unit 5. Service administration		Total	
Measurement time	T1	T2	T1	T2	T1	T2	T1	T2	T1	T2	T1	T2
Eligible participants, n.	87	120	147	125	90	90	76	82	126	229	526	646
Respondents, n. (%)	69 (79%)	82 (68%)	80 (54%)	86 (69%)	36 (40%)	51 (57%)	59 (78%)	49 (60%)	101 (80%)	120 (52%)	345 (65%)	388 (60%)
Gender, n. (%)												
Female	58 (84%)	67 (82%)	64 (80%)	66 (77%)	31 (86%)	36 (70%)	37 (64%)	35 (70%)	45 (45%)	55 (46%)	235 (68%)	259 (67%)
Male	9 (13%)	11 (13%)	13 (16%)	16 (19%)	4 (11%)	7 (14%)	18 (30%)	13 (26%)	55 (54%)	58 (48%)	99 (29%)	105 (27%)
No answer	2 (3%)	4 (5%)	3 (4%)	4 (4%)	1 (3%)	8 (16%)	4 (5%)	1 (4%)	1 (1%)	7 (6%)	11 (3%)	24 (6%)
Age group, n. (%)												
<29	2 (3%)	1 (1%)	3 (4%)	1 (1%)	–	–	2 (3%)	3 (6%)	6 (6%)	9 (7%)	13 (4%)	14 (4%)
30–49	20 (29%)	30 (37%)	31 (39%)	36 (42%)	20 (55%)	21 (41%)	26 (44%)	23 (47%)	54 (53%)	71 (59%)	151 (44%)	181 (46%)
>50	46 (67%)	49 (60%)	43 (54%)	47 (55%)	15 (42%)	21 (41%)	30 (51%)	19 (39%)	39 (39%)	34 (28%)	173 (50%)	170 (44%)
No answer	1 (1%)	2 (2%)	3 (3%)	2 (2%)	1 (3%)	9 (18%)	1 (2%)	4 (8%)	2 (2%)	6 (5%)	8 (2%)	23 (6%)
Managerial role, n. (%)	10 (14%)	11 (13%)	11 (14%)	15 (17%)	4 (11%)	3 (6%)	4 (7%)	4 (8%)	9 (9%)	10 (8%)	38 (11%)	43 (11%)
Office type pre-relocation, n. (%)												
Cell/shared office	43 (62%)	–	65 (81%)	–	4 (11%)	–	37 (63%)	–	11 (11%)	–	160 (46%)	–
Open plan office	4 (6%)	–	5 (6%)	–	31 (86%)	–	6 (10%)	–	22 (22%)	–	68 (20%)	–
Non-territorial office	18 (26%)	–	7 (9%)	–	–	–	15 (25%)	–	60 (59%)	–	100 (29%)	–
No answer	4 (6%)	–	3 (4%)	–	1 (3%)	–	1 (2%)	–	8 (8%)	–	17 (5%)	–
Interviewees												
All participants, n.	–	11	–	23	–	16	–	12	–	13	–	75
Those with managerial roles, n.	–	2	–	4	–	2	–	1	–	1	–	10

women are overrepresented in both healthcare and administrative roles. There was a slight deviation in Unit 5 (service administration) in terms of gender distribution, which also is in line with the overall differences between units with technical roles versus those with administrative roles. In addition to the surveys, focus group interviews were held with 75 employees from the included work units who volunteered to participate. A breakdown of responsibilities, roles, and types of tasks at each unit is given in Table 3.

Data collection and analysis

Surveys

The surveys were collected using a secure online service and contained anonymous data only. The questions were based on a survey developed by Rolfö and colleagues (Rolfö 2018b; Rolfö, Eklund, and Jahncke 2018), which aims to evaluate office designs. The questions were selected based on previous research on activity-based working (Engelen et al. 2019; Marzban et al. 2023) and its consequences for the perceptions of: functionality, privacy and distractions, performance, and social interaction.

Functionality comprised four questions measuring respondents' satisfaction with the physical work environment, task-environment alignment, furniture adjustability, and storage. Perceptions of privacy and distractions involved four questions exploring access to secluded spaces, visual and acoustic privacy, and speech level. Perceived performance included perceptions of productivity, handling confidential tasks in a satisfactory manner, and the frequency of work interruptions. Finally, the social interactions category encompassed four questions focusing on the social atmosphere, belonging to community, and cooperation within and between units (Appendix A, Table A1).

To explore perceptions of the workplace design, the survey data was analysed using descriptive statistics. For enhanced readability in reporting, the scales were simplified. The seven-item scales were simplified as 'negative' responses (1–3: very dissatisfied, slightly dissatisfied, and dissatisfied), 'positive' responses (5–7: very satisfied, slightly satisfied and satisfied) and neutral responses (4: neither satisfied nor dissatisfied). The five-item scales were simplified to 'frequently' (1–2: always and often), 'sometimes' (3) and 'rarely' (4–5: seldom and never). To describe general task characteristics for each unit, survey items about the nature and extent to which they involved confidential tasks, tasks requiring concentration, and interaction with others were analysed. According to a classification proposed by Rogelberg, Scott, and Kello (2007), tasks performed for less than five hours per week were considered to be low frequency, tasks performed for 5–22 hours per week were classified as medium frequency, and tasks performed for more than 23 hours per week were considered as high frequency. The analysis focuses on identifying frequent tasks.

Interviews

All employees who were relocated to the AFO were invited via e-mail to participate in the focus group interviews. The interviewees represented different units and had different roles and tasks that portrayed the general profile of each unit. The focus group interviews involved open-ended questions that aimed to capture alignments and misalignments between interviewees' tasks and the office environment. The following question was posed with prompts to encourage

Table 3. Task characteristics at the work units based on T2 measurements.

Units	Confidential tasks, n. (%) (Answered yes)	Concentrative work, n. (%) (more than 23 hours per week)*	Individual work, n. (%) (more than 23 hours per week)*	Group work, n. (%) (more than 23 hours per week)*
Unit 1. Healthcare administration (E.g. recruitment, training, planning, administration, coordination with care centres, and analysis of patient data)	44 (54%)	69 (84%)	28 (34%)	42 (51%)
Unit 2. Healthcare administration (E.g. telephone support, data analysis, meetings with care centres, and providing digital healthcare services)	62 (72%)	72 (84%)	34 (39%)	33 (38%)
Unit 3. Creative production (E.g. meetings with external partners, developing visual material, conducting interviews, and communication with different stakeholders)	4 (8%)	41 (80%)	16 (31%)	18 (35%)
Unit 4. Service administration (E.g. facilitating logistics and administrative services across all units by coordinating meetings and offering comprehensive support to managers)	28 (57%)	36 (73%)	23 (47%)	17 (35%)
Unit 5. Service administration (E.g. planning, building administration, and maintenance of both administrative and healthcare facilities, customer service, and collaborating with other units)	41 (34%)	91 (76%)	50 (42%)	44 (37%)

*Number and percentage of respondents who reported that they predominantly work under high concentration work individually or work together with others (group work). The responses about task characteristics are separate items and may not collectively add up to 100%.

elaboration and exemplification: *How well does the AFO support your individual tasks?* To address collaboration and interactions, the following questions were posed: *How well is the collaboration between you and your colleagues supported in the AFO? What (if any) changes have you observed with respect to how you communicate in the AFO in comparison to your previous offices?* The focus group interviews included up to seven participants and took between 50 to 145 minutes (average = 84.4 mins). These were recorded and transcribed verbatim for analysis.

The interview transcripts were analysed to assess the alignment between the tasks performed by the interviewees and the AFO environments. The analysis involved a coding process to identify (1) individual and unit-level tasks, and (2) the design principles that were perceived to support or hinder the interviewees' tasks. These were coded as alignments or misalignments and categorised into the key themes derived from the survey: functionality, privacy and distractions, perceived performance and social interactions. The identified alignments or misalignments were segmented based on the work units to help explain the survey results and illustrated with selected quotes (de-identified with a number for the interviewees and the units they represent e.g. 15–U2).

The task descriptions from interviewees were aggregated with survey data to provide an in-depth description of the nature and contexts of tasks at each unit (Table 3).

Result

The results are presented in four sections. Each section presents the survey responses on workplace design from pre-and-post relocation to Activity-based Flexible Offices (AFOs), followed by insights from post-relocation interviews with employees. The interviews shed light on the alignments and misalignments between interviewees' tasks and the design principles of the AFOs.

Perceived functionality

All five units showed a general negative trend between T1 and T2 regarding the employees' perceptions of functionality (See examples in Figure 3). Large variations were seen between different units, with the largest changes seen for the creative production unit (Unit 3), followed by the healthcare administration unit (Unit 1), while the difference between pre- and post-relocation was smaller in the other units. For instance, the proportion of those with a positive rating of task-environment alignment decreased from 59% to 16% in Unit 3, while in Unit 2 (healthcare administration), it decreased from 64% to 44% after relocation. The service administration unit (Unit 5) had fewer positive responses at T1, i.e. before the relocation to the AFO, compared to other units and the changes between T1 and T2 in this unit were marginal. For instance, the proportion of those with a positive rating of the task-environment alignment in unit 5 declined from 44% to 36%.

The interview findings show several misalignments between interviewees' tasks and the AFO design principles (Table 4). In Unit 3, interviewees emphasised that their unit – unlike the other units – worked primarily with creative tasks and was thus not identified as an administrative unit. The interviewees' tasks involved, for example, developing visual material, conducting

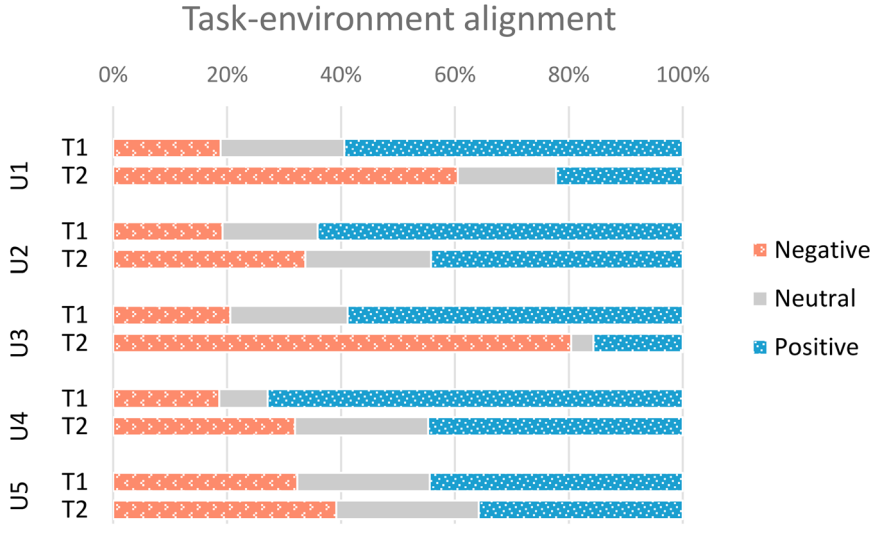


Figure 3. Units' survey responses on perceptions of task-environment alignment, showing proportion of respondents.

interviews, and communicating with different stakeholders. One aspect raised was that their previous location was designed to display their production and work-in-progress. However, in the new premises, the interviewees were concerned about limited storage space for their material, as well as the "removed visual identity" of the unit due to clean desk policies that prevented all units from use of any group or individual visual expressions: '*Our unit has struggled with a challenge: it was quite invisible. But we worked hard to make it more visible. Now, we find ourselves in a building with floors that look exactly alike*' (18–U3). Furthermore, the relocation was associated with the adoption of centralised digital systems, which added to the workload of the unit: '*The novelty was not just in the physical environment or the way of working, but also in the complete change of all our systems. Simply, we were forced to use the centralised systems*' (22–U3).

The other four units had administrative and/or support functions, such as human resources management that required collaboration with internal stakeholders. One alignment mentioned was the provision of various workspaces that were perceived to match their task variation. As one interviewee from Unit 5 noted: '*It [activity-based office] suits my tasks well. I can work at different workspaces depending on the activity*' (27–U5). In addition, the interviewees from Unit 5 mentioned that they were used to activity-based working, but their previous offices were not designed with a variety of spaces, which they appreciated in the new offices.

Table 4. Reported alignments and misalignments between interviewees' tasks and the AFO design principles that explain the reasons behind perceptions of functionality.

Perceived functionality	Design principle
Alignment:	
• Workspace variety and furniture (Units 2,4,5)	• Adjustable workstations for individual work and different types of furniture for collaborative work
Misalignment:	
• Insufficient surface for work material (Units 1 and 3)	• One-size personal lockers
• Lack of fully equipped workstations in collaboration zones (Units 1 and 3)	• Uniform zone types and proportions
• Lack of opportunity to display production hence removed visual identity (Unit 3)	• Non-assigned desks with clean desk policy • Identical colour schemes, artworks, and greenery

Perceptions of privacy and distractions

The overall trend regarding satisfaction with privacy and distractions was negative (see examples in Figure 4). Unit 3 (creative production unit) had the largest decline in satisfaction with access to secluded spaces (from 76% to 14%). The healthcare administration units (units 1 and 2) and service administration units (units 4 and 5) showed over 20% declines in the proportion of positive responses regarding access to secluded workspaces. Unit 4 maintained a satisfaction rate of over 60%, while Unit 5 had a marginal decline from 45% to 37%.

A common misalignment observed across all units was the exposure to distractions and difficulty finding secluded workspaces (Table 5). In Unit 3, the interviewees described a misalignment between their need to focus during writing tasks and creative work and the AFO environments: '*I have a writing process where I need to be by myself. But I can't because there is no room for that. There are some dark ones that I can't tolerate. It neither fits such tasks, nor when I have to research and call around. There is no stimulating place to go to*' (17–U3).

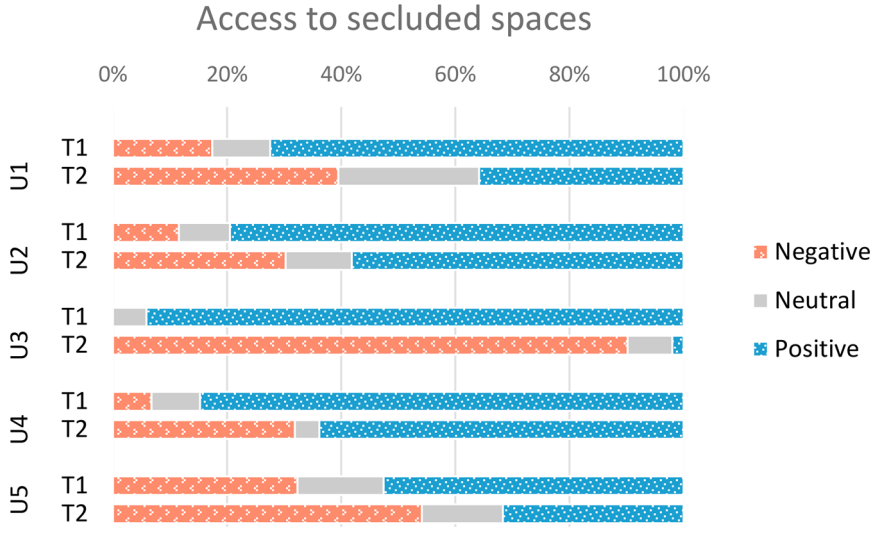


Figure 4. Units' survey responses on perceptions of access to secluded spaces, showing proportion of respondents.

Employees working in Units 1 and 2 mainly work with healthcare administration and a large proportion of respondents reported having confidential tasks (56% in Unit 1 and 70% in Unit 2). This was confirmed in the interviews, where work tasks such as analysis of patient data, meetings with care centres, and providing digital healthcare services were common (Table 3). Particularly, the interviewees from Unit 1 found it difficult to find available and suitable workspaces: '*The frustration from not finding a place that works for my task takes my motivation away. We endure this every day*' (25–U1). This shortage of appropriate workspaces was perceived to be due to miscalculations in the assumed occupancy of the facilities. The interviewees in Unit 1 also pointed to the removal of quiet zones on the floor they worked, which did not align with their need to focus or handle confidential tasks: '*We have remodelled floor 10. Now there are no quiet or semi-quiet zones. These areas have now been allocated to individuals who need fixed workspaces*' (14–U1).

Table 5. Reported alignments and misalignments between interviewees' tasks and the AFO design principles that explain the reasons behind perceptions of privacy and distractions.

Perceptions of privacy and distractions	Design principle
Alignment:	
• Access to secluded spaces (Unit 5)	• Uniform zone types and proportions: primarily open-plan spaces with a limited number of enclosed back-up spaces
Misalignment:	
• Exposure to distractions and shortage of secluded workspaces for concentration demanding tasks (All units) • Removal of quiet zones (Unit 1) • Shortage of secluded rooms for creative tasks (Unit 3)	• Uniform zone types and proportions: primarily open-plan spaces with a limited number of enclosed back-up spaces

Despite the survey results indicating a decline in satisfaction in Unit 5, where 60% of employees were relocated from non-territorial workspaces, interviewees highlighted that they had access to secluded workspaces suitable for both collaborative and individual work: '*I deal with questions that require meetings with colleagues throughout the region. We meet mostly here because it is easiest and there are very good meeting rooms and collaboration areas. It works very well when we work in groups and projects. It is also easy to find a private space for individual work, or spaces in proximity to colleagues with large screens to work on*' (25–U5).

Perceived performance

The overall trend in perceptions of performance was negative (See examples in Figure 5). The creative production unit (Unit 3) had the largest decline compared to other units. To illustrate, the proportion of respondents with positive ratings of self-rated productivity dropped from 75% to 33% in Unit 3, while positive responses among respondents in the healthcare administration unit (Unit 2) showed a decline from 91% to 72%.

A common misalignment across all units was the loss of time caused by the need to carry items around and search for and set up a workstation (Table 6). On the other hand, the identified alignments were, for instance, ease of access to other units because of colocation and easier delivery of customer service, particularly relevant to the specific tasks in Units 4 and 5.

The observed negative trend in survey responses within Units 1 and 2 is in line with the outlined misalignments and dissatisfaction with privacy and

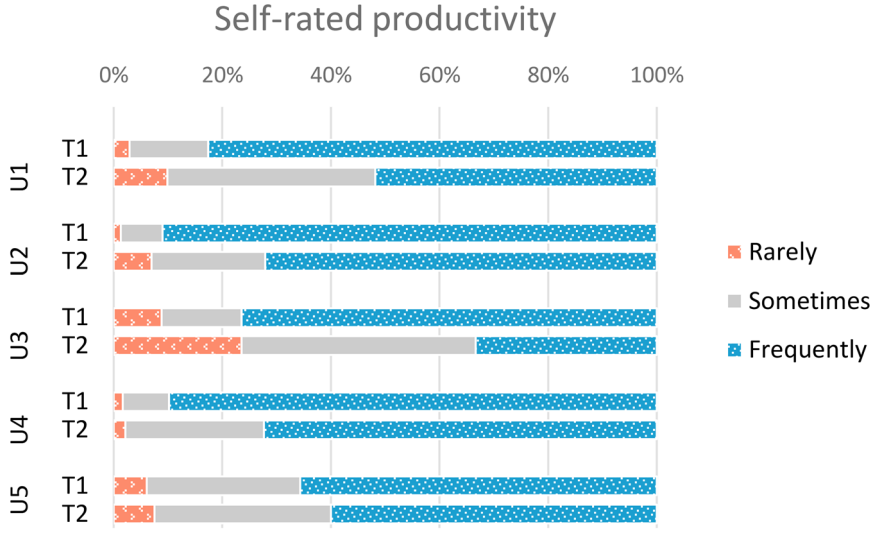


Figure 5. Units' survey responses on self-rated productivity, showing proportion of respondents.

distractions (See Table 5). According to the interviewees, the tasks of Units 1 and 2, responsible for healthcare administration, involved handling sensitive patient data, that required privacy and concentration. These needs were not supported due to a shortage of secluded spaces in the AFOs. Similarly, the AFOs did not align with the specific needs and demands of the creative production unit (Unit 3), which involved accommodating meetings with external networks and creating visual materials.

Perceptions of social interactions

The overall trend in satisfaction with the social interactions varied depending on specific aspects. Satisfaction with the social atmosphere remained relatively stable across units. However, there were negative trends in perceptions of belonging to community and cooperation, which were particularly evident in units 1, 3, and 5 (see examples in Figure 6). Among these, the creative production unit (Unit 3) showed the largest decline in the number of respondents who were satisfied with cooperation both within the unit and between units. The proportion of those who were satisfied dropped from 74% to 35% and from 62% to 24%, respectively. On the other hand, Units 1 and 5 saw a decline in satisfaction with cooperation within their units, from approximately 80% to 60% of respondents. Units 2 and 4 showed no change in satisfaction with cooperation within their units, maintaining levels above 80%.

The interviewees from Units 2, 4, and 5 mentioned the need to frequently move between different premises for their internal and external meetings, and as a result, they appreciated the central location of the new offices and the access to collaboration spaces that supported their collaborative tasks (Table 7). On the other hand, a common misalignment reported by the interviewees was difficulty finding colleagues due to dispersed locations in the building. A misalignment reported by interviewees in Unit 3 related to the

Table 6. Reported alignments and misalignments between interviewees' tasks and the AFO design principles that explain the reasons behind perceptions of performance.

Perceived performance	Design principle
Alignment:	
• Improved efficiency due to co-location other units (Units 2,4,5)	• Co-location with other units and access to all floors
Misalignment:	
• Time loss due to carrying things around, finding and setting up a workstation • Exposure to distractions and shortage of secluded workspaces (All units)	• Non-assigned desks with clean desk policy • Uniform zone types and proportions: primarily open-plan spaces with a limited number of enclosed back-up spaces

Table 7. Reported alignments and misalignments between interviewees' tasks and the AFO design principles that explain the reasons behind perceptions of social interactions.

Perceptions of social interactions	Design principles
Alignments:	
• Access to other units (Units 2,4,5) • Chances for spontaneous meetings (all units)	• Co-location with other units and access to all floors
Misalignment:	
• Difficult to find and meet colleagues due to dispersed locations in the buildings (all units) • Challenges in coordinating meetings with external parties (Units 3)	• Non-assigned desks with clean desk policy • Restricted access for external collaborators and visitors

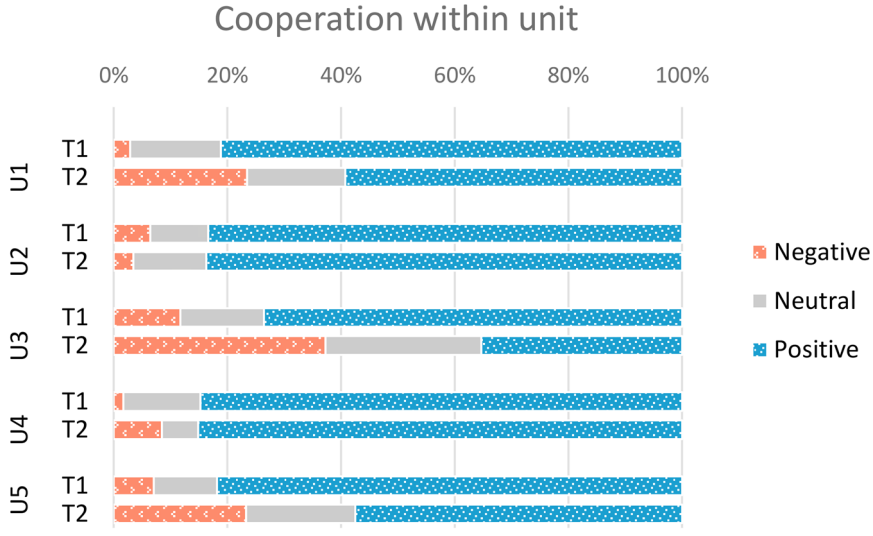


Figure 6. Units' survey responses on perceptions of cooperation within unit, showing proportion of respondents.

limited opportunities to accommodate meetings with their external network–a central part of their assignments–in the new building due to accessibility limitations: '*We engage in promotional work to empower others to thrive in their development [artistic production]. However, we lack the necessary accessibility here for external collaboration. Unfortunately, they are not welcome in these premises. We are supposed to meet them at the reception and take them to meeting rooms in the conference facilities, which have been fully booked throughout the autumn*' (16–U3). The interviewees referred to a sense of division and an increased reliance on digital communication as a result of activity-based working: '*We used to sit together and had close collaborations. Now that we are more spread out, it is more difficult to stay connected. We see each other less frequently, resulting in a noticeable and unfavourable difference. On the other hand, we find ourselves encountering people who we don't necessarily need to meet*' (14–U3).

Discussion

The aim of the study was to examine perceptions of workplace design across different work units in a large public service organisation before and after relocation to Activity-based Offices (AFOs). The findings showed predominantly negative trends in the perceptions of functionality, privacy and social interactions, and perceived performance in AFOs. The results also revealed that the AFO design principles did not adequately support creative, high concentration, and confidential tasks. Our discussion will outline the conundrums and consequences of applying uniform AFO design principles to units with different missions and work tasks.

The findings show that the AFO design did not align with concentration-demanding tasks, regardless of which unit was studied. More than 70% of respondents across the different units reported having work tasks that require a high degree of concentration. However, the total floor area allocated to workspaces suitable for high concentration tasks was only 5–10%, which did not align with the needs for privacy and concentration. These findings are in line with other studies that also report negative outcomes regarding the impact of AFOs on distraction and privacy (De Been and Beijer 2014; De Been, Beijer, and Den Hollander 2015; Haapakangas et al. 2018; Radun and Hongisto 2023; Öhrn et al. 2021). Organisations adopting AFOs often face challenges related to open layouts and a shortage of workspaces designed for high-complexity tasks (Hoendervanger et al. 2019) and it has been shown that typical AFO layouts include mainly open zones which are not suitable for supporting high concentration and confidential tasks (Hoendervanger et al. 2019; Wohlers and Hertel 2017). Previous studies, however, overlook differences between AFOs in terms of layout characteristics and provide little information about the spatial characteristics of the studied AFOs. Here, we demonstrate a misalignment between the proportion of secluded spaces and the units' needs to carry out concentrated and confidential tasks, which most probably explains the lower satisfaction ratings for visual and acoustic privacy. The result of this study thus confirms that typical AFO designs, with mainly open layouts, do not provide adequate support for concentrated or confidential tasks. This highlights the need to customise AFO design for different units within larger organisations. By explicitly describing the design principles, we also provide a reference point for future comparisons.

The findings also revealed that the AFO design did not align with the creative tasks performed by the creative production unit, mainly due to limitations for visual identity expression, personalisation, storage and logistic challenges related to accommodating meetings with external stakeholders. The literature suggests that to support creativity, workspaces should reflect a specific creative identity (Thoring et al. 2020), which contradicts one of the core design principles of AFOs, where personalisation and identity expressions are discouraged. There is a widely held assumption that open workspaces are the best option for creativity due to the facilitation of spontaneous interactions (Ngah and Jusoff 2009), but our findings support other studies highlighting the importance of privacy and a distraction-free environment for creative tasks (van der Voordt 2004; Yekanialibeiglou, Demirkan, and Denti 2021). To address these challenges, it is suggested that AFO layouts should provide a balance between visual and physical openness and meet employees' needs for privacy as well as identity expression (Colenberg et al. 2021).

Another finding from this study was that while satisfaction with social atmosphere remained stable in all work units, there were notable decline in perceptions of belonging to community and cooperation. The design principle of non-assigned desk with clean desk policy led to difficulties finding colleagues, increased the reliance on digital communication and triggered a sense of division from immediate colleagues. These results align with the findings of Haapakangas et al. (2019) that showed that problems in finding colleagues in AFOs can impair communication and sense of community. However, the findings contradict with previous research suggesting that AFOs generally enhance collaboration and social interaction by

providing open and diverse spaces for different tasks (Divett 2020; Gerdenitsch, Korunka, and Hertel 2018; Mache, Servaty, and Harth 2020). Specifically, between-team cooperations did not improve in our study due to distance and placement of units that were to cooperate. These findings contradict with Wohlers and Hertel (2018) that showed improvements in between-team collaborations. Our study implies that AFOs do not necessarily support all types of cooperation and that organisations should consider the unique needs of various work units, regarding internal and external cooperations, when adopting AFOs.

Practical implications

The application of typical AFO design principles imposes several conundrums for organisations that adopt the concept, as well as for the architects and designers that create the spaces. Organisations need to account for diverse and emergent requirements related to social and environmental sustainability, costs, savings, security, branding, technological changes and new ways of working (Bentley et al. 2021). The trend of activity-based and flexible arrangements offers a potential solution to address such diverse requirements (ibid). However, understanding the needs of different work units in large organisations and creating customised solutions may be challenging, particularly in public organisations where resources are limited and must be carefully allocated.

The negative results and design shortcomings in our case study may have been avoided if users were invited to be more involved in the design process. It must, however be acknowledged that user participation can be quite challenging in larger organisations, particularly when trying to balance the needs of multiple work units of different sizes in the planning and the design process. Larger units tend to skew the results of a need analysis in the planning process, leading to the under-prioritisation of smaller units with unique needs. Given that the implementation of AFOs is a socio-technical work system change (ibid), participation is necessary for its success (Babapour Chafi and Rolfö 2019; Brunia, De Been, and van der Voordt 2016; Lahtinen et al. 2015). Financial investments are required for well-planned programme decisions, thorough analysis of unit needs, and participatory design processes. Designers and decision-makers should strive to align the AFO design principles to suit all units, irrespective of size and task characteristics and recognising that not every unit requires identical design principles. Opting for a combination of customised and standard design principles can provide a more effective solution, fostering better alignment with the diverse needs of various units within organisations.

Our findings indicate a discrepancy between "work as imagined" by decision-makers and designers and "work as done" by employees. It is therefore relevant to pay closer attention to contextual task characteristics in pursuit of task supportive AFOs. This may be achievable through user involvement, given the persistence and engagement of unit representatives and managers during the planning and design process (Babapour Chafi, Forooraghi, and Hultberg 2022). Unit representatives may also face another conundrum in their roles in planning processes, that is, finding a balance between the needs of the unit as a whole versus the needs of the individual. To mitigate such issues, occupational health experts can act as '*political reflective navigators*' (Broberg and Hermund 2004), facilitating an understanding of unit-specific needs and mediating between stakeholders throughout the process (Babapour Chafi, Forooraghi, and Hultberg 2022). In addition, there is a potential to develop systematic methods for task analysis, inspired by observational and probing task analysis methods used in the ergonomic/human factors discipline. Whether architects have the training and competence to systematically analyse employees' tasks and needs can be a subject of future research (Sailer et al. 2008).

Typical design principles in AFOs also impose challenges for employees, leading to deviations from the "expected use and behaviour". These deviations, such as taking a phone call in a zone designated for quiet work often arise when the zone proportions do not align with employees' specific tasks and needs. Consequently, zones designated as quiet may not actually stay quiet, and employees may switch workspaces less frequently than anticipated. One possible explanation for these discrepancies is individuals' tendency to safeguard their resources perceived to be at risk (Parker et al. 2013). In AFOs with insufficient spaces for concentration and collaboration, employees may become more possessive of their current spaces and hesitate to switch workspaces as frequently as they otherwise would (Bäcklander and Richter 2022).

Strengths and limitations

This longitudinal mixed methods study offers insights into how AFOs with mainly open-plan areas impact work units with different task characteristics. When examining general workspace satisfaction (Bodin

Danielsson and Bodin 2009; Kim et al. 2016; Kim and de Dear 2013), activities are often disregarded. Studies that examine the perceived fit of office activities with the environment compare tasks at an individual level (Radun and Hongisto 2023; Öhrn et al. 2021). One strength of this study is that it takes a different approach, compared to previous studies, using the group level as a unit of analysis. The focus is on activities at a work unit, which is of relevance as unit-level needs are collected during planning processes (Babapour Chafi, Forooraghi, and Hultberg 2022). The mixed methods approach, which incorporates both quantitative and qualitative data, proved advantageous. This is particularly true because the unit-level analysis of tasks is often overlooked in workplace research where a contextual understanding of work practices is required. Another strength of this study is its detailed description and analysis of the design principles of the studied AFO, providing a reference point for the study of work environment in activity-based offices.

Our study has several limitations. First, our data collection did not allow for linking individual responses before and after relocation, due to privacy concerns at the organisation. As a result, statistical tests for modelling or repeated measures analysis of variance were not viable. Therefore, we presented the results with descriptive statistics and reported qualitative comparisons.

Second, it is important to note that the number of eligible participants increased in all units (except U3). This increase was due to changes in the planning process with respect to the number of employees who were originally designated to move to the new building within most units. Thus, the number of participants was similar for the two different timepoint, but due to higher number of eligible participants, the response rates declined in Units 1, 4, and 5, with Unit 5 having the largest decline (28%). The large decline in Unit 5 can be explained with the considerable increase in the number of eligible participants (from 126 to 229). The new eligible participants may have refrained from responding to the survey as they were not included in the baseline measurement. Generally, declined response rate may be due to a lack of interest, situational factors such as competing priorities, or concerns such as being over-surveyed (Rogelberg and Stanton 2007). Our data does not capture non-response motives, and our results therefore reflects the respondents experience, and cannot be generalised to the entire unit (in particular those with lower response rates). In contrast to the general trend of declining response rates in survey studies, two work units in our study (Units 2 and 3) had an increased response rate by over 15% from T1 to T2. The increased response rate could indicate that more employees chose to voice their dissatisfaction after relocation and potentially lacked interest in the relocation at T1.

Another limitation is that the selected questionnaire used for data collection was initially designed during a period where AFOs were scarce and thus may not include all aspects relevant to study in AFOs (Rolfö 2018a). For instance, our study did not control for potential differences in leadership between the different work units. Particularly, change-oriented leadership has been found to mitigate the loss in perceived productivity after relocation to AFOs (Bergsten et al. 2021). Another limitation is that our survey captured general perceptions of the respondents in response to the AFO as a whole, and not with respect to particular spaces. A more detailed investigation would be needed to identify the type of spaces in AFOs that are more functional for the different work units.

The choice of medium-sized work units in combination with qualitative data collection, compensated for this limitation by allowing us to capture the contextual nature of the work environment at each unit. Owing to the limitations of our analysis, causal relationships should not be inferred from the findings. In terms of practical implications, it is unclear what improvements would lead to satisfaction with, for instance, privacy, and improve the perceived performance ratings. Our findings could be addressed further in interventions that provide evidence on alternative design principles, such as providing predominantly enclosed instead of open spaces.

Our data may have captured novelty effects of relocating to AFOs, as surveys were collected three months before and six months after relocation. Additionally, the interviews were conducted one year after relocation. Some studies report potential positive outcomes after approximately 1.5 years, such as an increase in perceived performance (Meijer, Frings-Dresen, and Sluiter 2009) and satisfaction (Ekstrand and Karsten Hansen 2016). In contrast, other studies report negative outcomes over time, such as decreased productivity (Mosselman, Gosselink, and Beijer 2010) and declining perceived benefits due to fading novelty effects (Gerdenitsch, Korunka, and Hertel 2018). It is, however, argued that improving the AFO design post-relocation and acclimatisation may resolve the initial challenges and negative impacts of AFOs (Babapour 2019; Ekstrand and Karsten Hansen 2016). A longer follow-up period could have been beneficial, as it would have allowed us to capture any changes over longer time spans.

The generalisability of the findings is restricted by the fact that data were gathered in one Swedish organisation before the outbreak of the COVID-19 pandemic, when employees mostly worked in offices. It is, however, important to note that our intention was to contextualise how AFOs are perceived by workers. Our results are transferable to similar contexts. The transferability of findings was strengthened by triangulation between different data sources, detailed and clear descriptions of the AFO design principles, and the tasks at each work unit, which allowed for a comparison with other contexts. Despite the unit differences, the study population exhibited a low-to-neutral level of satisfaction with privacy and functionality, while satisfaction with social aspects was high. These results are in line with results from a large number of studies reported in the systematic literature review by Engelen et al. (2019). Lastly, as remote work has increased, the way employees experience their workplaces may have changed. Studies suggest new challenges and needs emerging in office environments after the COVID-19 pandemic (Babapour Chafi, Hultberg, and Bozic Yams 2022), and more research is needed to explore whether AFOs meet these emergent needs.

Conclusions

This paper examined the perceptions of workplace design in five units within a large organisation before and after relocation to Activity-based Flexible Offices (AFOs). The findings suggest that (1) the typical AFO design principles, mainly with open zones, may not adequately support tasks requiring high concentration or confidentiality, (2) design principles that limit personalisation may not align well with the needs of groups with creative tasks, and (3) co-location and clean desk policy may not necessarily improve cooperations within and between groups. When planning and designing AFOs, it is advantageous to consider a group-level perspective, acknowledging the diverse needs and tasks of different units that may require customisation. A balanced approach, combining customised and standard design principles, can be more effective for aligning the workplace design with the diverse needs of different groups within an organisation.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

The author(s) reported there is no funding associated with the work featured in this article.

References

Appel-Meulenbroek, R., P. Groenen, and I. Janssen. 2011. "An End-User's Perspective on Activity-Based Office Concepts." *Journal of Corporate Real Estate* 13 (2): 122–135. doi:10.1108/14630011111136830.

Appel-Meulenbroek, R., S. Colenberg, and V. Danivska. 2021. "Towards an Interdisciplinary Employee-Workplace Alignment Theory." In *A Handbook of Theories on Designing Alignment Between People and the Office Environment*, edited by R. Appel-Meulenbroek and V. Danivska, 1st ed., 272–288. London: Routledge.

Babapour Chafi, M., A. Hultberg, and N. Bozic Yams. 2022. "Post-Pandemic Office Work: Perceived Challenges and Opportunities for a Sustainable Work Environment." *Sustainability* 14 (1): 294. https://www.mdpi.com/2071-1050/14/1/294. doi:10.3390/su14010294.

Babapour Chafi, M., and L. Rolfö. 2019. "Policies in Activity-Based Flexible Offices -'I am Sloppy with Clean-Desking. We Don't Really Know the Rules." *Ergonomics* 62 (1): 1–20. doi:10.1080/00140139.2018.1516805.

Babapour Chafi, M., M. Forooraghi, and A. Hultberg. 2022. "Success Factors and Challenges in Implementing Activity-Based Flexible Offices – A Qualitative Process Evaluation with Key Stakeholders." 3rd TWR Conference, Politecnico di Milano, Italy. https://mellanarkiv-offentlig.vgregion.se/alfresco/s/archive/stream/public/v1/source/available/sofia/hos4380-250679164-21283/surrogate/Babapour%20et%20al%202022%20-%20TWR-III-Proceedings.pdf

Babapour, M. 2019. "From Fading Novelty Effects to Emergent Appreciation of Activity-Based Flexible Offices: Comparing the Individual, Organisational and Spatial Adaptations in Two Case Organisations." *Applied Ergonomics* 81: 102877. doi:10.1016/j.apergo.2019.102877.

Bäcklander, G., and A. Richter. 2022. "Relationships of Task–Environment Fit With Office Workers' Concentration and Team Functioning in Activity-Based Working Environments." *Environment and Behavior* 54 (6): 971–1004. doi:10.1177/00139165221115181.

Bentley, T., N. Green, D. Tappin, and R. Haslam. 2021. "State of Science: The Future of Work–Ergonomics and Human Factors Contributions to the Field." *Ergonomics* 64 (4): 427–439. doi:10.1080/00140139.2020.1841308.

Bergsten, E. L., A. Haapakangas, J. Larsson, H. Jahncke, and D. M. Hallman. 2021. "Effects of Relocation to Activity-Based Workplaces on Perceived Productivity: Importance of Change-Oriented Leadership." *Applied Ergonomics* 93: 103348. doi:10.1016/j.apergo.2020.103348.

Bodin Danielsson, C., and L. 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.

Bodin Danielsson, C., and L. Bodin. 2009. "Difference in Satisfaction with Office Environment among Employees in Different Office Types." *Journal of Architectural and Planning Research* 26 (3): 241–257.

Bodin Danielsson, C., L. Bodin, C. Wulff, and T. Theorell. 2015. "The Relation between Office Type and Workplace Conflict: A Gender and Noise Perspective." *Journal of Environmental Psychology* 42: 161–171. doi:10.1016/j.jenvp.2015.04.004.

Broberg, O., and I. Hermund. 2004. "The OHS Consultant as a 'Political Reflective Navigator' in Technological Change Processes." *International Journal of Industrial Ergonomics* 33 (4): 315–326. doi:10.1016/j.ergon.2003.10.005.

Brunia, S., I. De Been, and T. 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. doi:10.1108/JCRE-10-2015-0028.

Colenberg, S., R. Appel-Meulenbroek, N. R. Herrera, and D. Keyson. 2021. "Conceptualizing Social Well-Being in Activity-Based Offices." *Journal of Managerial Psychology* 36 (4): 327–343. doi:10.1108/JMP-09-2019-0529.

De Been, I., and M. 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, I., M. Beijer, and D. Den Hollander. 2015. "How to Cope with Dilemmas in Activity Based Work Environments-Results from User-Centred Research." 14th EuroFM Research Symposium.

Divett, M. 2020. "Team Dynamics within Activity-Based Working." *Journal of Facilities Management* 18 (3): 181–194. doi:10.1108/JFM-10-2019-0054.

Ekstrand, M., and G. Karsten Hansen. 2016. "Make It Work! Creating an Integrated Workplace Concept." *Journal of Corporate Real Estate* 18 (1): 17–29. doi:10.1108/JCRE-10-2015-0031.

Engelen, L., J. Chau, S. Young, M. Mackey, D. Jeyapalan, and A. Bauman. 2019. "Is Activity-Based Working Impacting Health, Work Performance and Perceptions? A Systematic Review." *Building Research and Information* 47 (4): 468–479. doi:10.1080/09613218.2018.1440958.

Forooraghi, Melina, Elke Miedema, Nina Ryd, Holger Wallbaum, and Maral Babapour Chafi. 2023. "Relationship between the Design Characteristics of Activity-Based Flexible Offices and Users' Perceptions of Privacy and Social Interactions." *Building Research & Information* 51 (5): 588–604. doi:10.1080/09613218.2023.2180343.

Gerdenitsch, C., C. Korunka, and G. Hertel. 2018. "Need–Supply Fit in an Activity-Based Flexible Office: A Longitudinal Study During Relocation." *Environment and Behavior* 50 (3): 273–297. doi:10.1177/0013916517697766.

Haapakangas, A., D. M. Hallman, S. E. Mathiassen, and H. Jahncke. 2019. "The Effects of Moving into an Activity-Based Office on Communication, Social Relations and Work demands - A Controlled Intervention with Repeated Follow-up." *Journal of Environmental Psychology* 66: 101341. ARTN101341 doi:10.1016/j.jenvp.2019.101341.

Haapakangas, A., V. Hongisto, J. Varjo, and M. Lahtinen. 2018. "Benefits of Quiet Workspaces in Open-Plan offices - Evidence from Two Office Relocations." *Journal of Environmental Psychology* 56: 63–75. doi:10.1016/j.jenvp.2018.03.003.

Hoendervanger, J. G., N. W. Van Yperen, M. P. Mobach, and C. J. Albers. 2019. "Perceived Fit in Activity-Based Work Environments and Its Impact on Satisfaction and Performance." *Journal of Environmental Psychology* 65: 101339. doi:10.1016/j.jenvp.2019.101339.

Kim, J., and R. 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.

Kim, J., C. Candido, L. Thomas, and R. de Dear. 2016. "Desk Ownership in the Workplace: The Effect of Non-Territorial Working on Employee Workplace Satisfaction, Perceived Productivity and Health." *Building and Environment* 103: 203–214. doi:10.1016/j.buildenv.2016.04.015.

Lahtinen, M., V. Ruohomäki, A. Haapakangas, and K. Reijula. 2015. "Developmental Needs of Workplace Design Practices." *Intelligent Buildings International* 7 (4): 198–214. doi:10.1080/17508975.2014.1001315.

Mache, S., R. Servaty, and V. Harth. 2020. "Flexible Work Arrangements in Open Workspaces and Relations to Occupational Stress, Need for Recovery and Psychological Detachment from Work." *Journal of Occupational Medicine and Toxicology (London, England)* 15 (1): 5. ARTN5 doi:10.1186/s12995-020-00258-z.

Marzban, S., C. Candido, M. Mackey, L. Engelen, F. Zhang, and D. Tjondronegoro. 2023. "A Review of Research in Activity-Based Working over the Last Ten Years: lessons for the post-COVID Workplace." *Journal of Facilities Management* 21 (3): 313–333. doi:10.1108/JFM-08-2021-0081.

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

Miles, M. B., A. M. Huberman, and J. Saldana. 2020. *Qualitative Data Analysis: A Methods Sourcebook* (M. B. Miles, A. M. Huberman, and J. Saldana, Eds., 4th ed.). Los Angeles: Sage Publications, Inc.

Mosselman, N., A. Gosselink, and M. Beijer. 2010. *Long-Term Effects of Activity Based Working*. Vol. 15. EuroFM Insight.

Ngah, R., and K. Jusoff. 2009. "Tacit Knowledge Sharing and SMEs' Organizational Performance." *International Journal of Economics and Finance* 1 (1): 216–220. doi:10.5539/ijef.v1n1p216.

Öhrn, M., V. Wahlström, M. S. Harder, M. Nordin, A. Pettersson-Strömbäck, C. B. Danielsson, D. Olsson, M. Andersson, and L. S. Järvholm. 2021. "Productivity, Satisfaction, Work Environment and Health after Relocation to an Activity-Based Flex Office-The Active Office Design Study." *International Journal of Environmental Research and Public Health* 18 (14): 7640. doi:10.3390/ijerph18147640.

Parker, S. K., A. Johnson, C. Collins, and H. Nguyen. 2013. "Making the Most of Structural Support: Moderating Influence of Employees' Clarity and Negative Affect." *Academy of Management Journal* 56 (3): 867–892. doi:10.5465/amj.2010.0927.

Radun, J., and V. Hongisto. 2023. "Perceived Fit of Different Office Activities - The Contribution of Office Type and Indoor Environment." *Journal of Environmental Psychology* 89: 102063. doi:10.1016/j.jenvp.2023.102063.

Radun, J., H. Maula, V. Rajala, M. Scheinin, and V. Hongisto. 2021. "Speech is Special: The Stress Effects of Speech, Noise, and Silence during Tasks Requiring Concentration." *Indoor Air* 31 (1): 264–274. doi:10.1111/ina.12733.

Rogelberg, S. G., and J. M. Stanton. 2007. "Understanding and Dealing with Organizational Survey nonresponse - Introduction." *Organizational Research Methods* 10 (2): 195–209. doi:10.1177/1094428106294693.

Rogelberg, S. G., C. Scott, and J. Kello. 2007. "The Science and Fiction of Meetings." *MIT Sloan Management Review* 48 (2): 18–22.

Rolfö, L. 2018a. "Activity-Based Flexible Office Work Environments: Design and Implementation Processes and Outcomes." Doctoral thesis., Stockholm: KTH Royal Institute of Technology. http://kth.diva-portal.org/smash/get/diva2:1265084/FULLTEXT02.pdf.

Rolfö, L. 2018b. "Relocation to an Activity-Based Flexible office - Design Processes and Outcomes." *Applied Ergonomics* 73: 141–150. doi:10.1016/j.apergo.2018.05.017.

Rolfö, L., J. Eklund, and H. Jahncke. 2018. "Perceptions of Performance and Satisfaction after Relocation to an Activity-Based Office." *Ergonomics* 61 (5): 644–657. doi:10.1080/00140139.2017.1398844.

Sailer, K., A. Budgen, N. Lonsdale, A. Turner, and A. Penn. 2008. "Evidence-Based Design: theoretical and Practical Reflections of an Emerging Approach in Office Architecture." Design Research Society Conference, Sheffield- UK. https://shura.shu.ac.uk/492/1/fulltext.pdf

Soriano, A., W., M. Kozusznik, J. M. Peiró, and C. Mateo. 2020. "The Role of Employees' Work Patterns and Office Type Fit (and Misfit) in the Relationships Between Employee Well-Being and Performance." *Environment and Behavior* 52 (2): 111–138. doi:10.1177/0013916518794260.

ten Brummelhuis, L. L., A. B. Bakker, J. Hetland, and L. Keulemans. 2012. "Do New Ways of Working Foster Work Engagement?" *Psicothema* 24 (1): 113–120. https://www.psicothema.com/pdf/3987.pdf.

Thoring, K., R. M. Mueller, P. Desmet, and P. Badke-Schaub. 2020. "Spatial Design Factors Associated with Creative Work: A Systematic Literature Review." *Artificial Intelligence for Engineering Design, Analysis and Manufacturing* 34 (3): 300–314. doi:10.1017/S0890060420000232.

van der Voordt, T. J. M. 2004. "Productivity and Employee Satisfaction in Flexible Workplaces." *Journal of Corporate Real Estate* 6 (2): 133–148. doi:10.1108/14630010410812306.

van Meel, J. 2020. *The Activity-Based Working Practice Guide*. 2nd ed. ICOP. https://www.briefbuilder.com/pages/the-activity-based-working-practice-guide.

Wohlers, C., and G. Hertel. 2017. "Choosing Where to Work at Work - towards a Theoretical Model of Benefits and Risks of Activity-Based Flexible Offices." *Ergonomics* 60 (4): 467–486. doi:10.1080/00140139.2016.1188220.

Wohlers, C., and G. Hertel. 2018. "Longitudinal Effects of Activity-Based Flexible Office Design on Teamwork." *Frontiers in Psychology* 9: 2016. ARTN2016 doi:10.3389/fpsyg.2018.02016.

Yekanialibeiglou, S., H. Demirkan, and L. Denti. 2021. "Enhancing Creativity in Activity-Based Offices: A Critical Incident Study of Knowledge Workers." *Creativity and Innovation Management 30* (4): 763–782. doi:10.1111/caim.12464.

Appendix A

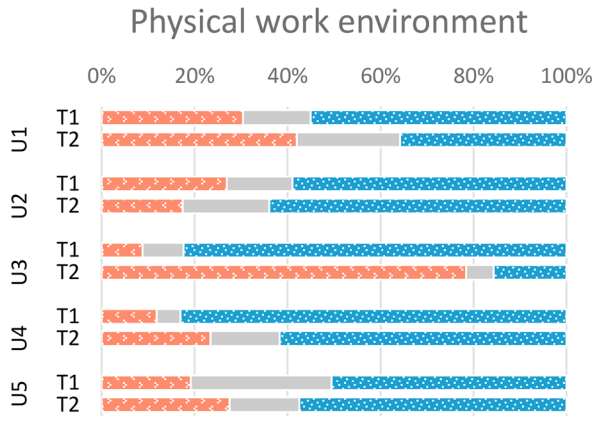
Table A1. Survey variables and scales.

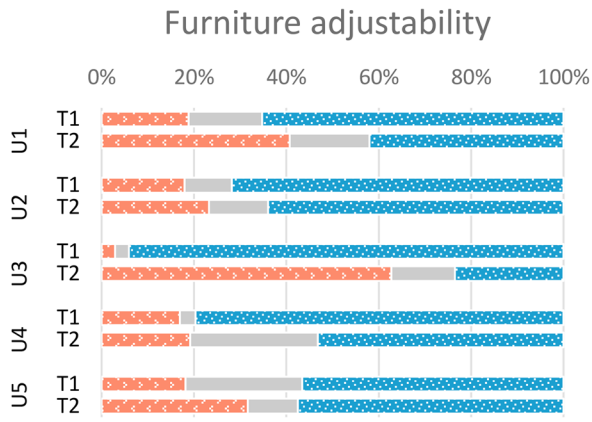
Theme	Variables	Question	Scale
Task characteristics	Confidential tasks	Do you handle sensitive information?	Yes/No
	High concentration tasks	What percentage per week do you typically work on tasks that require your full attention and concentration?	0–100 %
	Individual work	How many hours per week do you usually work alone (does not require interaction with colleagues/management)?	0–40 h
	Group work	How many hours per week do you usually work in a group?	0–40 h
Functionality	Physical work environment	How satisfied are you with the physical work environment?	1 = Very dissatisfied 7 = Very satisfied
	Task-environment alignment	The office design aligns with your work tasks optimally.	1 = Completely disagree 7 = Completely agree
	Furniture adjustability	How satisfied are you with the possibility to adjust the furniture to meet your individual needs (chairs, tables, drawers)?	1 = Very dissatisfied 7 = Very satisfied
	Storage	How satisfied are you with storage opportunities?	
Perceptions of privacy and distractions	Access to secluded spaces	How satisfied are you with the possibility to retreat to private areas for conversations, phone calls, or quiet, high concentration work?	1 = Very dissatisfied 7 = Very satisfied
	Visual privacy	How satisfied are you with the visual privacy at your workstation (capacity to not be observed)?	
	Acoustic privacy	How satisfied are you with the acoustic privacy at your desk (ability to engage in conversations without your neighbours hearing)?	
	Speech level	How satisfied are you with the speech volume level you can hear from your workstation?	
Perceived performance	Work interruptions	How often are you disturbed for some reason so that you do not get the opportunity to fully concentrate on your task?	1= Always 2= Often
	Handling confidential tasks	How often can you perform your tasks with sensitive information in a satisfactory manner?	3= Sometimes 4= Seldom
	Self-rated productivity	How often are you able to be productive in your current workplace/workroom?]	5= Never
Social interaction	Social atmosphere	Is there a good atmosphere between you and your colleagues?	1 = Very bad
	Sense of belonging	Do you feel part of a community at your place of work?	7 = Very good
	Cooperation within work units	How does cooperation work within your unit?	
	Cooperation between work units	How does cooperation work between units?	

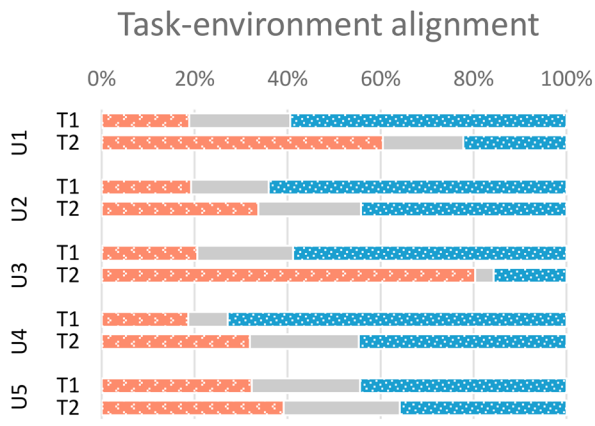
Appendix B

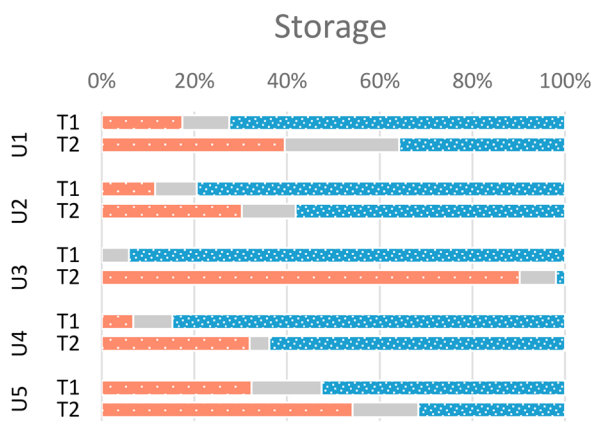
Figures illustrating units' survey responses on perceptions of functionality, privacy and distractions, social interactions showing proportion of responders.

Functionality

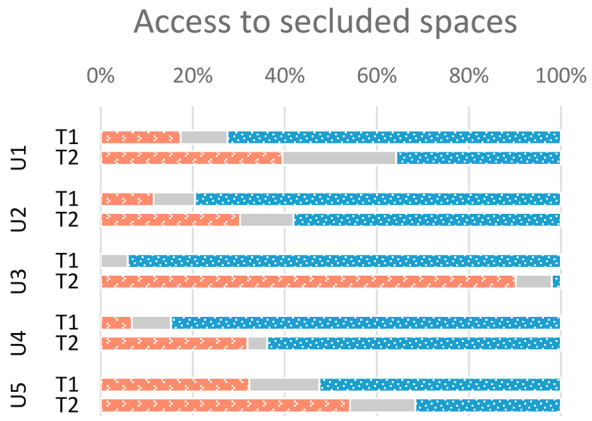


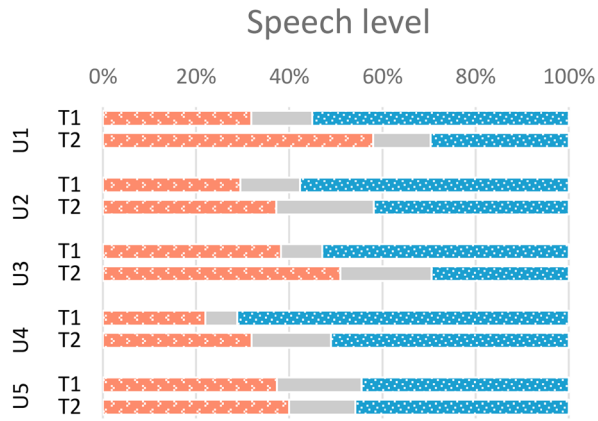


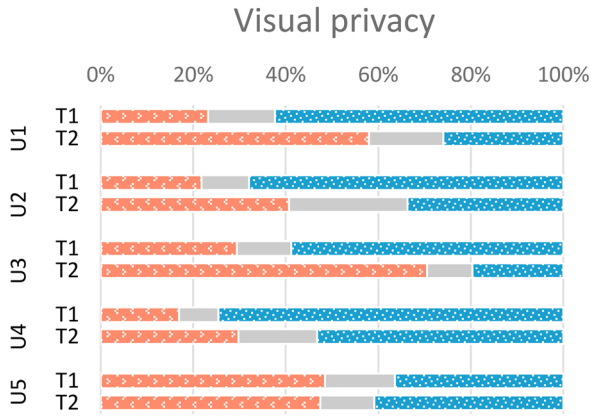


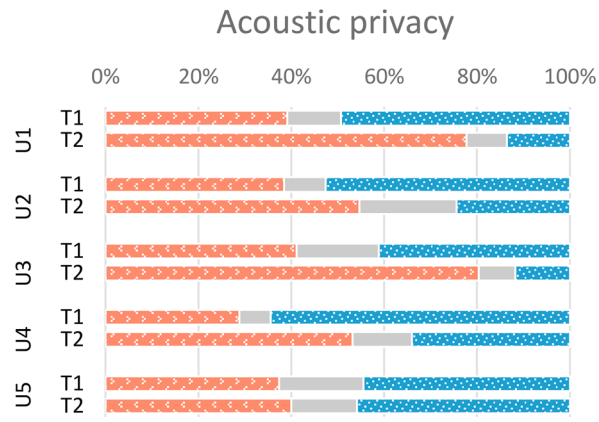


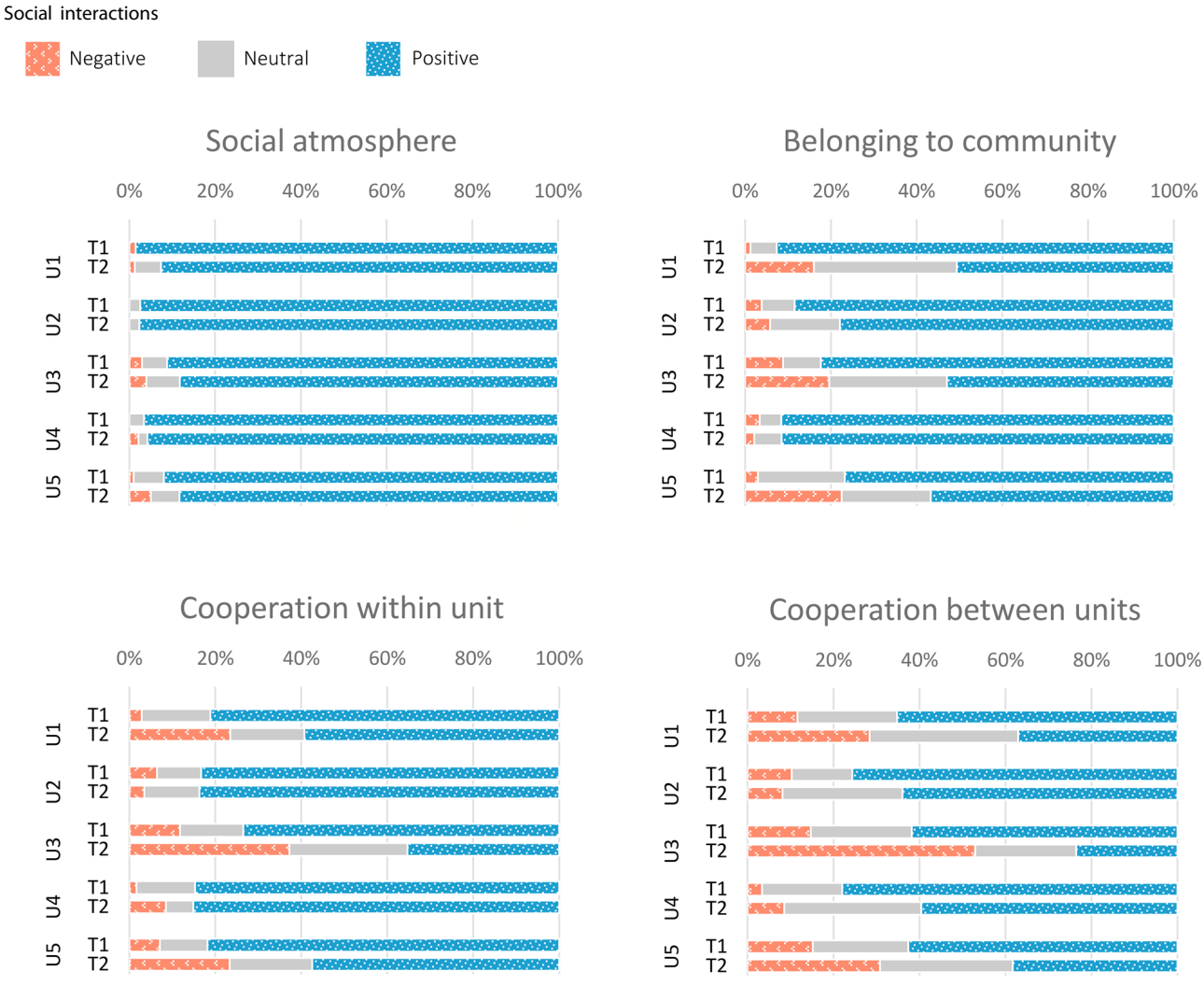
Perceptions of privacy and distractions










Social interactions
Negative
Neutral
Positive
Social atmosphere
Belonging to community
Cooperation within unit
Cooperation between units
0%
20%
40%
60%
80%
100%
U1
U2
U3
U4
U5
T1
T2

Perceptions of performance