

THESIS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

HEALTHY OFFICES

Conceptualizing Healthy Activity-based Offices

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Abstract

This thesis explores the interrelations between the design characteristics of activity-based offices, users' perceptions of them, and users' sense of coherence. The goal is twofold: (i) contribute to conceptualizations of healthy activity-based offices and (ii) facilitate practical use of the sense of coherence theory for office designers. Most research into healthy offices has focused on harm-causing factors (pathogenic aspects) while overlooking the health-promoting design characteristics in activity-based offices (salutogenic aspects). This thesis is a response to the call for a paradigm shift and explores the particular design characteristics of activity-based offices that promote health, drawing on the salutogenic approach and sense of coherence theory.

The thesis builds on a literature review and two mixed methods case studies on activity-based offices. Drawing on the sense of coherence framework, three types of design characteristics were identified: (i) those that promote a clear understanding of office environments, (ii) those that enhance users' access to relevant resources, and (iii) those that evoke meaning for users to cope with stressors. These characteristics and the perceptions of them are interrelated meaning that they can have multiple impacts on users' sense of coherence. The findings also highlighted temporal changes in users' perceptions, indicating that novelties of the new office wore off and the initial problems observed in the office environment worsened. Moreover, activity-based offices were not always perceived as intended because of suboptimal design solutions and contextual factors.

In conclusion, there are no definitive answers to how to design healthy activity-based offices. Activity-based offices are complex environments and consist of many interacting aspects including the design characteristics, individuals', and their work-related prerequisite as well as organization-related factors that influence users' perceptions and their sense of coherence. The framework developed in this thesis may contribute to better-informed discussions about designing for sense of coherence.

The thesis suggests that healthy activity-based offices should be viewed as a "moving project" that develops over time through experimentation and adaptation, with management's involvement. Thus, a healthy activity-based office provides users resources and opportunities to codesign an environment that enables them (i) build meaningful social relationships, (ii) manage visual and acoustic distractions, (iii) read and understand workspaces, and (iv) receive support from management in their daily work.

Keywords: Activity-based office, Health, Well-being, Sense of coherence, Office design, Workplace, Salutogenic, Case study

Terminology

Activity profile	The types and characteristics of employees' activities e.g., task variety, mobility, and share of communicative and individual work.
Contextual factors	The factors that relate to the context of an organization, individuals, and work processes, e.g., organizational culture, employee preferences, previous experiences and activity profiles.
Design concept	Design processes, methods, conceptual models and frameworks with certain goals in mind, relating to theory, users and expected outcomes.
Design intention	The objectives that the architectural design aims to achieve.
Design strategy	A set of abstract plans on how to achieve certain design intentions.
Activity-based office	An office type where users are provided with a variety of different shared workspaces to choose from, according to their needs and activity at hand.
Generalized resistance deficits	The deficits of a person, group, or community that hamper an individual's ability to effectively cope with stressors.
Generalized resistance resources	The resources of a person, group, or community that facilitate an individual's ability to effectively cope with stressors.
Health	The ability to adapt and to self-manage in the face of social, physical, and emotional challenges.
Interrelation	Mutual or reciprocal relations between two or more elements that are connected and affect one another.
Office user	An employee who works in an office.
Physical office environment	Every material object and stimulus that people encounter in their work, including features such as building design, room size and layout, furnishings, material and equipment, and indoor environmental quality such as noise, lighting, or air quality.
Salutogenesis	A health model that focuses on factors that create health rather than factors that cause illness.
Sense of coherence	The ability to cope with challenges by (i) understanding the nature of the problems (comprehensibility), (ii) identifying and using relevant resources (manageability), and (iii) viewing the perceived problems as worthy of investment and engagement (meaningfulness)

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List of appended papers and contributions

This thesis is based on the work contained in the following appended papers:

Paper A

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Contribution: Forooraghi planned and designed the database search, reviewed the literature, and wrote the paper. Miedema contributed to the analysis and the writing and provided feedback. Ryd contributed to the analysis and provided feedback. Wallbaum provided feedback.

Paper B

Forooraghi, M., Cobaleda-Cordero, A. and Babapour Chafi, M. (2022). "A healthy office and healthy employees: A longitudinal case study with a salutogenic perspective in the context of the physical office environment", *Building Research and Information*, Vol. 50 Issue 1-2: Building Health and Wellbeing, pp.134-151. <https://doi.org/10.1080/09613218.2021.1983753>

Contribution: Forooraghi planned and designed the study, collected, and analyzed the data, and wrote the paper. Cobaleda-Cordero contributed to the design of the study, analysis, and writing. Cobaleda-Cordero and Babapour provided feedback on the paper.

Paper C

Forooraghi, M., Miedema, E., Ryd, N. and Wallbaum, H. (2021), "How Does Office Design Support Employees' Health? A Case Study on the Relationships among Employees' Perceptions of the Office Environment, Their Sense of Coherence and Office Design", *International Journal of Environmental Research and Public Health*, Vol. 18 Issue 23. <https://doi.org/10.3390/ijerph182312779>

Contribution: Forooraghi planned and designed the study, collected, and analyzed the data, and wrote the paper. Miedema contributed to the analysis, and writing. Ryd and Wallbaum provided feedback on the paper.

Paper D

Forooraghi, M., Miedema, E., Ryd, N., Wallbaum, H., Babapour, M. (2022), "Relationship between the design characteristics of activity-based flexible offices and users' perceptions of privacy and social interactions: A comparative case study". [Submitted].

Contribution: Babapour led the planning and data collection. Forooraghi and Babapour analyzed the data and planned and wrote the paper. Miedema, Ryd and Wallbaum provided feedback on the paper.

Additional publications

The following publications are related to the topic of the office environment, but are not appended to the thesis.

Cobaleda-Cordero, A., Rahe, U., Wallbaum, H., Jin, Q. and Forooraghi, M. (2017), “Smart and Sustainable Offices (SSO): Showcasing a holistic approach to realize the next generation offices”. *Informes de la Construcción*, 69(548): e221, doi: <http://dx.doi.org/10.3989/id.55278>

Forooraghi, M., Wallbaum, H. and Ryd, N. (2019), “Health and well-being in offices - A study of literature on the Nordic perspective”. In: *IOP Conference Series: Earth and Environmental Science*, Vol. 297, p. 012013., doi: <https://doi.org/10.1088/1755-1315/297/1/012013>

Jin, Q., Wallbaum, H., Rahe, U., & Forooraghi, M. (2019), “SSO User Insight Toolbox for employees’ health, well-being and productivity”. *REHVA Journal*, 6, 58–63. From: <https://www.rehva.eu/rehva-journal/chapter/sso-user-insight-toolbox-for-employees-health-well-being-and-productivity>.

Babapour Chafi, M., Forooraghi, M., Hultberg, A. (2022), “Success factors and challenges in implementing Activity-based Flexible Offices – A qualitative process evaluation with key stakeholders”. In: *Transdisciplinary Workplace Research conference* (Forthcoming).

Forooraghi, M. (2022), “Conceptualizing healthy flexible office design”. In: *Transdisciplinary Workplace*

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Chapter 1 Introduction

This thesis explores the concept of healthy activity-based offices from an architectural design perspective.

1.1 Activity-based office design

Activity-based offices first appeared in the 1990s as a response to changes in IT technology and work practices and have become increasingly popular in recent decades (Brunia et al., 2016; Skyrme, 1994; van der Voordt, 2004a). Activity-based offices are designed to support flexible work by providing workspaces for a variety of activities, such as spaces for concentrated individual work or communicative work with others (De Been and Beijer, 2014; Hoendervanger et al., 2016; Wohlers and Hertel, 2018). Organizations around the world are implementing such offices to achieve strategic goals, including better cooperation, productivity, and job satisfaction, as well as reduced costs and energy consumption (e.g., Appel-Meulenbroek et al., 2011; Kim et al., 2016; Van Der Voordt, 2004; Wohlers and Hertel, 2017).

The two main types of activity-based offices are the ‘Activity-based Flexible Office’ (AFO) and ‘combi office’, with the distinction that users in combi offices have assigned desks, while users in AFOs share desks (Bodin Danielsson and Bodin, 2008). Activity-based offices can often be described with four typical design strategies: (i) variety of workspaces, (ii) spatial openness and transparency, (iii) standardization of design solutions and (iv) desk sharing (in AFOs). These strategies are described in detail below (Figure 1).

The first design strategy for activity-based offices is to provide a variety of workspaces for different activities (Appel-Meulenbroek et al., 2011). The design intention is to free office users from fixed locations, allow them to move freely, and choose a workspace depending on their activities and preferences, also known as new ways of working. These workspaces include, for instance, workstation zones for individual work, enclosed rooms for concentrated work, open

areas for collaboration, shared spaces for socialization, relaxation, phone booths for phone calls and conference calls, and meeting spaces of various sizes and functionalities. Office users are expected to adopt a new work routine of switching between workspaces that they may not have had access to in their previous offices. Additionally, users in activity-based offices use a combination of personal and shared artifacts that can become either an additional demand or an opportunity to cope with stressors.

Another design strategy is spatial openness and transparency in activity-based offices, which aims to promote higher spatial density, greater flexibility in layouts, opportunities for more cooperation within and among teams, and reduce costs (Kaarlela-Tuomaala et al., 2009; van der Voordt, 2004b). The idea is to divide an open layout into zones, with the collaboration zone being the largest, suggesting an emphasis on teamwork rather than individual work.

Standardization in activity-based offices means designing a space that is balanced and supports a variety of activities. Relocations to activity-based offices often involve organizational mergers. Thus, bringing together different teams and units with different needs, preferences, and activity profiles necessitates a generic space that can accommodate different users (Blakstad, 2001). Hence, standardization is adopted as a strategy to create “one” entity so that the same systems, principles, and procedures are applied within an organization (Ekstrand and Hansen, 2016). Furthermore, standardization may be a response to the increasing demand for building adaptability in the real estate sector. Adaptability relates to a building’s ability to meet its users’ changing functional needs either without physical changes or with physical changes, conceptualized as spatial generality and spatial flexibility, respectively (Arge, 2005).

Desk sharing is a key difference between the two activity-based office types. Desk sharing (also known as clean-desking/hot-desking) is predicated on the idea that not everyone will require a desk at the same time owing to activities such as meetings or remote work. It was introduced to mediate collaborative workspace use, facilitate individual and team rotation, and ensure workspace availability (Babapour Chafi and Rolfö, 2019). According to Knight and Haslam (2010), desk sharing policies involve using workstations on a first-come, first-served basis and ensuring that employees leave a clean and undecorated desk after use.

Relocation to activity-based offices therefore introduces changes to the users’ work environment. Users adapt to these changes and incorporate them into their current work routines to achieve organizational goals. These changes are suggested to influence user health and well-being (Engelen et al., 2019; Marzban et al., 2022).

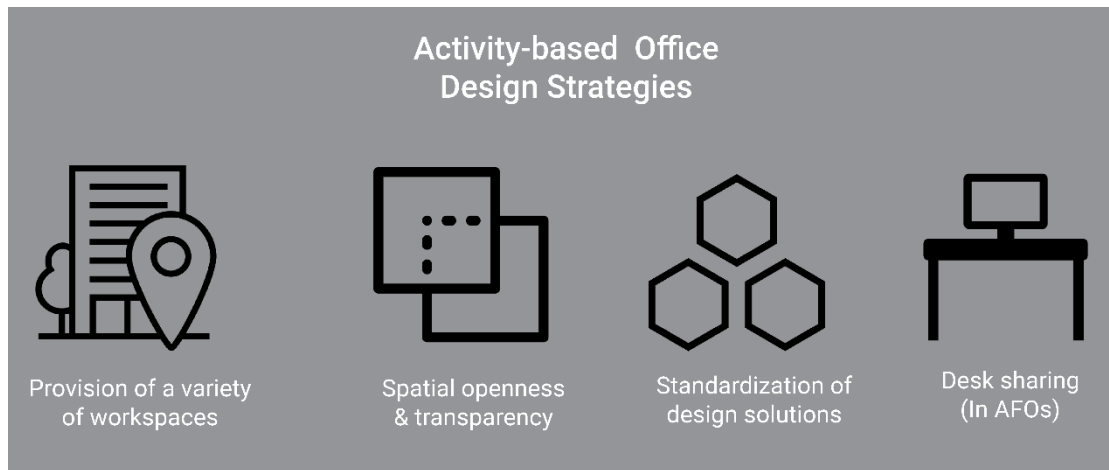


Figure 1. Typical design strategies in activity-based offices

1.2 Why healthy offices?

The right to health was recognized as a human right in 1966 (World Health Organization, 2002) and is often associated with access to health care and the building of hospitals. These associations are valid, but the right to health also extends to the factors and conditions that protect and promote the right to health beyond health services, goods and facilities. These include the right to healthy working and environmental conditions, among others (ibid). The focus on the working environment indicates that the right to a healthy physical work environment is embedded in human rights.

Public health challenges have become so complex that they can no longer be addressed solely by the health care sector (Marmot et al., 2008; Resnik, 2007; World Health Organization, 2014). These challenges, such as an increase in long-term health conditions (such as cancer, respiratory problems, and mental illnesses), an aging population, and reduced funding for health care, necessitate a new way of thinking, a paradigm shift, and innovative approaches to addressing public health (Chamberlain et al., 2015). This thesis argues, following Miedema (2020) and Dietscher et al. (2017), that there should be a much greater emphasis on shared responsibility for improving health in the building sector. Shared responsibility therefore requires building design researchers to contribute their knowledge of design theories, frameworks, and methods to facilitate the exploration of design opportunities for practitioners. It is also important that those involved in the design of activity-based offices, including corporate real estate owners, organizations, and designers, acknowledge their ethical and professional responsibility to protect the health of office users and allocate resources to address health in the physical office environment.

Healthy offices may also impact other values of individuals and organizations. A recent literature review by van der Voordt and Jensen (2021) confirmed the positive impact of appropriate design characteristics on health, satisfaction, and productivity. However, the review found that there are limited data on the costs and financial benefits of healthy workplace practices. The paper further argued that providing a healthy work environment is a moral responsibility and generally has a positive impact on user satisfaction and productivity as well as on society. Therefore, benefits must be weighed against the costs of interventions to create healthier work environments (van der Voordt and Jensen, 2021).

There is a need to study healthy offices from an architectural design perspective and to develop design guidelines and frameworks on the relationship between the physical office environment and health that can be tested, complemented and made available for architects and designers.

1.3 Previous research and knowledge gaps

Studies have linked physical office environments to health outcomes (c.f., Clements-Croome, 2018; Colenberg et al., 2021; Engelen et al., 2019; Jensen and van der Voordt, 2019). Most studies address outcomes such as satisfaction (Kim et al., 2016), symptoms of illness (Bluyssen et al., 2016), or perceptions of comfort (Al horr et al., 2016). These findings make significant contributions to understanding the relationship between the physical office environment and users' health. Nevertheless, more in-depth and contextualized insights are needed to better understand users' perceptions in relation to office design, support designers with evidence and develop theories to explore health-promoting design solutions for activity-based offices. Three research gaps have been identified in the literature and are described in detail below.

1.3.1 HEALTH PERSPECTIVES IN STUDIES OF OFFICES

Studies of offices have linked the physical office environment to user health from multiple perspectives. These research efforts have focused largely on indoor environmental quality aspects (Haapakangas et al., 2017; Al horr et al., 2016; Lamb and Kwok, 2016; Windlinger et al., 2012). Namely, they have investigated light, noise, indoor air quality, and temperature in relation to user concentration, long-term sick leave, perceived comfort, and satisfaction (Bluyssen et al., 2016; Clausen et al., 2009; Clements-Croome, 2015; Frontczak and Wargocki, 2011; Al horr et al., 2016; Kim et al., 2013). In general, studies of indoor environmental quality aspects have a longer history in healthy building research (Bergefurt et al., 2022). User health has also been studied from a sick building syndrome perspective, which focuses on identifying and removing factors that cause a range of irritative symptoms, such as eye, nose or skin irritations, allergy reactions, difficulties concentrating and headaches (Goyal and Khare, 2011). Studies in ergonomics have

investigated the impacts of office interventions such as adjustable furniture or ergonomic training on musculoskeletal disorders, sedentary behavior or back pain (Amick III et al., 2005; Foley et al., 2016; Robertson et al., 2008). Studies in the field of architecture have investigated the influence of office types on sick leave rate and general health (Bodin Danielsson et al., 2014; Bodin Danielsson and Bodin, 2008).

These studies have therefore made important associations between physical office environments. However, most research has focused on harm-causing factors (pathogenic aspects), while knowledge of the health-promoting potential (salutogenic aspects) of office design is limited (Colenberg et al., 2021; Groen, Brenda H, Jylha, T, Van Sprang, 2018; Jensen and van der Voordt, 2019). To move toward better health, researchers have called for a more proactive approach to building and office design that extends beyond the (mere) prevention of disease or discomfort and focuses on improving the quality of life (Bluyssen, 2014; Clements-Croome et al., 2019; Heerwagen et al., 1995a; Roskams and Haynes, 2019; Ruohomäki et al., 2015; Vischer, 2008a). This thesis is a response to the such calls for a paradigm shift and focuses on the health-promoting (salutogenic) design characteristics of activity-based offices.

Salutogenesis is a health model that focuses on the origins of health instead of the causes of disease (Antonovsky, 1987). The salutogenic concept ‘sense of coherence’ explains why some people manage to stay healthy in stressful situations (Eriksson, 2017) and reflects the ability to cope with challenges by (i) understanding the nature of the problems (comprehensibility), (ii) identifying and using relevant resources (manageability), and (iii) viewing the perceived problems as worthy of investment and engagement (meaningfulness) (Antonovsky, 1987). Applying the salutogenic theory and sense of coherence to the physical office environment can help to identify design characteristics that support users to cope with stressors more successfully and thus promote health.

A key element when investigating building design is the temporal dimension of space (Vischer, 2008b). Changes in perceptions necessitate continuous follow-up of users’ experiences of buildings, especially regarding their health. However, studies on the long-term impact of the office environment on user health are scarce and inconsistent. For example, some studies have found improvements in perceived health 15 months after relocation to an activity-based office (Meijer et al., 2009). In contrast, other studies observed long-term declines in perceived health, well-being, and performance due to increased exposure to environmental stressors in open-plan offices (Bergström et al., 2015; Brennan et al., 2002; Lamb and Kwok, 2016). Moreover, most longitudinal studies focus on comparing office users’ perceptions before relocation and within three to nine months afterward (e.g., Blok et al., 2009; Candido et al., 2019; Gerdenitsch et al., 2018; Rolfö et al., 2018), which may be enough time for office users to adapt to the new

environment and capture novelties. According to Wijk et al. (2020), a follow-up after nine months might be too soon, as they did not find health changes after switching from multiple office types to an AFO.

There are, however, exceptions. Some studies have examined the long-term effects of relocation to activity-based offices and found lower satisfaction with communication (Haapakangas et al., 2019; Wohlers and Hertel, 2018). Both studies emphasized that the long-term effects of relocations may vary depending on the follow-up period, previous office types, and differences between cases.

Thus, if the case-specific circumstances play an important role in explaining the observed discrepancies between studies, more in-depth qualitative research approaches seem particularly relevant to better understand (i) how and why initial perceptions evolve and (ii) how the new routines or coping strategies remain or change. Nonetheless, a recent systematic literature review reporting the influences of physical work environments on employee health and well-being showed that longitudinal studies adopting a qualitative approach are scarce (Berlin and Babapour Chafi, 2020). Further exploration is needed from an architectural design perspective to gain a deeper understanding of how the physical environment supports health over time.

1.3.2 ARCHITECTURAL DESIGN CONCEPTS IN RELATION TO HEALTH

Design for health is an emergent theme. In the office context, design concepts have been developed to address users' needs and promote their health and well-being, such as active design, codesign, and evidence-based design. The design concept is used as an umbrella term here to address design processes, office concepts, and conceptual models and frameworks. For example, active building design aims to promote health through design strategies that encourage physical activity (Van Cauwenberg et al., 2011; McGann et al., 2014; Zimring et al., 2005). Codesign and participatory design intend to empower building users by engaging them in open dialogs and shared decision-making (Myerson and Ramster, 2017).

Design concepts are considered more evidence-based, as they inquire about building users' needs and do not merely rely on clients' wishes and designers' intuition and experience. However, these concepts often lack clarity about design goals, design strategies and how they relate to health and healthy offices. This clarity in perspective is important because a focus on risk factors leads to the goal of eliminating or preventing risks and does not necessarily lead us to recognize the health-promoting potential of an environment (Miedema, 2020). van der Voordt (2021) reviewed design concepts in health care and office context and found that while the design concepts share many similarities, they have different emphases. They differ in their level of abstraction and in their focus on health promotion or health protection from problems and disease.

A clearer understanding of how design goals, characteristics and strategies of office concepts relate to health can support office design and research toward positive health outcomes and support organizational goals.

1.3.3 DISCREPANCY BETWEEN DESIGN INTENTIONS AND ACTUAL OUTCOMES

Despite the perceived benefits of activity-based offices for organizations and individuals, such as increased flexibility and productivity (Appel-Meulenbroek et al., 2011; Kim et al., 2016; van der Voordt, 2004b; Wohlers and Hertel, 2017), research reveals that these offices are not always used as intended. For example, some studies show that users in AFOs do not switch workspace as often as intended (Appel-Meulenbroek et al., 2011; Brunia et al., 2016; Hoendervanger et al., 2016). The results of studies on the impact of spatial openness and transparency on communication and collaboration are mixed (see literature reviews by Colenberg et al., 2021; De Croon et al., 2005; Engelen et al., 2019); while some studies indicate increased communications (Kim and de Dear, 2013), others suggest that spatial openness may be overstimulating and thus decrease concentration and productivity (Bernstein and Turban, 2018; Brennan et al., 2002). In other words, more openness and transparency do not always result in the intended positive outcomes. Whereas standardization is widely applied in activity-based office design, research shows that a lack of user involvement in design leads to mismatches between users' activities and workspaces. For instance, Babapour Chafi (2019) showed that activity-based offices with less input from users led to suboptimal design solutions which are often underutilized (Babapour Chafi, 2019a; Yekanalibeiglou et al., 2021).

Studies of activity-based offices show that assumptions about users' behaviors regarding desk sharing do not always hold in practice. A case study showed that teams claimed an area of the office for themselves by leaving papers on cabinets and decorating the walls with posters (Kingma, 2019). Nesting behaviors and leaving items behind have been linked to a desire to leave a stamp of one's identity (Elsbach, 2003; Hirst, 2011). Nesting tendencies indicate that desk sharing norms have not been adopted or are being broken, preventing users from rotating between departments and teams.

Such observations suggest that the design strategies of activity-based offices are often challenged by users due to the complexity of activity-based office environments. In summary, there seems to be a disconnect between the design intentions and how users perceive and use activity-based offices. Contextual aspects may partly explain these discrepancies. For instance, users' activity profiles, such as the degree of task complexity or variety, can place specific demands on the environment and are thus critical to the success or failure of an office design (Bruyne and

Beijer, 2015; Greene and Myerson, 2011; Haynes, 2012; Soriano et al., 2020). Hoendervanger (2021) also found differences in activity profiles to be a significant factor in explaining users' perceived fit in the use of different workspaces for their activities.

Office environments involve many interacting aspects; hence, studying them from multiple perspectives is beneficial. However, healthy office research from an architectural design perspective is limited (Jensen and van der Voordt, 2019), and studies often focus on generic architectural and functional characteristics such as open vs. enclosed or shared vs. assigned workstation (e.g., De Croon et al., 2005; Danielsson and Bodin, 2008; Pejtersen *et al.*, 2011). For instance, while the study by Bodin Danielsson and Bodin (2008) provides valuable insights into the relationship between office types and users' health, the results did not give indication of which specific architectural or functional characteristics in each case played a decisive part in explaining the differences in health outcomes. The results suggest that defining an office as an activity-based office without considering the nuanced design characteristics is not sufficient to gain a richer understanding of its impact on users. Layouts of activity-based offices differ in the extent to which they provide workspaces for both concentrated and collaborative work (Bodin Danielsson and Bodin, 2008; Brunia et al., 2016; Rolfö, 2018), or in the balance between individual workstations and team workspaces (Appel-Meulenbroek et al., 2011). In addition to the number and variety of workspaces, satisfaction with design characteristics such as interior design, the level of openness, the subdivision of space, building accessibility, and the implementation process have been found to be the main differences between the best and worst cases of activity-based offices (Brunia et al., 2016).

These findings demonstrate the need to explore the role of case-specific design characteristics within the broad category of activity-based offices. However, objective information on design characteristics and workspace density is often overlooked in studies of offices. A more in-depth insights into the case-specific and nuanced design characteristics can help us understand the gap between intended and actual use and support the development of appropriate theoretical frameworks.

1.4 Aims and research questions

This thesis explores the interrelations between the design characteristics of activity-based offices, users' perceptions of them, and users' sense of coherence (Figure 2). The goal is twofold: (i) contribute to conceptualizations of healthy activity-based offices and (ii) facilitate practical use of the sense of coherence theory for office designers. For this goal, an overarching research question has been formulated as follows:

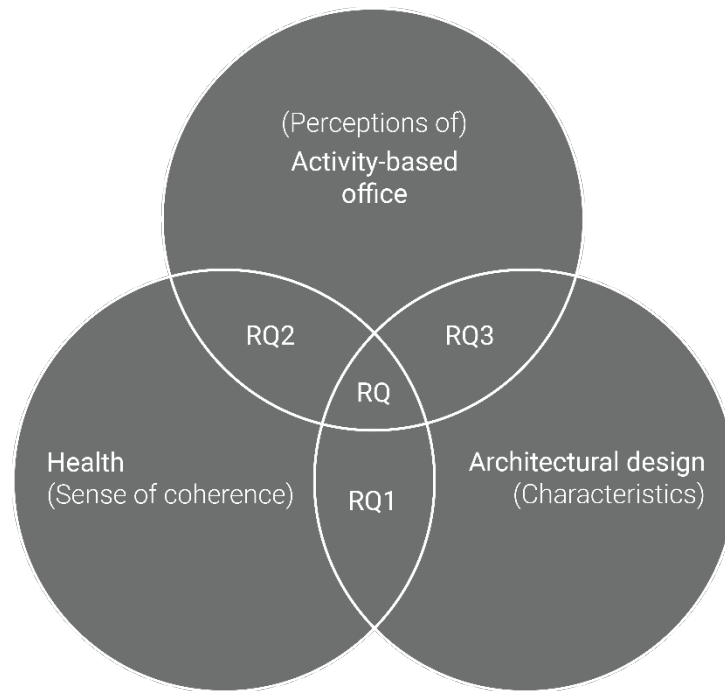


Figure 2. Illustration of the research focus and corresponding research questions.

RQ. What are the interrelations between the design characteristics of activity-based offices, users' perceptions of them, and sense of coherence?

To answer this question, three subquestions are formulated to approach the topic of healthy activity-based offices from different angles. The first subquestion focuses on mapping design office design concepts and the ways in which they relate to health:

RQ1. In what ways do office design concepts relate to health and healthy offices?

The second subquestion focuses on mapping design characteristics that support or weaken users' sense of coherence (in the long term):

RQ2. What are the (short-lived and long-lasting) interrelations between users' perception of design characteristics in activity-based offices and users' sense of coherence?

While the third subquestion does not specifically address users' sense of coherence, it aims to gain a deeper understanding of the relationship between the design characteristics and users' perceptions of activity-based offices, which is assumed to influence users' sense of coherence:

RQ3. How do the design characteristics of activity-based offices relate to users' perceptions of them?

1.5 Scope

The thesis focuses on the physical office environment, which encompasses every material object and stimulus that people encounter in their work, such as building design, room size and layout, furnishings, material and equipment, plus indoor environmental quality such as noise, lighting or air quality (Davis et al., 2011; Sander et al., 2019). Contextual aspects such as organizational culture, users' needs, activity profiles and previous office types are considered only when they are found relevant to explain office users' perceptions of their office environment.

1.6 Thesis structure

This thesis is divided into seven chapters (Figure 3). Following this introduction, Chapter 2 describes the theoretical background of salutogenesis and sense of coherence in relation to efforts in the built environment and explores the user and organizational implications. Chapter 3 details the empirical material and methods, including summaries of the methodological approach of the three studies. Chapter 4 continues with a summary of the findings. Chapter 5 discusses the main findings, the research approach, suggestions for further research and implications of the findings. Chapter 6 then presents the overall conclusions and summarizes the contributions of the thesis.

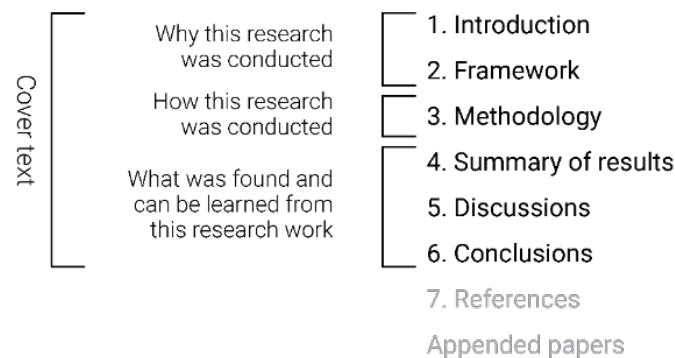


Figure 3. Structure of the thesis

Chapter 2 Framework

This architectural perspective in this thesis is combined with theories of health, salutogenesis, and sense of coherence. In this chapter, the theoretical framework is explained.

2.1 What is health?

There are a wide variety of definitions for health. In the biomedical context, health is often defined as the mere absence of disease. Disease is typically defined as a physiological malfunction that translates into a medicine addressing exclusively the physical aspects of the illness (Farre and Rapley, 2017). In contrast, the World Health Organisation (1948) defines health as “*a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity*”. Although this definition broadens our perspective on health from the mere absence of disease to include the physical, mental, and social dimensions, it has been criticized for being overly static, especially as it relates the word “complete” to well-being. Arguably, such a definition “*would leave most of us unhealthy most of the time*” (Smith, 2008).

Others have framed health as a more dynamic concept based on resilience and the capacity to cope (Huber et al., 2011). This thesis adopts the conceptualization of health, proposed by Huber et al. (2016), as “*the ability to adapt and to self-manage in the face of social, physical and emotional challenges*”, including six interrelated dimensions: bodily functions, mental functions and perception, spiritual/existential dimension, quality of life, social and societal participation, and daily functioning. This conceptualization is preferred over that by the World Health Organization because it is dynamic and emphasizes people’s resilience and their ability to cope with disease. It also considers the opportunities individuals have to improve their health rather than focusing solely on their disease. One criticism of this conceptualization is that it is applicable only in circumstances where individuals are in control, while some social conditions may prevent individuals and communities from adapting to their circumstances (Jambroes et al., 2016). Nonetheless, health from this perspective is a dynamic balance between opportunities and

constraints that are influenced by social and environmental challenges (Huber et al., 2011). In an inclusive work environment, people who are less able to take care of their health can work or participate in social activities and be part of society despite their limitations.

2.2 Salutogenesis: the origins of health

The word "salutogenesis" comes from the Latin *salus* (health) and the Greek *genesis* (origin). The term was coined by Antonovsky, a medical sociologist, to explain “*why some people stay healthy*” (Mittelmark and Bauer, 2022). He then developed the sense of coherence theory to explain the origins of health, which he later defined as follows (Antonovsky, 1987):

“The sense of coherence is a global orientation that expresses the extent to which one has a pervasive, enduring though dynamic feeling of confidence that (1) the stimuli deriving from one’s internal and external environments in the course of living are structured, predictable, and explicable; (2) the resources are available to one to meet the demands posed by these stimuli; and (3) these demands are challenges, worthy of investment and engagement.”

Antonovsky considered the sense of coherence as the key concept of the salutogenic model comprising three interrelated components: (1) comprehensibility, (2) manageability, and (3) meaningfulness (Figure 4). Comprehensibility means that individuals can cope with stressors in life only if they feel that they clearly understand the nature of the problem (Antonovsky, 1990). Manageability is the feeling that adequate resources for coping with stressors can be found in one's own hands or the hands of others (ibid). The third component is meaningfulness, which refers to a way of looking at life as worth living while seeing stressors as painful yet worthy of being coped with (ibid).

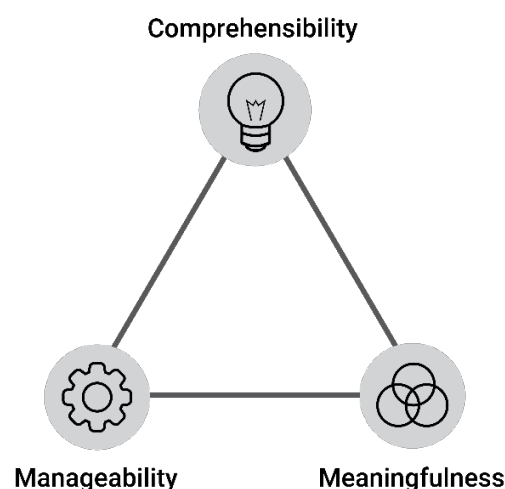


Figure 4. An illustration of three (interrelated) components of sense of coherence.

Antonovsky argued that not all stress has negative effects and that the way one responds to stressors in life depends on one's sense of coherence. In fact, he pointed out that life is chaos and how individuals are able to manage that chaos is critical (Antonovsky, 1992):

"... life is inherently full of stressors, with life-situation stressor complexes by far deserving most of our attention if we wish to understand either health or disease. Focusing on health, I expressly rejected the implicit assumption that stressors are inherently pathogenic. Their health consequences can only be understood if we understand the coping process."

In the salutogenic approach, health is viewed as a continuum of health-ease and dis-ease (Figure 5). An individual's ability to cope effectively with stressors, i.e., their sense of coherence, determines their position on the health continuum. In other words, one's resources determine the impact of a stressor. Movement toward the healthy end is either facilitated by generalized resistance resources (GRRs) or impeded by generalized resistance deficits (GRDs). GRRs and GRDs respectively correspond to the resources or deficits of an individual, group, or community that contribute to or impede the development of the individual's sense of coherence (Antonovsky, 1979, 1987). Resources can be divided into three (interrelated) domains: those that enhance comprehensibility, those that enhance manageability, and those that enhance meaningfulness. Examples include material resources (e.g., money), coping strategies, knowledge, social support, commitment, and cohesion with one's cultural roots (ibid).

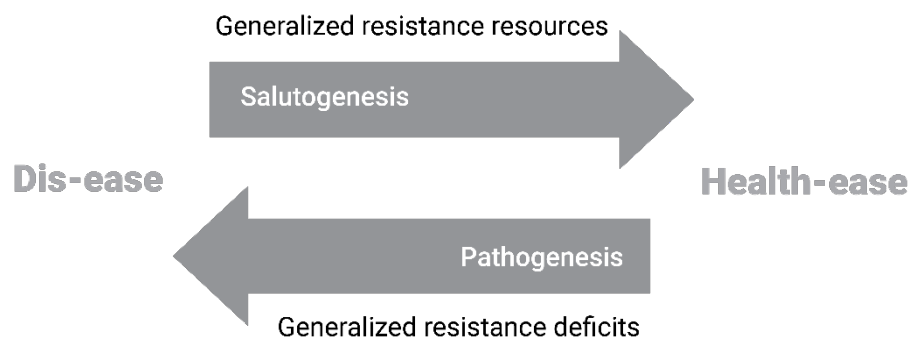


Figure 5. Illustration of the health continuum.

The relationship between the sense of coherence and health has received much attention and is now well established. A large number of studies indicate that a strong sense of coherence is associated with healthier behaviors, resilience and motivation to cope with stressors, good perceived health, and quality of life (Braun-Lewensohn et al., 2016; Eriksson and Lindström, 2007; Idan et al., 2017; Koelen et al., 2016). In addition, a sense of coherence is closely related to mental health and is associated with higher levels of optimism, self-esteem, and control and lower levels of depression, anxiety, and hopelessness (Eriksson and Lindström, 2006).

Antonovsky's work is directed to not only his colleagues in medical sociology but also sociologists, psychologists, physicians, health care organizers, epidemiologists, community organizers, and architects, as well as to those who are professionally and personally committed to understanding human adaptability (Antonovsky, 1979; Vinje et al., 2016). In this regard, design research can provide in-depth insights about the design characteristics of activity-based offices that support or impede a sense of coherence.

2.3 Sense of coherence in the context of work

In the book of 'Unravelling Mystery of Health', Antonovsky emphasizes the importance of work environment for sense of coherence (Antonovsky, 1987):

"[...] the strength of the sense of coherence [...] can be modified, detrimentally or beneficially, by the nature of the current working environment".

Several empirical studies have investigated the impact of the sense of coherence in relation to work (see the review by Mayer and Krause, 2011). These studies have shown that a sense of coherence is positively associated with work engagement (Fourie et al., 2008; Pillay, 2008; Redelinghuys and Rothmann, 2005), job satisfaction (Rothmann, 2001; Strümpfer et al., 1998), and active coping with stressors (Redelinghuys and Rothmann, 2005). A longitudinal study found that a good organizational climate and low job insecurity were related to a strong sense of coherence, which in turn was associated with high general and occupational well-being (Feldt et al., 2000). The study emphasized the importance of a positive organizational climate in improving the sense of coherence and thus well-being.

Health develops through the interaction between individuals, their determinants of health, and their respective living environments (Bauer and Jenny, 2016). Organizations, in this view, are living environments that contribute to both pathogenic and salutogenic health development. In this sense, the organizational structure, strategy, and culture interact with individual competence, motivation, and identity to influence health (Bauer and Jenny, 2016). Therefore, health in an office context becomes relevant when examining individual health development.

2.4 Office design through the lens of the sense of coherence

Given that the built environment influences health, the work environment is an important resource for supporting a sense of coherence and hence a person's, a family's, and even a community's health. The elements of office environments can be seen as resources that contribute to the development of office users' sense of coherence. Because salutogenic theory is social, its application to the physical environment is subject to interpretation (Mazzi, 2021).

Golembiewski (2010) has made notable contributions to our understanding of the built environment from a sense of coherence perspective. His work focuses on the neurological and mental impacts of space, including how well architectural design provides GGRs to support the sense of coherence. Golembiewski (2010) lists design characteristics of psychiatric care facilities as resources for patient's sense of coherence, such as a nonclinical esthetic, the presence of familiar objects, the use of natural materials, control of room size and number of patients, inclusion of landmark elements or art, use of texture and pattern, provision of sporting opportunities, the passage of time, and complexity and richness of the environment. He also discusses the importance of providing opportunities for mental health patients to receive social support and even facilities for their friends and facilities to stay overnight (Golembiewski, 2010).

In the office context, few studies have applied salutogenesis and the sense of coherence to the physical environment. Roskams and Haynes (2019) proposed a conceptual framework in which environmental demands and resources such as behavioral rules, opportunities for personal identity expression, and biophilic design solutions were suggested to influence the sense of coherence. Ruohomäki et al. (2015) stated that users should be able to understand the stressors, for example, a relocation to a new or redesigned office (comprehensibility), believe that resources to cope are available (manageability), and be motivated to cope (meaningfulness). However, no explicit relation was made to the physical environment. A recent case study investigated indicators of the sense of coherence during office relocation to an AFO with a two-wave questionnaire and focus group interviews (Wijk et al., 2020). The study showed that meaningfulness, manageability, and comprehensibility significantly increased from baseline to nine months post-relocation. Thus, the implementation process facilitated a sense of coherence with support, tools on how to work in an AFO and clear communication.

Although research on the application of salutogenesis to the physical office environment is limited, there are research findings that from a salutogenic perspective, are of immense importance. Hence, the following framework draws on previous research, the architectural extrapolation of the salutogenic theory proposed by Golembiewski (2010) and Roskams and Haynes (2019), and reinterprets some of the architectural characteristics for the office context, as summarized in Figure 6. The next sections describe the sense of coherence framework in further depth.

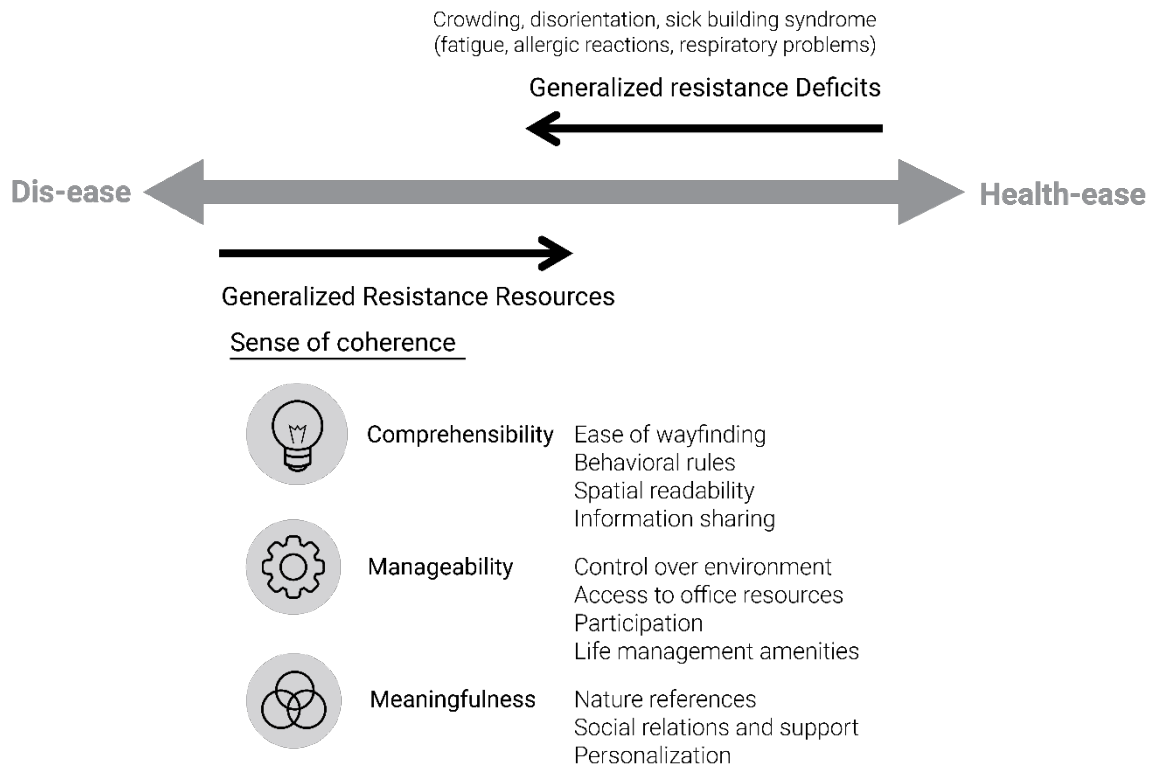


Figure 6. The sense of coherence framework in the context of the physical office environment
(Adapted from Forooraghi et al., 2021).

2.4.1 COMPREHENSIBILITY

Comprehensibility is the ability to understand and negotiate the contexts in which we find ourselves (Golembiewski, 2016). A highly comprehensible office provides a sense of confidence to its users and signals that the work environment is structured, predictable, and explicable (Antonovsky, 1987). Comprehensibility in the office environment can be promoted by good wayfinding and spatial readability, clear behavioral rules, and transparent information sharing before and after an office relocation. Spatial comprehensibility is particularly important for navigation in complex office buildings wherein poor wayfinding can affect a person's stress levels, anxiety, and coping effectiveness (Danko et al., 1990). People tend to use landmarks, boundaries, nodes, and colors to navigate in buildings (Oseland, 2009). A comprehensible space has cues and signs and is psychologically accessible. For example, a recognizable entrance, clear functional zoning, and the differentiated use of colors and materials allow for easy navigation (van der Voordt et al., 1997).

Behavioral rules are often necessary to provide structure and predictability. Desired behaviors can be discussed among office users in relation to how the various office zones should be used. While many organizations establish behavioral protocols and rules for workspace use, these rules

may not work as well as intended (Appel-Meulenbroek et al., 2011; Babapour Chafi et al., 2018; Rolfö et al., 2018; Skogland, 2017). Studies show that users disregard desk sharing rules and tend to claim a particular desk or area for themselves (Elsbach, 2003; Hirst, 2011; Kingma, 2019). In one case study, noncompliance with rules was associated with ambiguity, which was due to users' lack of involvement in the change process. Conversely, involving users in the design process and making rules more explicit resulted in increased acceptance, greater compliance and users feeling more confident in their choice of action (Babapour and Rolfö, 2019).

Finally, during relocation to a new office, users are often unaware of how changes in the work environment will affect them. Transparency and predictability are necessary during a change process, for example, by providing early and continuous information about the change, next steps, status, and outcomes (Kämpf-Dern and Konkol, 2017; Lahtinen et al., 2015). Communication should be accessible and understandable, explaining the purpose of the office relocation and the impact of change on users (ibid).

2.4.2 MANAGEABILITY

Manageability is about action and empowerment (Golembiewski, 2022) and reflects a person's sense of control over their environment and work. In the context of the office environment, manageability can refer to a sense of control over the environment (e.g., tools, resources, and stimuli), participation, and life management amenities.

Sense of control is a broad concept and is recognized in the literature as a proven determinant of well-being at work (Myerson and Ramster, 2017). Control can refer to freedom of choice in the perception of visual and acoustic stimuli, as well as isolation from unwanted observations and background noise, also known as visual and acoustic privacy (Kupritz, 1998; van der Voordt et al., 1997). Visual and acoustic privacy allow people to regulate the amount of social contact they have. Dissatisfaction occurs when the situation deviates from what a person considers optimal (Kupritz, 1998). There is good evidence that inadequate control over environmental stressors such as noise, disturbances, and visual distractions can negatively impact employee well-being, job satisfaction, and motivation (e.g., Evans and Johnson, 2000; Banbury and Berry, 2005; Kim and de Dear, 2013).

Another form of control is empowering office users to participate in the design and change processes (Vischer, 2008a). Research findings are fairly consistent in linking the degree of control and empowerment associated with participation in design decisions to higher levels of well-being (e.g., Dewulf and Van Meel, 2002; Myerson and Ramster, 2017a; Vischer, 2008b). The sense of empowerment may also influence the sense of belonging or ownership in the workplace, contributing to what Vischer refers to as 'psychological comfort' (Vischer, 2008b, 2008a).

Access to office resources is also an important component of office environments to facilitate manageability. These resources refer to technical solutions (e.g., IT equipment, furniture, storage space) designed to support office work, and their impact on office users' satisfaction and physical and mental health have been highlighted. For example, Kim et al. (2016) showed that the impossibility of adjusting desks, chairs, screens, and other equipment prevented AFO users from meeting their needs and comfort standards. In other studies, satisfaction with personal storage and technical equipment has been linked to overall satisfaction with the environment, which in turn is related to well-being (Haapakangas et al., 2018). Babapour Chafi et al. (2020) identified reasons for preferences and non-preferences for AFOs. Examples of reasons for preferences included the provision of dual screens, height-adjustable desks, whiteboards, and projectors. Reasons for non-preferences included limited ergonomic and easily adjustable chairs, dual screens, and malfunctioning technical solutions, e.g., broken keyboards, chairs, and missing items in different workspaces.

Finally, life management amenities include resources that help employees balance the pressures of work and home life and relate to a wide range of services, such as child care or flexible working culture, both of which are important ways to reduce stress and relax mentally (Danko et al., 1990). The rise of hybrid work can also contribute to increased autonomy and thus may promote employee manageability.

2.4.3 MEANINGFULNESS

Meaningfulness in the work environment refers to the extent to which one feels that environmental stressors are worth one's investment and engagement (Antonovsky, 1987). Factors that can evoke meaning in an office environment may include the use of nature references, opportunities for social relations and support, and workspace personalization.

Previous studies have associated connection to the natural environment with positive health outcomes (Ulrich, 1984; Wilson, 1984). Humans are thought to have an innate tendency to seek connections to nature and thus to other forms of life (Wilson, 1984). In one survey, the top five most desired elements in the office were related to elements of the natural environment, such as indoor plants, daylight, and views of natural landscapes (Cooper and Browning, 2015). An office environment enriched by colors, materials, art, and elements of the natural environment, such as daylight, views, and/or access to the natural landscape and indoor plants, is often associated with higher perceived well-being, esthetic satisfaction, better perceptions of workplace quality, better attention capacity and lower stress (Bakker et al., 2013; Bauer, 2007; Kaplan, 1995; Lohr et al., 1996; Nieuwenhuis et al., 2014; Raanaas et al., 2011; Smith and Pitt, 2009).

Antonovsky (1979) finds personal connections and sense of community as resources for meaningfulness: *“profound ties to concrete, immediate others... and between an individual and their community are decisive resistance resources”*. The role of the physical environment in community building and supporting social relationships is then quite crucial in evoking the motivation for users to cope. The physical layout of the office influences patterns of social interaction and a sense of community and thereby shapes the social and relational aspects of work (Davis et al., 2011). Design characteristics such as proximity, meeting and breakout spaces, the distance between spaces, spatial density, and the way spaces are connected by doorways and passageways facilitates or constrains social interaction. A review by Heerwagen et al. (1995) showed that perceived high density (number of people per area) is strongly associated with several negative social outcomes, such as alienation and negative moods in crowded conditions, and decreases in social cooperation.

Workspace personalization is another way of giving meaning to an environment by adding visual cues (Brunia and Hartjes-Gosselink, 2009). There is ample evidence that a sense of ownership resulting from workspace personalization can positively influence employee well-being, attitudes, and relationships (Brown et al., 2005; O’Driscoll et al., 2006; Pierce et al., 2001; Wells, 2000). Environments enriched by plants, artwork, and personal items that reflect personal relationships with family and friends have a greater impact on employees’ psychological comfort, autonomy and job satisfaction than environments enriched by others (Knight and Haslam, 2010; Wells and Thelen, 2002). Artifacts and symbols of cultural and group identity are examples of meaningful resources that can foster a collective sense of meaning (Heerwagen et al., 1995b). Furthermore, a significant amount of change in the workplace is often met with resistance (Kämpf-Dern and Konkol, 2017; Laframboise et al., 2002; Vischer, 2005). People often experience a loss due to emotional attachment to the physical environment, such as a personal space, a crafted environment, or cherished objects and facilities when they are relocated, which is referred to as “place attachment” (Inalhan and Finch, 2004). Additionally, physical changes usually require people to change their work routines and behaviors. Therefore, it is essential to address psychological and emotional reactions and provide resources for coping during and after an office relocation process.

In summary, this chapter provided an overview of the key concepts of salutogenesis, demonstrated how they relate to the built environment and presented a framework of the sense of coherence theory in the architectural context.

Chapter 3 Methodology

3.1 Research approach and worldview

A key assumption in design research (of which architecture is considered a part here) is that "*a design-based knowledge paradigm can contribute meaningfully in situations of unsettlement*" (Janssens, 2012). This is particularly applicable to the context of activity-based office research, as the evidence across disciplines is seen as contradictory or scattered (cf. Appel-Meulenbroek and Danivska, 2021; Engelen et al., 2019; Marzban et al., 2022). The multidisciplinary nature of architecture and design research provides an opportunity to bring various disciplines together and offers ways to create, synthesize, and develop knowledge about design (Rendell, 2004). Moreover, "Doing research" as a means of change is often inherent in design research (Janssens, 2012). Accordingly, this thesis can be understood as belonging to 'research for design' as outlined by Forlizzi et al. (2009): "*a theoretical outcome of many different activities that provides designers with theories they can apply to improve their practice of design*".

The architectural disciplinary context provides this work with a pragmatic starting point. Pragmatism acknowledges that there may be a single or many realities based on socially created beliefs and habits (Yefimov, 2004) that are open to empirical investigation (Creswell and Plano Clark, 2017). As such, pragmatism in architecture is to focus on realities derived from individuals' perceptions of spaces and buildings. The emphasis, then, is a concern with people rather than (merely) buildings, considering both the social and material implications of perceptions and design of activity-based offices. This complexity, therefore, requires multiple modes of inquiry.

While this research is based on empirical data from interviews and questionnaires that capture users' perceptions and sense of coherence, it also includes a spatial and material understanding supported by studies of floor plans, building documents, and observations. This mixed-method approach is consistent with pragmatic paradigm (Creswell and Plano Clark, 2017) as it (i) captures the plurality of experiences, and (ii) allows researchers to gather evidence from a range

of sources and critically evaluate it in terms of its strengths, limitations, and applicability to practice (Plath, 2013). This research approach was ultimately useful in identifying both case-specific and general insights about activity-based offices essential to understanding the conditions under which particular outcomes occur and to improving design practice.

In the following sections, the research approach and methods are described in detail.

3.2 Method

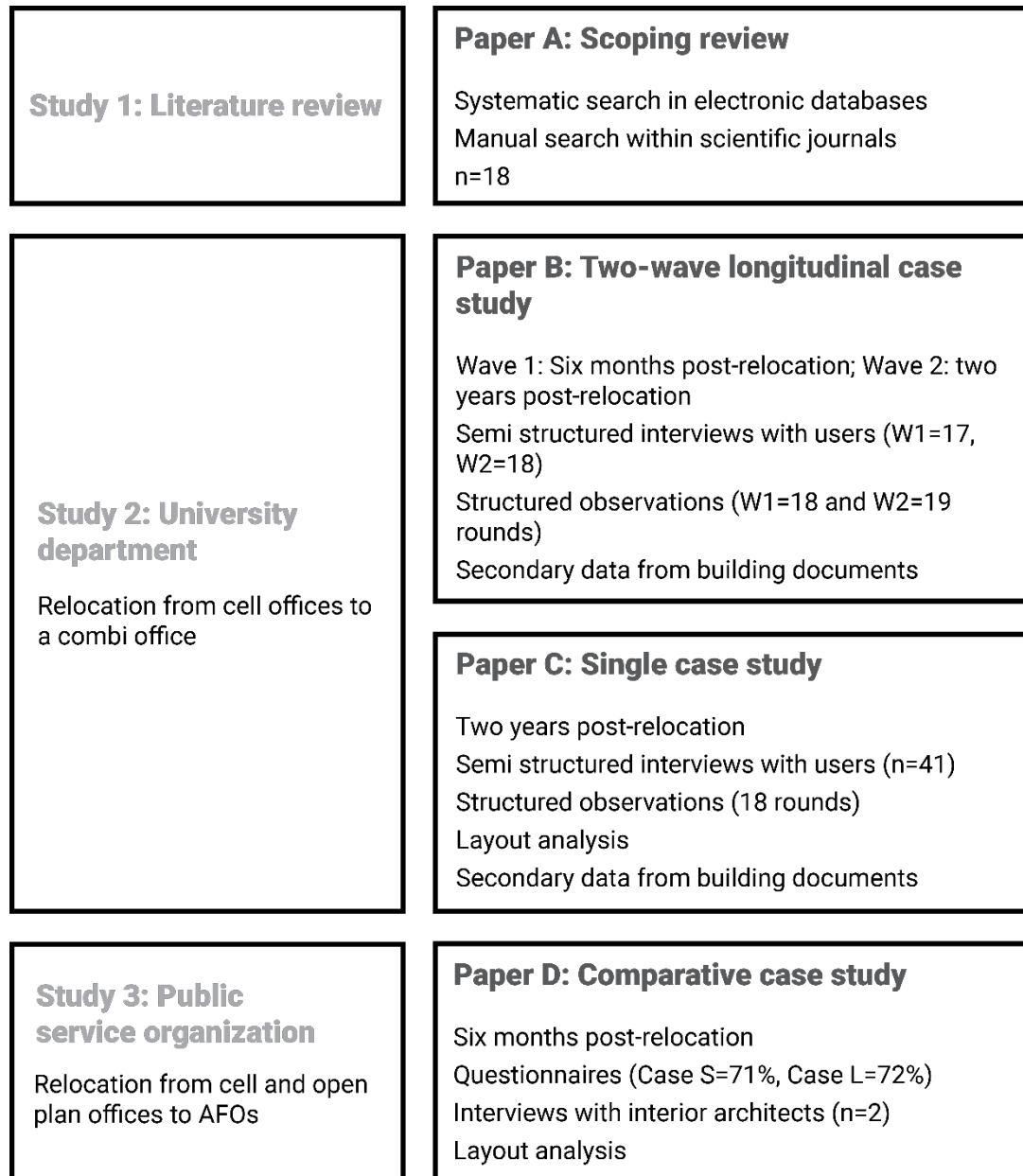


Figure 7. Overview of the research design and corresponding papers.

This thesis is based on three studies that resulted in four papers (Figure 7). The first study provides a literature review (paper A). The second study followed a university department that relocated to a combi office (papers B and C). The third study involved two public service organizations that relocated to two AFOs. In all cases, employees had access to a variety of workspaces, such as quiet rooms, phone booths and meeting rooms, with the main difference being that users in the university department had assigned desks, whereas those in public service organizations shared desks.

In summary, this thesis produced papers A, B, C, and D, each of which contributed to answering the research questions posed in this thesis (see Figure 8).

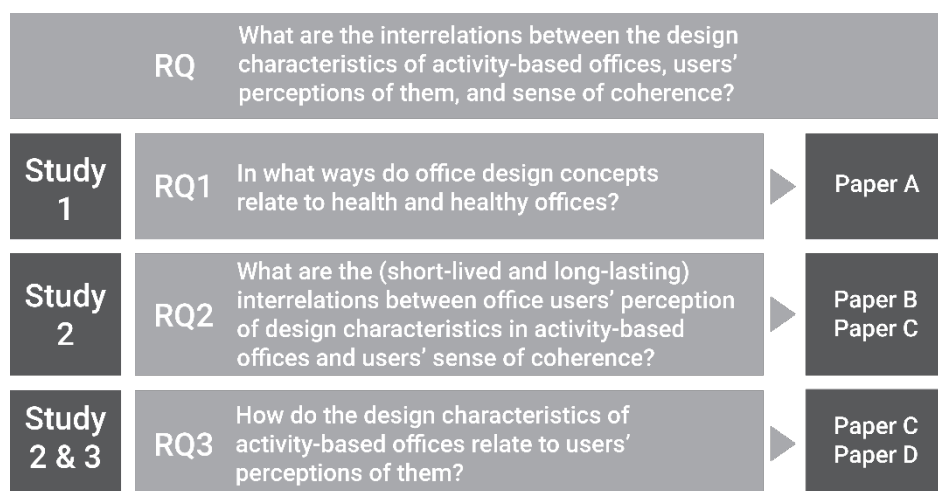


Figure 8. Research questions and the corresponding papers resulting from this thesis.

3.2.1 STUDY 1: LITERATURE REVIEW

The scoping review (paper A) explored ways in which design concepts addressed health and healthy office design, resulting in paper A. The scoping review method was chosen because it aims to provide an overview of the available research on a particular area by scanning a large body of literature without evaluating the quality of individual studies (Pham et al., 2014). The five phases of this scoping review were based on Arksey and O'Malley's (2005) framework: (i) identifying the research questions; (ii) identifying relevant studies; (iii) study selection; (iv) data extraction; and (v) collating, summarizing, and reporting the results.

In the *identification* phase, articles were collected through two types of searches: general database searches in four electronic databases and manual journal searches within five journals. The *selection* process aimed to ensure that the articles included were related to the study's inclusion criteria: (1) address office design, (2) be written in English, (3) published in the last 30 years (1988-2018), and (4) be prescriptive. Eighteen studies met the inclusion criteria, and data were

extracted addressing design concepts, health, and/or office design. The data were moved into a spreadsheet and grouped into columns for source information (authors, year), title, method, and summary text segments. To aggregate and synthesize the data, the content of the papers was coded and analyzed using NVivo 12 (Krippendorff, 2004). This step helped to identify and map office design concepts, their definitions, and goal orientations and addressed building design features and aspects of health. Finally, the design concepts were compared to identify differences and similarities in the way design concepts related to health aspects and building design features.

3.2.2 STUDY 2: THE UNIVERSITY DEPARTMENT

The second study focused on a Swedish university department that had relocated from cell offices to a combi office in a renovated building two years earlier. The relocation was combined with an organizational merger with 10 other units of employees. This case study resulted in two papers:

- Paper B concerned one division of employees within the university department and included two study waves. Due to a prior study, data from six months post-relocation (Wave 1) were available for comparison with data from two years post-relocation (Wave 2). The two-wave study enabled an investigation of the temporal changes in users' perceptions and thus in their sense of coherence.
- Paper C was a single case study that was extended to the whole university department. The paper integrated a design perspective to contrast users' perceptions and sense of coherence with the design characteristics of the activity-based office.

Data collection procedure

Data were collected in September 2019, two years post-relocation, and focused on (i) office users' perspectives, (ii) office use, and (iii) office design characteristics.

Users' perspectives were captured through in-depth semi-structured interviews. Invitations to participate in interviews went out to all division employees. Forty-one office users volunteered to take part in the study. The interviews averaged an hour, and they were audio recorded. The questions were designed to enable the interviewees to share their insights into how they experienced the office environment, their activities, and their preferences. During the interviews, a card-sorting exercise as well as floorplan drawings, markers and notes were used as mediation tools (see Babapour Chafi and Cobaleda-Cordero, 2020). The card sorting exercise consisted of a biaxial chart visualizing levels of satisfaction and importance and a set of cards relating to predefined themes to sort on the chart. The themes covered a variety of factors, such as behavioral rules, personal storage, and acoustic and visual privacy. The participants were asked to sort the cards one by one while describing the motivation for their choice. At the end of the exercise, blank

cards were also provided in case participants wanted to raise new topics for discussion. The drawings, markers and notes aided interviewees in elaborating their explanations, describing their routines and space use, or signaling relevant aspects of these spaces.

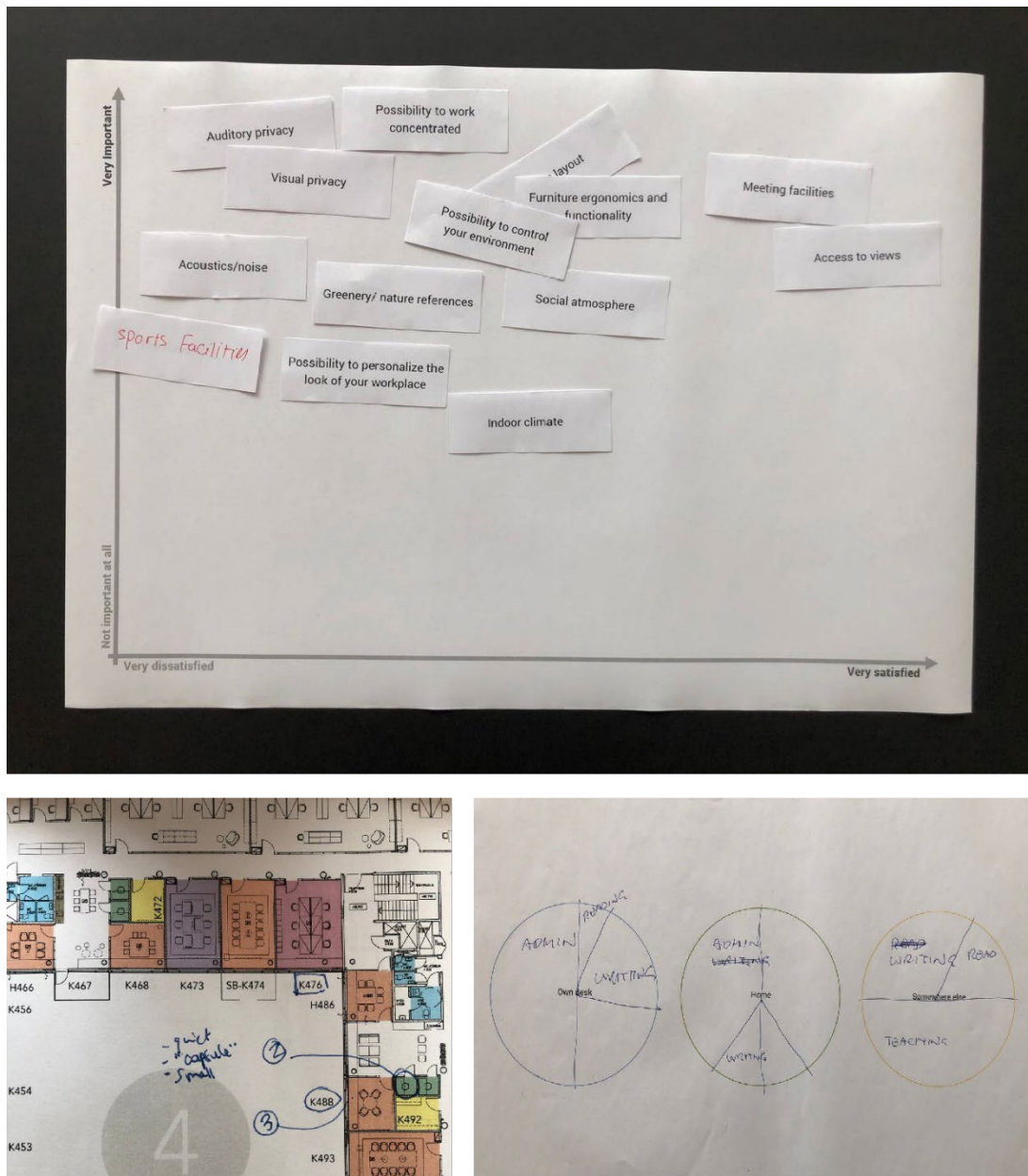


Figure 9. The card-sorting exercise and participants notes.

Space use was studied through structured observations in the office, i.e., a systematic plan with a predefined route was used, and office users were aware of the observer. A total of 18 rounds were conducted. Each predefined route included walking around all the workstations, back-up spaces and breakout areas, with the observer taking structured field notes and drawing annotations and pictures. The field notes indicated, for example, the workstations and back-up spaces in use, the number of persons per space, the available facilities and equipment, flows of people between

spaces, and whether different spaces were organized and orderly. The rounds were scheduled according to the observer's availability, avoiding events that were not part of employees' daily routine and that caused abnormal occupancy rates, such as a monthly department meeting. The observations were conducted over two weeks and across four intervals (8:00–10:00, 10:00–12:00, 13:00–15:00, and 15:00–17:00), with the aim of covering the equivalent of a regular Monday to Friday working week.

The study of office design combined secondary data from floor plans and an in-house guidebook provided. Information about the relocation process was collected through a semi-structured interview with coordinator premises. The office interior had been modified two years post-relocation by facility management:

(i) A quiet room with couches was turned into a shared office room due to a lack of workstations, (ii) a windowless meeting room was turned into a printing room, following complaints about the lack of printers, (iii) translucent curtains were added to office rooms facing stairs to enhance visual seclusion, and (iv) couches in the lunchroom were moved to other breakout areas on the fourth floor and replaced with dining tables and chairs. The floor plans had to be updated by the author, because the documents provided had not been updated after the modifications.

To ensure comparability between the two study waves in paper C, several discussions between the authors ensured that data collection was conducted in the same way. The discussions concerned information and techniques on how to facilitate the interviews, formulate questions, introduce mediation tools in the interviews, and plan observation routes and avoid disrupting employees' routines. These discussions were followed by a practice interview and a test of the observation protocols. The questions addressing the relocation process in Wave 1 were adapted to Wave 2 to focus instead on users' perceptions and involvement in the modifications. The results of Wave 1 are published in Cobaleda-Cordero et al. (2019).

Data analysis procedure

The data analysis in both papers B and C consisted of multiple iterative stages, including content analysis of the interviews, descriptive analysis of the observation rounds, and floor plan analysis of the building material.

The interviews were transcribed and coded using NVivo 12. An abductive approach was adopted to analyze the content, combining an inductive and deductive approach and thus using empirical data and theoretical prepositions dialogically to analyze qualitative data (Timmermans and Tavory, 2012).

The longitudinal analysis (paper B) followed a parallel-convergent design, in which the two separate datasets from each wave were analyzed independently and jointly referenced during the

interpretation (cf. Creswell, 2014). That is, the findings were contrasted with the reasons extracted from both waves to capture changes in the way various design characteristics were perceived over time. The reasons were then related to users' sense of coherence. The comparison between the first and second study waves led to a deeper understanding of the short- and long-term influences of the office environment on employees' perceptions and thus their sense of coherence.

In paper C, the first step involved analyzing the interview transcripts to identify recurring themes related to perceptions of the office environment and to identify positive and negative perceptions of office environment features. For instance, users referred to 'exposure to visual stimuli', which in step 2 was coded under 'control over the environment'. In a further deductive round of coding (step 3), office environment features were related to the components of the sense of coherence: comprehensibility, manageability, and meaningfulness.

Furthermore, data from the observations (in both papers B and C) were analyzed to support and complement the findings from the interviews. This process involved reviewing and summarizing observation field notes and occupancy data. Occupancy was calculated for office rooms based on the percentage of workstations occupied with respect to the maximum number of workstations. Utilization percentages were calculated for back-up spaces by dividing the times the spaces were observed in use by the total number of observation rounds ($W1=19$, $W2=18$). The themes from observations were compared with the interviewees' insights in the analysis.

Secondary data, including drawings and the in-house guide, were analyzed from an architectural design perspective, thus contrasting the office users' perceptions with observation data, architectural drawings, secondary data, and pictures of the office to understand the underlying reasons for these perceptions. For instance, exposure to visual stimuli was mentioned as a negative aspect by the majority of office users. The level of transparency observed in drawings and observations confirmed that the extensive use of glass partitions led to a high level of exposure to visual stimuli. Another example is that when users referred to behavioral rules, the in-house book was analyzed to determine what type of information the organization had communicated about expected behavior in shared office rooms and back-up spaces.

The preliminary findings were presented to the employees to acquire feedback and confirmation.

3.2.3 STUDY 3: THE PUBLIC SERVICE ORGANIZATION

The third study involved a public service organization that had recently launched AFOs in different Swedish cities: Case S (small) and Case L (large). Case S was a 6-floor building with approximately 400 employees who were brought together from 12 different office locations in November 2018. Case L was a 13-floor building with approximately 1500 employees who were brought together from 15 different office locations in June 2019. Prior to relocation, the majority of employees in Case S worked in private cell offices, and most employees in Case L worked in open plan offices. The organization's units were geographically dispersed, while they moved to central locations in the cities after relocation.

Both AFO solutions offered a variety of non-assigned workspaces, divided into three types of zones: (i) strictly quiet zones were (semi)enclosed spaces for concentrative work, (ii) semi-quiet zones were open workspaces that allowed for brief interaction, and (iii) collaboration zones were open and enclosed spaces for meetings and breaks. Codes of conduct and guidelines for the effective use of these different work areas were communicated to employees with brochures, emails, and signs posted at the entrance of different settings. For every workstation, employees were asked to clean their desks when leaving to make the desk available for the next user (clean desk policy). Speech rules indicated no speaking in the quiet zones, while in the semi-quiet zones, speaking was allowed with quiet voices. Nearly all employees had non-assigned workstations.

The study adopted the explanatory sequential mixed methods approach (Creswell, 2014). That is, the results from the quantitative data analysis were further explained and interpreted using qualitative data from the open-ended questions.

Data collection procedure

The post-occupancy evaluation was based on an AFO-specific questionnaire developed by Rolfö (2018) consisting of 60 items. The questionnaire was screened to identify and select questions that addressed similarities and differences in the design characteristics of the two AFOs and the outcomes associated with these aspects. Four questions were asked about satisfaction with the general characteristics of the AFO: storage, esthetics, the functionality, and adjustability of furniture. Three items related to privacy: satisfaction with workstation seclusion, satisfaction with visual privacy, and satisfaction with acoustic privacy. The scale ranged from (1) very dissatisfied to (7) very satisfied. Four questions concerned the social interactions: between-and-within cooperation, working atmosphere, and sense of belonging to the community. The scale ranged from (1) very bad to (5) very good.

The questionnaire included additional open-ended questions asking respondents to provide their comments on the AFOs. The open-ended questions encouraged AFO users to express their

opinions on AFO-related issues and provide information that could be used to understand why employees experienced the office the way they did.

The questionnaire was collected from each office building six months after relocation and was administered through a secure online service that collected only anonymous data. All relocated employees (approximately 2000) were invited to complete the questionnaire via a link emailed directly to them. The response rates were 72% in Case S and 71% in Case L. A total of 1223 individual comments were derived from the open-ended questions, providing a significant amount of qualitative data for analysis.

For the layout analysis, architectural drawings and pictures were obtained from the project leader.

Data analysis procedure

The analysis involved statistical analysis of the questionnaire data, content analysis of the open-ended questions, and layout analysis based on floor plan drawings.

For the questionnaires, statistical analysis was conducted. Comments were coded in NVivo 12 according to three main categories: (i) general comments about the AFO, (ii) visual and acoustic privacy, (iii) social interactions and (iv) sense of belonging to the community.

Architectural drawings and pictures were used to compare the spatial density and design characteristics of the AFOs. Space types were categorized following Bodin Danielsson and Bodin (2008), including single rooms, shared rooms and open plan rooms. To complement the original list of space types, several other room types, such as phone rooms, open work areas, meeting rooms, group rooms, and lounges, were included in the categorization. The ratio of user per room/workstations/seats for the different space types was calculated as a measure of 'spatial density'. Design characteristics were categorized in terms of furniture, technical solutions, ergonomics and zoning.

Chapter 4 Summary of the results

This chapter presents the main findings of each of the three studies (for a more detailed presentation of the results, see the corresponding papers).

4.1 Office design concepts in relation to health and healthy offices

Study 1 (corresponding to paper A) aimed to map office design concepts and how they relate to health and healthy offices. The design concept is used as an umbrella term here to address design processes, office concepts, and conceptual models and frameworks. The findings describe the identified design concepts, their goal orientations, outcomes, and strategies to address users' health.

Design concepts – The identified design concepts reflect a range of foci and goal orientations, with some referring to the process of design while others outlining the implications of design decisions. These concepts were grouped into three main themes: (i) health-focused, (ii) user-focused, and (iii) office concepts. *Health-focused* design concepts indicated that office design intends to improve and/or promote users' health, well-being, or safety, such as salutogenic design, active design, or participatory design. For instance, salutogenic design was defined as a design process that focuses on interconnections among events, procedures, people, and places. *User-focused* concepts placed users and organizations at the center of the design activity. Examples are user-centered, participatory, or codesign that focused mainly on the process of involving building users in planning and decision-making to achieve an optimal design solution. More specifically, the premise of user-centered design was that buildings exist to support users' activities, and the relationship between user and environment is dynamic, with the user being an active agent and consumer of the environment. The AFO was addressed as an *office concept* that aims to support users' activities by providing a range of different workspaces.

Addressing health and healthy office – Few design concepts defined healthy offices and only one paper provided a definition of health. Instead, the concepts addressed different health-related outcomes representing salutogenic health, well-being, physical health, and mental health (Figure 10). The health perspectives were mainly pathogenic; thus, traditional risk-oriented health outcomes were mentioned with regards to physical and mental health, such as increased stress, anxiety, fatigue, sick leave rate, and physiological reactions from the heart and vasculature. In this context, a healthy work environment was characterized as being free from harm-causing factors where safety hazards are minimized, pointing in a pathogenic direction. Positive health perspectives were found to focus on well-being outcomes, such as mood, affect, comfort and satisfaction. Other positive aspects of health, such as meaning, personal growth, coping, social cohesion, and sense of community were mentioned to a lesser extent. Incorporating artifacts and symbols of cultural and group identity, for example, was found to support cultural and collective meaning, or providing services/policies such as child care and flexible working hours support coping. A salutogenic work environment was conceptualized as requiring both the absence of environmental stressors and the presence of certain features (nature, sunlight, daylight, windows, esthetic amenities). Similarly, health was seen as more than the mere absence of disease, requiring greater emphasis on long-term issues of health maintenance, psychological well-being, and personal growth in the workplace. Salutogenesis was also implied in the conceptualization of positive and supportive built environments that promote human activities and help people achieve their aspirations.

Design characteristics – The design concepts addressed indoor environmental quality: the need for a good thermal environment, fresh indoor air, access to daylight and artificial lighting, low noise level and acoustic quality. Other building design characteristics included spatial (e.g., textures and colors, elements of the natural environment), sociospatial (e.g., sense of control, privacy, territoriality), social (e.g., communication, collaboration, and learning). Contextual aspects (e.g., task variety, organizational culture, individual preferences), were mentioned to a lesser extent. Productivity and performance were frequently addressed as organizational outcomes, often paired with health and well-being, but without accompanying definitions. An exception was a description of performance as the degree to which stated objectives are met or the relationship between predicted and accomplished work. However, it was not always clear whether design concepts referred to the subjective or objective dimensions of design characteristics, such as layout and wayfinding.

DESIGN CONCEPTS	HEALTH	OFFICE DESIGN CHARACTERISTICS
Focus on health Active design Environmental design Participatory design Salutogenic design Sustainable design Focus on users Agile design Co-design Evidence-based design Inclusive design Participatory design Performance-oriented design Sustainable and flexible design User-centered design Office concepts Activity-based (flexible) office	Physical health Sick building syndrome, e.g., allergic reactions and respiratory problems. Musculoskeletal injuries, e.g., neck aches and back pain. Safety and hygiene. Mental health Stress, fatigue, anxiety and depression. Well-being Moods, affects, comfort, and satisfaction. Personal growth, life management, social cohesion, and a sense of community. Salutogenesis Salutogenic environment. Positive and supportive built environment.	Indoor environmental quality (IEQ) Daylight, Artificial lighting, Temperature, Air quality, Noise. Spatial characteristics Interior design e.g., use of texture, material, aesthetics, color, plants, storage space, and , ergonomic design. Spatial layout, e.g., proximity, active layout design, physical and psychological accessibility, and wayfinding. Sociospatial characteristics Control/autonomy incl. control over environment, autonomy at work and empowerment. Privacy incl. visual privacy and acoustic privacy. Territoriality/sense of ownership incl. space personalization and sense of belonging. Social characteristics Communication, collaboration and learning through providing formal and informal spaces (e.g., corridors coffee room). Contextual aspects Tasks, e.g., task variety, activity profile, and work styles. Organizations, e.g., culture, leadership, and strategic goals. Organizational outcomes, e.g., productivity, sick time, costs, energy efficiency, staff recruitment and retention. Person-related, e.g., age, gender, individual preferences, and personality traits.

Figure 10. Overview of design concepts, health aspects and design characteristics. Adapted from Forooraghi et al. (2020).

In summary, the results from Study 1 suggest that while health in the office context and particularly in design concepts is an emerging theme, a wider perspective on positive health and a healthy office is not necessarily found. Instead, the perspectives could be seen as productivity-driven interpretations of health. Another notable observation was that none of the approaches holistically incorporated all building design features and health aspects. For instance, most user-

focused approaches did not address indoor environmental quality or sociospatial factors, such as privacy and a sense of territoriality or health. Another example is health-focused concepts that paid little attention to activities and individual preferences. A reason could be that these design concepts had different focal points. That is a focus on either: (i) the process of involving users in the design decisions or (ii) physical work environment by relating design characteristics to health outcomes. Mapping these design concepts helped to reveal these diverse foci and strategies in relation to health, which may contribute to the theoretical development and practical use of holistic design concepts for healthy offices.

4.2 Users' perceptions and their sense of coherence

Study 2 explored the interrelations between users' perceptions of an activity-based office and the components of the sense of coherence, taking into account temporal changes in perceptions (papers B and C).

Users' perceptions of wayfinding, spatial readability, behavioral rules and information sharing were related to **comprehensibility** (Figure 11). Perceptions of wayfinding varied among users. For some, orientation in the building became intuitive once they became accustomed to the labeling system and layout, while others had difficulty understanding the design configuration due to the identical design characteristics of the corners and the square floor plate. Additionally, users seemed to read and use some workspaces differently than intended. For instance, phone rooms were found to be suitable for concentrated work because they were compact with few distractions or signaled unavailability to colleagues (see more examples in Figure 11). The (lack of) behavioral rules was influential in structure and predictability of the office environment. Users believed that relying on common sense was sufficient to coexist and share different workspaces. However, there were also feelings of uncertainty and confusion over individual responsibilities concerning order and cleanliness. This made the office environment less comprehensible for some and subsequently led to feelings of frustration toward colleagues. Users also found the maintenance service unresponsive to fault reports concerning the automated shades, generating feelings of uncertainty and a lack of predictability.

SENSE OF COHERENCE	DESIGN CHARACTERISTICS	USERS' PERCEPTIONS
COMPREHENSIBILITY 	Wayfinding	Clear and convenient wayfinding Difficulties in orienting in the building
	Spatial readability	Using quiet rooms for informal discussions Using phone booths for concentrated work Using meeting rooms for individual, and concentrative work Using breakout areas for individual work and informal meetings Meeting rooms with 4-person capacity perceived too small for 4 persons
	Behavioral rules	Reliance on common sense Exposure to stimuli and noise Mess and visual clutter
	Information sharing	Ambiguous maintenance systems/procedure

Figure 11. Users' perceptions of design characteristics related to comprehensibility. Adapted from Forooraghi et al. (2021)

Users' perceptions of control over the environment, access to office resources, participation and life management amenities related to **manageability** in the office (Figure 12). The limited opportunities to control the temperature, automated shades and stimuli affected the manageability of the office. The automated climate control system did not allow for personal adjustments, as many users considered the temperature cold. Similarly, lack of control over the automated shades was perceived as limiting and uncomfortable, as they restricted access to daylight. In terms of exposure to visual and acoustic stimuli, users' opinions varied depending on personal preferences, the location of the workstation, and the location of the room. The workstation seclusion and coping resources (such as noise-canceling headphones or desk dividers) were considered helpful for concentration and coping with stimuli. However, exposure to acoustic and visual stimuli caused by spatial transparency and openness was regarded as distracting.

SENSE OF COHERENCE	DESIGN CHARACTERISTICS	USERS' PERCEPTIONS
MANAGEABILITY 	Control over environment	Increased visibility Facilitated coping Disturbance due to low temperature Disturbance due to automated shades Exposure to visual distractions Exposure to acoustic distractions Poor soundproofing
	Access to office resources	Increased access to technical equipment Increased access to adjustable furniture Access to diverse workspaces Adequate storage space Limited storage space Difficulties working with technical equipment
	Participation and empowerment	Facilitated opportunities for involvement in the design and change processes Limited opportunities to participate in the design and change processes
	Life management amenities	High level of autonomy Possibility for resting and recovery Sufficient bike parking Lack of bike facilities

Figure 12. Users' perceptions of design characteristics related to manageability. Adapted from Forooraghi et al. (2021)

Users found that office resources, including quality and adjustable furniture, storage space, diversity of workspaces and technical equipment, positively impacted their ability to manage their work. However, other users complained about a lack of storage space, difficulty using equipment, and a lack of IT support and training.

The opportunities to be involved in the design process was considered as more of a formality for users, so they felt their opinions were not heeded and the possibilities to influence design decisions was limited. In addition, it was reported that post-relocation modifications, such as installing curtains in some offices to cover glass partitions, were made without communication or user involvement. This experience led to a sense of resentment and limited manageability.

Life management amenities, such as the provision of a resting room, bike parking and autonomy, were perceived as beneficial for work-life balance. The trust-based work model, where

employees are free to choose when and where they work, was highly valued by users. This model also helped users cope with suboptimal design characteristics. For example, to improve concentration, some users chose to work remotely or avoid office rush hours by coming in early.

SENSE OF COHERENCE	DESIGN CHARACTERISTICS	USERS' PERCEPTIONS
MEANINGFULNESS 	Nature references	Access to inspiring and soothing views Increased access to daylight Compromised daylight Insufficient indoor nature
	Social relations and support	Increased access and proximity to colleagues Facilitated social interactions thanks to diverse meeting rooms and breakout areas Feelings of isolation; lack of sense of belonging
	Personalization	Minimal and neutral look Sterile and impersonal look Freedom to personalize workspaces Limited possibilities for personalization

Figure 13. Users' perceptions of design characteristics related to meaningfulness.

Perceptions of nature references, social relations, and personalization related to **meaningfulness** in the office (Figure 13). Users described their office as "inspiring", "bright", and "beautiful" thanks to large windows and balconies overlooking nature and associated this design with positive meanings. However, nature references such as greenery and indoor plants were perceived as insufficient. Although users appreciated the abundance of daylight, the automatic shades limited their access to daylight. Users perceived an increased access to colleagues and preferred face-to-face interactions for quick information sharing. They appreciated the diverse, proximate meeting rooms and breakout areas that facilitated meetings and breaks with colleagues, improving the social atmosphere and leading to more meaningfulness. In particular, the balconies were among the most popular places, as they provided a bright, relaxing environment for socializing (Figure 14).



Figure 14. Outdoor balcony offering views and daylight (Study 2). Photo by Kalle Sanner.

Conversely, a lack of sense of belonging to the community was experienced due to difficulty finding colleagues. This experience ultimately led to feelings of isolation, making the office environment less meaningful. The shared nature of the workspace and the esthetic design of the office caused the organization to discourage workspace personalization, even in assigned office rooms. The esthetic design was considered "neutral," "minimalist," and "modern", which made users feel valued. Others, however, found the esthetic design too “sterile” and “impersonal”, which led to a sense of anonymity and thus reduced the sense of meaningfulness of the office. Some users indicated that they disregarded the rules and personalized their workspaces. Personalization was done by adding personal items (e.g., pictures of family members, drawings, and arts), indoor plants, and work-related items (e.g., posters, publications, models). Posters were also used on glass partitions to block connection with the corridors. In some divisions of employees, users personalized specific meeting rooms or breakout areas that they frequented, with books, magazines, or posters. This personalization signaled ownership to others, thus prevented others from using those spaces.

Temporal changes — Paper B focused on temporal changes in users’ perceptions and thus their sense of coherence in a division of employees within the university department. In the long term, users perceived the activity-based office to be less comprehensible and meaningful two years post-relocation, although they found the office to be (somewhat) equally manageable.

In general, several design characteristics were found to have *long-lasting* influences on users' perceptions and thus their sense of coherence in both study waves. The long-term positive perceptions of the variety, availability, and technical solutions of meeting rooms and breakout areas, as well as daylight, made the office manageable and meaningful for users. However, there were rather low utilization rates for meeting rooms (4-6 persons) in both waves (W1=30.3%, W2=25%). Negative perceptions concerning control over automated shades and visual and acoustic distractions were also long-lasting, as there were no modifications to the design.

The impact of several design characteristics on users' perceptions was *short-lived*. Few changes were positive, including adequate personal storage space and furniture that signaled luxury and status. However, perceptions of some design characteristics became more negative. For instance, proximity to colleagues and opportunities for social relations had a positive impact on users in Wave 1 (six months post-relocation). In Wave 2 (two years post-relocation), perceptions became more negative, and feelings of isolation were recurrent. A lack of a division-specific space was mentioned in this regard, as a factor impacting group cohesion and thus meaningfulness. Perceptions of the appearance and personalization also became more negative. The observations showed that the office environment became cluttered over time which reduced the structure and thus the comprehensibility in the office environment.

Contextual aspects were critical to illuminate temporal changes in perceptions. As mentioned, the trust-based working model offered a high level of autonomy for employees to manage their work. Workspace choices were influenced partly by users' activity profiles, e.g., those with low task variety preferred to work primarily at their workstations. Preferences varied between those who were more adaptable and/or less sensitive to stimuli or those who had experienced better or worse conditions in their previous offices. The results indicated that these preferences did not change over time. Therefore, users adopted coping strategies to manage distractions at their workstations (e.g., noise-cancelling headphones, divider screens, avoiding rush hours). The motives for preferring their workstations were (i) a sense of ownership over the workstations and (ii) the difficulty of carrying belongings to other workspaces, which may explain the low utilizations in both waves. Hence, organization, activity, and individual aspects led to different perceptions of the activity-based office in the long term.

In summary, Study 2 provided in-depth insights into the ways in which perceptions of design characteristics of an activity-based office supported or hindered comprehensibility, manageability, and meaningfulness, considering temporality in office users' perceptions.

4.3 Activity-based office design in relation to users' perceptions

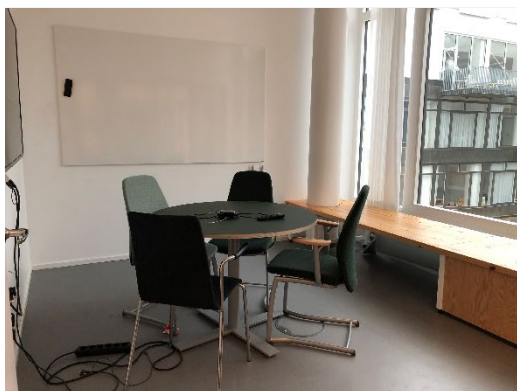
Papers C and D adopted a design perspective considering users' perception of the office environment. That is, the layout and design characteristics of activity-based offices were compared with users' perceptions of them.

The case studies revealed that the perceptions of activity-based offices did not always align with their design characteristics. For example, users complained about the lack of biking facilities and changing rooms, while a locker room equipped with showers and a changing room was provided in the basement of the building. This information was provided in an in-house guidebook but did not reach users.

On the other hand, users read and used workspaces differently than intended by the designers. For instance, users indicated using quiet rooms for informal discussions, small meeting rooms for brainstorming and individual work, and phone rooms for concentrated work. Analysis of the design characteristics indicated that this deviance was likely due to the material affordances of the respective spaces. The small meeting rooms were compact and equipped with a whiteboard, large table, and IT equipment. The quiet rooms had soft furniture reminiscent of lounge spaces. The phone booths were compact and therefore secluded with fewer distractions (Figure 15).



Quiet room with facing sofas resembling a meeting space (Study 2). Photo by the author.



Small meeting room for four persons (Study 2). Photo by the author.



Phone room with a compact design in Case L (Study 3). Photo by Felix Gerlach.

Figure 15. Spatial readability of workspaces.

Differences were also found between expectations and user perceptions of activity-based offices. Study 3 compared the design characteristics and perceptions of two AFOs: Case S (Case Small) and Case L (Case Large) (Figure 16 and Figure 17). A lower ratio of workstations per person in enclosed spaces did not lead to more positive perceptions of visual and acoustic privacy. Users' comments suggested that this outcome may be due to a combination of three main factors: (i) nuanced design characteristics, (ii) activity profiles, and (iii) previous office types.

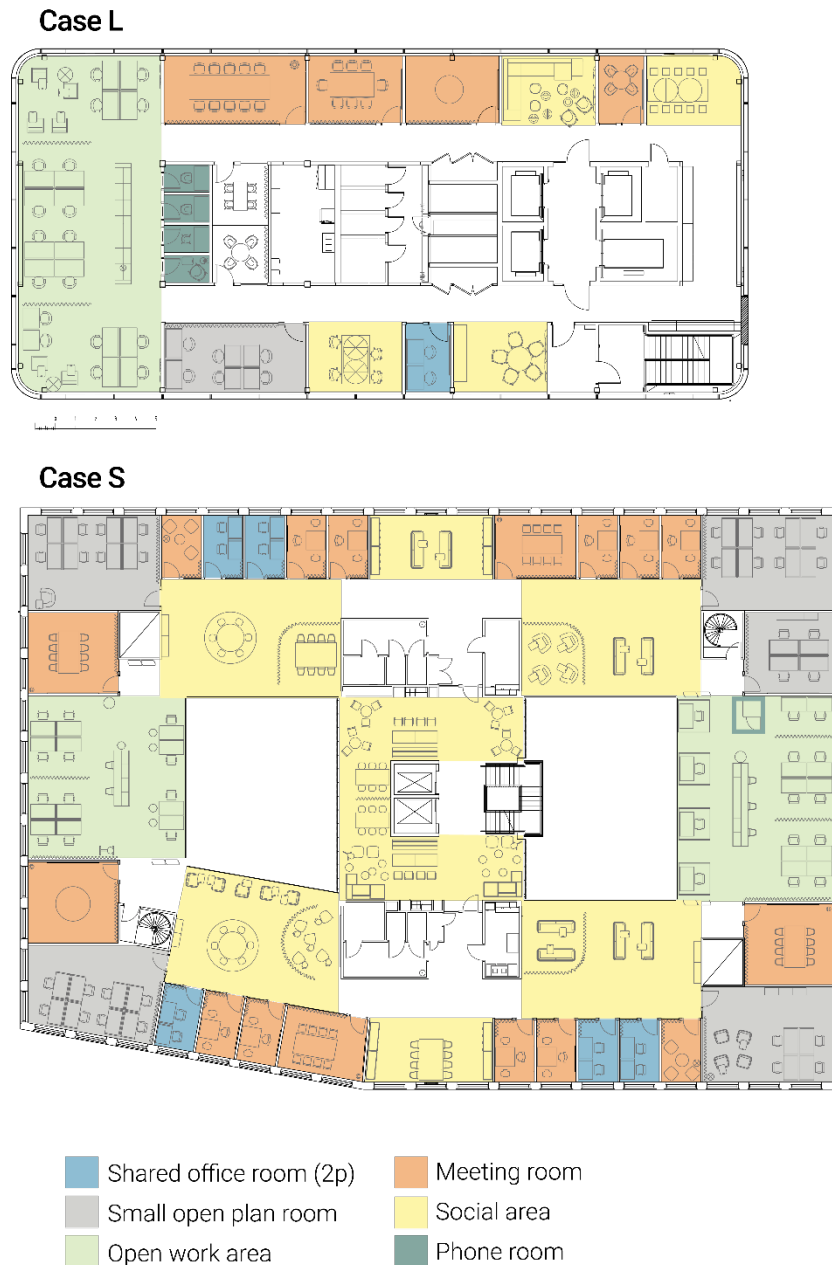


Figure 16. Case S and Case L floor plans.

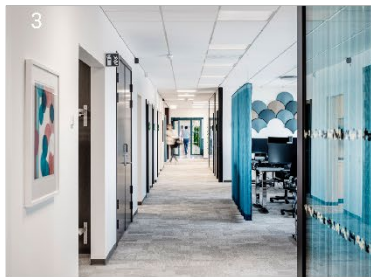
*In Case L floors 1 to 4 were identical and roughly twice as large as floors 5 to 13.



Facade of Case L.



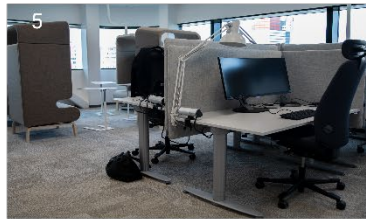
Facade of Case S.



View of a corridor in Case S.



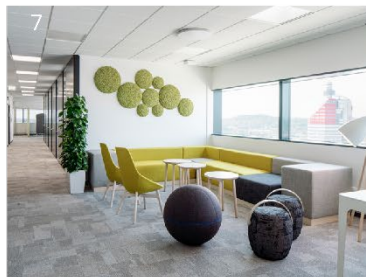
Example of a social area in Case S intended for socializing, informal discussions, individual or collaborative work.



Example of an open work area intended for individual or side-by-side work, provides height adjustable desks, chairs and one wide screen each.



Glass facade of the central atrium in Case S.



Example of a social area in Case L, intended for socializing, informal discussions, individual or collaborative work.



Example of a meeting room equipped with a large table, video conferencing equipment, a whiteboard and chairs.



Example of a meeting room equipped with a large table, video conferencing equipment, a whiteboard and chairs.



Example of a phone room intended for phone calls equipped with a desk, a lamp and a chair.

Pictures 1, 3, 4, 7, and 10 Felix Gerlach
 Picture 2: Abako Arkitektkontor AB
 Pictures 5 and 8: Maral babapour
 Picture 6: Antonio Cobaleda-Cordero

Figure 17. Pictures of workspaces in Case S and Case L.

First, the perceived nuanced design characteristics included deficient zoning, poor soundproofing, high levels of spatial openness and transparency, and a lack of adjustable furniture and technical equipment. Users in Case S indicated that poor soundproofing caused problems with noise and overhearing in the building: (i) sounds from the collaboration zones were heard in the adjacent semi-quiet zones and quiet rooms, and (ii) spatial transparency in the layout was visually distracting. Layout analysis showed that the central atriums in Case S and the subsequent use of glass inside the building partially explain the visual and acoustic distractions (**Figure 18**).



Figure 18. View into the atrium in Case S (Study 3). Photo by Lasse Olsson.

A recurring theme was a sense of distress and uncertainty in finding a workspace for concentration and coping with the lack of supportive workspaces for activities. On the other hand, users in Case L indicated that the small phone rooms were sometimes used as a quiet room or for Skype calls and that these rooms were highly occupied, had poor reception, and lacked daylight, adjustable furniture, and large screens. The layout comparison shows that the phone rooms in Case L were distributed on different floors (four rooms per floor) and possibly served as cell offices. In Case S, the cell offices were located on two floors only, and there was one phone booth per floor.

User activities in Case S included frequent Skype calls, phone calls, and/or handling confidential material, so a quiet and secluded environment with adjustable furniture and large screens was needed. However, this offering was perceived to be limited or nonexistent at the AFO.

The office types prior to the move also affected how users perceived the AFOs. While the majority of users in Case L had cell offices, users in Case S had activity-based or open-plan offices. Therefore, in Case L, the move to the AFO was perceived as an improvement, while in Case S, the move from cell offices to an AFO was perceived as a loss of privacy and control over visual and acoustic distractions.

The higher ratio of open and closed meeting rooms per person did not lead to a more positive perception of cooperation and working atmosphere. In both cases, users felt that within-team collaboration worked despite the challenges presented by the physical work environment. However, recurring challenges included difficulty finding teammates, fewer spontaneous interactions, more scheduled/online meetings, lack of a team feel, and more remote work. While users appreciated the increased social contact with other units, they indicated that their work did not necessarily benefit from this proximity. Users' motives for choosing a workspace suggested a dilemma: they wanted either to be close to their teams or to sit in enclosed spaces to concentrate better, which in turn affected their social interactions and team dynamics.

As expected, users in Case L, which was denser (fewer square meters per person), had more negative experiences of belonging to the community than in Case S. The AFOs were considerably different in size and density. Case S was a six-story office building with approx. 400 employees, whereas Case L was a 13-story office building with approx. 1500 employees. Although users in both cases reported feelings of isolation and loneliness, these feelings occurred more often in Case L. Others also reported a sense of anonymity and a loss of "team spirit" due to the building size.

4.4 Reflections on interrelations

Designing healthy activity-based offices is complex. An in-deep understanding of the interrelations between the design characteristics, users' perceptions and their sense of coherence seems to be fundamental to manage this complexity and explore design opportunities.

One design solution to improve one component of the sense of coherence may have positive effects on other components. For example, workspace personalization can take the form of identity expressions or blocking visual and auditory stimuli, which is beneficial to users in both ascribing meaning and managing their office environment.

Design characteristics can have conflicting effects on users' perceptions and sense of coherence. For example, spatial openness improves users' comprehension due to visual proximity to colleagues and a better overview of the environment, but it can also lead to overstimulation and difficulty managing distractions. Similarly, high spatial density (fewer square meters per person) can be a double-edged sword: it provides opportunities for social interactions with non-team members and improves the sense of belonging to the community, or it leads to social isolation for

others. Desk sharing is another example that can lead to uncertainty about where to work (comprehensibility). This means either sitting in a quiet area (to manage distractions) or sitting in a collaborative zone for proximity to teams and better social dynamics within one's team (meaningfulness).

The design characteristics are not separate but interrelated. For example, a combination of activity-based working, a variety of workspaces, desk sharing, and spatial openness influences a sense of belonging to the community and thus meaningfulness.

Additionally, workspaces are multipurpose for users. This use implies that users can identify the opportunities structured in the environment and cope with the lack of supportive workspaces. On the other hand, the different activities (quiet or communicative) can belong to different zones and cause disturbances.

The need to address this complexity underscores the importance of holistic research approaches to the study of office environments. As highlighted in the introduction to Chapter 1, design concepts and methods have evolved toward a more holistic and evidence-based perspective. This means that designing highly complex office environments is not only possible but is becoming an integral part of the design discipline.

Chapter 5 Discussions

This thesis explored the interrelations between the design characteristics of activity-based offices, users' perceptions of them, and users' sense of coherence, with the goal of: (i) contributing to the conceptualizations of healthy activity-based offices and (ii) facilitating practical use of the sense of coherence for office designers. This chapter discusses the findings in relation to previous research, recommends future directions and reflects on the research approach of the thesis.

5.1 Reading the environment

Spatial and object comprehension involves understanding what spaces and objects are and what they are for. The findings showed that users were able to read more into the activity-based offices beyond the intended use and use appropriate workspaces according to their needs and preferences.

Spatial comprehensions of workspaces may be based on prior experiences and memories that subsequently affected users' behavior (Canter, 1977). In this thesis, for instance, quiet rooms were reminiscent of a meeting room and phone rooms reminiscent of a cell office. The misuse of workspaces (using spaces differently than intended) is a strategy employed by users to cope with suboptimal design characteristics (Appel-Meulenbroek et al., 2011; Babapour Chafi and Rolfö, 2019; Søiland, 2021). Suboptimal design includes insufficient spatial enclosure, high density, deficient zoning, poor soundproofing, and lack of adjustable furniture and technical equipment. These deficiencies created circumstances in which, for instance, quiet and semi-quiet zones were not quiet, which is often caused by open layouts (Babapour Chafi, 2019a). Therefore users had difficulty reading and comprehending the intended use and behavior in different workspaces (Søiland, 2021). From an architectural design perspective, 'misuse' can be characterized as 'alternative use' reflecting a building's adaptability, i.e., the capacity of a building to serve different social uses (Arge, 2005; Groak, 2002). Future research can benefit from exploring the affordances of activity-based offices: opportunities that are structured into the environment to deepen the

understanding of multipurpose workspaces for better spatial readability, and avoid common design mistakes (Rao et al., 2009).

The findings showed that behavioral rules were critical for the comprehension of the space. In the activity-based office in Study 2, users relied on common sense due to the lack of rules; in Study 3, although the organization had explicitly communicated expected speech rules, different zones and rooms were used regardless of zoning. This incompliance led to increased distractions and feelings of distress. According to Babapour Chafi and Rolfö (2019), better compliance with rules is achieved when (i) office users are well informed about how and why to follow the rules, (ii) the rules are explicitly communicated and easy to follow, and (iii) following the rules is perceived to facilitate work and improve working conditions. Hence, users may benefit from design modifications that improve their work environment and thus compliance with rules.

Furthermore, feelings of ambiguity and frustration were caused by an unresponsive maintenance to fault reports in Study 2. This finding is consistent with other studies showing that a sense of resignation occurs when management does not address issues that disrupt employees' work (Babapour Chafi, 2019b), and that management's role is critical in creating a sense of comprehensibility, manageability, and meaningfulness (Lahtinen et al., 2015).

Interior architects can use design cues, divider panels, spatial seclusion and soundproofing to create a comprehensible environment in which users are able to easily read and understand the use and expected behavior in zones. Moreover, facilities management should regularly check whether workspaces are in order and that the maintenance system/procedures are responsive to fault reports and follow-ups.

5.2 The importance of being able to make a difference

Manageability relates to the sense that a person has control of their circumstances and environment which is very empowering, whereas the feeling of no longer having control is incapacitating (Golembiewski, 2010).

Different aspects of the activity-based offices influenced perceptions of control. The high level of spatial openness and transparency, which is inherent in activity-based offices, led to increased exposure to visual and acoustic distractions and thus a lack of sense of control. This finding is consistent with other studies showing that working in open workspaces with six or more people tends to reduce privacy and negatively impact well-being when there are no enclosed workspaces for retreat (Brennan et al., 2002; Colenberg et al., 2021; De Croon et al., 2005). Furthermore, a sense of control has been linked to workplace satisfaction and perceptions of privacy (Brunia et al., 2016; Hoendervanger et al., 2019; Kim and de Dear, 2013; Weber and Gatersleben, 2021). The findings showed that the sense of control can differ depending on previous experiences of

office types. The same effect as in Sirola et al. (2021) was observed in Study 3: when users move from shared or open-plan offices to an activity-based office, their perceptions are more positive (Arundell et al., 2018; Blok et al., 2009; Gerdenitsch et al., 2018; Robertson et al., 2008; van der Voordt, 2004a), while users who move from private offices are more likely to perceive activity-based offices more negatively (Haapakangas et al., 2019; Morrison and Stahlmann-Brown, 2020; van der Voordt, 2004a). Future studies can investigate whether users who relocate from cell offices would benefit from a higher level of enclosed space and thus more control over visual and acoustic stimuli.

The automated shade and climate system were centralized and did not allow for personal adjustments. This lack of control negatively impacted perceptions of daylight and temperature. Similarly, Meerbeek et al. (2012) showed that users felt frustrated with the automated shades not taking into account their preferences and permanently turned off the automatic mode. Skinner (1996) identifies three important factors that influence the sense of control: information, choice, and predictability. In this context, building automation in offices could cause users to lose their sense of control as decisions about the indoor environment are made by technology. Automated systems may need to integrate (i) communication from the system with users and (ii) a level of individual override control in the automated systems to improve user acceptance, their experience of the indoor environment and thus their manageability. Future studies may benefit from investigating whether smart (automated) technologies would lead to energy gains or compromised user experience and a resulting performance gap.

Difficulties in adjusting furniture and making technical equipment work were also found to limit the sense of control. This finding was due partly to the shared workspaces and artifacts in activity-based offices, where adjustments of artifacts change constantly. Babapour Chafi (2019) recommended post-relocation processes such as supervision (Brunia et al., 2016), ergonomic training (Robertson et al., 2008), and adjustments to standardized solutions (Ekstrand and Hansen, 2016; Kim et al., 2016) to help users overcome poor furniture issues and make activity-based offices work.

The findings also revealed that the lack of user participation in the planning and design process reduced a sense of control. Participation in design processes is associated with empowerment and higher levels of well-being in a number of studies. Vischer (2004) suggests that participation in the design process and feeling 'empowered' in design decision-making affects employees' sense of belonging or ownership in the workplace. These positive effects were also observed by Rolfö (2018a): user participation led to a sense of belonging to the office, a sense of pride in one's contribution, and higher levels of overall satisfaction. Moreover, work environment authorities and researchers often emphasize the need for employee participation and involvement in

systematic work environment management (Hasle and Sørensen, 2013; Nielsen et al., 2010; Swedish Work Environment Authority, 2001). An important lesson, then, is to engage in a design process that gives users a voice in decisions and includes shared objectives about what the new office should accomplish.

Life management amenities were provided in the activity-based offices to support employees' work-life balance. The trust-based working culture and the subsequent high level of autonomy were specifically appreciated in Study 2. Autonomy at work refers to employees' control of work time and place (Demerouti et al., 2014) and is associated with positive outcomes related to health and well-being (Deci and Ryan, 2008). The provided resting room and biking facilities are examples of supporting stress recovery and healthy behavior, although they were not highly utilized by users.

A manageable work environment should then focus on meeting users' needs such as concentration through a range of resources (e.g., noise-canceling headphones, noise-absorbing artifacts, and quiet rooms). Facility management should allocate a budget for such coping resources to help mitigate the negative impacts of acoustic and visual stressors in the long term. Employees may have a greater understanding of what aspects of office design (do not) work since during the pandemic, many succeeded in creating a well-functioning workspace at home. Nevertheless, some employees will need offices due to the lack of space and impossibility of concentrating at home. Other constraints, such as specific technical requirements, can also limit the possibility of remote work. Participatory design processes are therefore necessary to ensure that users' needs and preferences are captured and translated into design solutions.

5.3 A reason for seeing

Meaning is the most important component of the sense of coherence (Antonovsky, 1987). In *The Handbook of Salutogenesis*, Golembiewski (2022) explains meaningfulness as:

"[...] the thing that not only makes life worth living but can even turn hopeless adversity into joy. It is meaningfulness, the motivational power that drives us 'to get out of bed in the morning'. With a strong sense of meaningfulness, the salutogenic resource of affect (emotion) provides the capacity to turn ones' attention away from the uncertainties, negatives and difficulties of life and instead to focus instead on positive desires and what is otherwise good and purposeful".

Given that meaning is found in social relations, the thesis showed that activity-based office design can lead to social isolation and thus a less meaningful environment, especially in the long run. The results of recent longitudinal studies are inconsistent. While Gerdenitsch et al. (2018)

show that improvements in communication remained stable between the first and second measurements, while Haapakangas et al. (2019) report a decline in satisfaction with communication, teamwork and a sense of belonging post-relocation, which this thesis confirms. One reason for the observed deterioration in social interactions could be the novelty effect of relocating from cell offices to shared rooms and/or the increase in breakout spaces (Babapour Chafi, 2019b; Gerdenitsch et al., 2018). That is, the novelty of the new office wore off over time and the negative impact of noise and visual distractions may have outweighed the initial positive experiences. Thus, physical and visual proximity do not always result in positive outcomes for social interactions but may sometimes cause disturbances and, consequently, avoidance. As also shown in a recent study by Irving et al. (2020), users in open and collaborative workspaces adopted strategies such as minimizing social interactions to avoid new collaborations with others. Future studies could investigate whether these changes are related mainly to novelty effects or whether there are differences, e.g., between organizations with different needs for collaboration and task interdependencies.

This thesis also showed that relocation to activity-based offices that accommodate multiple teams and units under one roof created feelings of anonymity and a lack of a sense of community and belonging. This finding is consistent with the findings of Wohlers and Hertel (2018) who reported improved between-team collaboration in an AFO due to more contact and communication with nonteam members, while showing a decrease in communication and cooperation within teams. They also highlighted challenges for team management, such as ensuring cohesion and communication among team members given the spatially dispersed locations within the office building (Wohlers and Hertel, 2018). This challenge is a major drawback of activity-based offices given that activity-based office design is promoted as a means to improve communication and knowledge exchange through spatial openness and transparency (van der Voordt, 2004a). This challenge is important to address, given that humans derive meaning from their social relations, which is critical to their health and well-being (Diener and Seligman, 2004; Ryff and Keyes, 1995). Facilities management can address the difficulty of locating colleagues in large office buildings by assigning social spaces to groups. In addition, a digital platform may be helpful in which users can voluntarily notify their colleagues where they are in the building. To promote team cohesion, team managers can schedule collective activities such as coffee breaks. Future research can investigate how activity-based offices can strengthen within-team cohesion through design solutions.

The impossibility of personalizing workspaces was another disadvantage of activity-based office design that led to feelings of anonymity. Studies have shown that personalization is one way of ascribing meaning to space (Brunia and Hartjes-Gosselink, 2009), and the perceived

inability to personalize workspaces in activity-based offices can hinder identity developments within organizations (Ashkanasy et al., 2014). Personalization at the individual level, however, may become less important as the acceptance of activity-based offices may increase due to hybrid work practices and less time spent in offices. Collective personalization of dedicated social spaces with pictures, indoor plants and work-related items may help mitigate the negative effects on the social environment and promote a meaningful office environment. A relevant theory to better understand what makes a meaningful work environment is the ‘place attachment’ theory within the psychology of place. Workplace attachment has been broadly defined as a person’s emotional attachment to their physical work environment(s) (Inalhan, 2009). Future research can therefore investigate how users develop a sense of place attachment and belonging through collective identity expression in activity-based offices.

Access to the elements of the natural environment, including views, daylight, and balconies, was associated with positive meaning. Important connections between access to the natural environment and positive health outcomes have been made by Ulrich et al. (2008). Golembiewski (2010) suggests that the health benefits derived from access to a natural landscape occur because people find meaning in nature.

Designers should consider design strategies that promote access to nature references to promote a meaningful environment. Understanding these findings about meaningfulness has distinct importance in the new era of hybrid working. Recent surveys conducted by leading stakeholders in workplace design show that remote workers miss social connections and that meetings, networking, or spontaneous interactions are the main motivations to come to office (Gensler, 2020; Leesman, 2021). However, the rise in the hybrid work model is expected to lead to even greater difficulties in promoting team cohesion and a sense of belonging, given the different schedules and time spent in the office. Meaningfulness is therefore perhaps the most crucial and yet challenging component of activity-based offices.

5.4 Design for everyone is design for no one

While the standardization of spatial design solutions helps organizations create “one” unit with the same systems, principles and procedures (Ekstrand and Hansen, 2016), the findings of this thesis show that highly standardized design solutions and generic design do not meet particular needs of users and may result in underutilization of workspaces.

Standardization of activity-based offices may be because (i) different work units are merged and (ii) resources are limited and thus initial cost savings are prioritized over a long-term perspective. Standardized design solutions then imply a balanced solutions that can meet everyone’s needs on a generic level. However, the lack of modifications can lead to lingering

mismatches (Babapour Chafi, 2019b). As shown in this thesis, these mismatches can become so large over time that small adjustments are no longer sufficient to solve the issues of the office environment (Blakstad, 2001). Studies show that suboptimal office design is one reason for low employee retention, resulting in additional costs to organizations associated with loss of talent, high staff turnover, and the ongoing need for training new employees (British Council for Offices, 2016; van der Voordt, 2004a). Moreover, generic workspace designs that fail to address users' particular needs are often underused (Babapour Chafi et al., 2020; Yekaniabeiglou et al., 2021). Therefore, design for everyone is design for no one. Workspace underutilization contradicts the cost reduction agenda of activity-based office design (cf., Appel-Meulenbroek et al., 2011; Bodin Danielsson et al., 2014; Brunia et al., 2016; de Paoli et al., 2013; van der Voordt, 2004). User involvement can therefore lead to better design, a more manageable office environment and more cost-efficient solutions in the long run.

The findings suggest that the standardization of design solutions and ways of working does not always fit user needs and contradicts the core principle of activity-based office design: meeting a variety of needs through provision of supportive workspaces. Design solutions need to be customized so that users can choose a workspace that best suits their activities and preferences (Appel-Meulenbroek et al., 2011), not the other way around.

Therefore, standardization of planning, design, implementation, and operation processes may be a better approach to finding the correct balance between standardization and customization. Rather than emphasizing one-size-fits-all design solutions, a standardized process can provide guidelines for those in charge of relocation processes toward the steps necessary to create higher levels of adaptation and more dynamic design solutions. From this perspective, activity-based offices can be thought of as "moving projects" that develop over time, as described by Latour and Yaneva (2017):

"The problem with buildings is that they look desperately static. It seems almost impossible to grasp them as movement, as flight, as a series of transformations. Everybody knows – and especially architects, of course – that a building is not a static object but a moving project, and that even once it has been built, it ages, it is transformed by its users, modified by all of what happens inside and outside, and that it will pass or be renovated, adulterated, and transformed beyond recognition".

The term 'moving project' here refers to the changing nature of organizations, their work processes and their employees. Dynamic design solutions should enable users to interact with the design and adapt it to their own needs, which may require less standardization. In this sense, a

question of interest for office designers and researchers is: How do we design for the changing needs of changing organizations?

5.5 Desk sharing or ownership

Desk sharing impacted the predictability of the office environment in Study 3. The need to search for and set-up a workstation without knowing if a suitable workstation would be available caused feelings of uncertainty and distress. This uncertainty was even more stressful for those whose tasks involved handling sensitive information, because the availability of enclosed workstations was not always assured. As shown by van den Berg et al. (2020) workspace enclosure and control were among the most important design characteristics for users. Furthermore, enclosed workspaces are most preferred for concentrated work (Hoendervanger et al., 2021; Seddigh et al., 2014) and hence can be expected to be highly utilized by users, as was also the case in Study 3.

Users' preference to work at their assigned workstations in Study 2 may have been due to old habits, difficulty caring belonging and adjusting the furniture, a sense of ownership, and their activity profiles. Users develop office habits and work routines over time which may have remained consistent after relocation to activity-based offices (Babapour et al., 2018), especially when switching workspace is perceived as difficult. Desk ownership allowed users to maintain pre-move routines. Thus, the theoretical benefits of the activity-based office design were not fully realized, considering the low occupancy rates of back-up workspaces (e.g., quiet rooms). Another explanation could be the sense of ownership that motivated users to work at their workstations despite distractions. The preference for assigned workstations could also be related to the low heterogeneity of users' activity profiles, which may not have benefited from a change of workspace. But in the case of shared desk offices, users with more mobile and heterogeneous activity profiles were more positive about sharing workstations (Hoendervanger, 2021; Hoendervanger et al., 2016).

Practitioners and decision makers can benefit from analyzing users' activity profiles to determine whether desk sharing benefits their employees or what level of flexibility is needed on a case-by-case basis. Mapping activity profiles and preferences is an important input for activity-based office design and critical to the success of an office relocation/intervention (Bruyne and Beijer, 2015; Greene and Myerson, 2011; Soriano et al., 2020). Nevertheless, future studies can examine whether the acceptance of desk sharing has changed following the Covid-19 pandemic and the increasing interest in hybrid work models. To address the difficulties of switching workspaces, further design efforts could be made, for example, to rethink artifacts for sharing, as suggested by Babapour (2019). Currently, artifacts in the office are virtually the same as they were before the introduction of flexible working (ibid.).

5.6 Reconceptualizing healthy offices

The review findings showed a lack of definition/conceptualization of health and healthy offices in office design concepts. The identified health-related outcomes shows that the dominant focus of the reviewed papers was pathogenic aspects (Bergefurt et al., 2022; Colenberg and Jylhä, 2021), which may stem from the traditional view of health as 'the absence of disease'. Recent literature reviews in corporate real estate management and facilities management have also confirmed the lack of definitions of the key concepts of a 'healthy workplace', 'health' and 'well-being' (Groen, Brenda H, Jylha, T, Van Sprang, 2018; Jensen and van der Voordt, 2019).

This thesis argues that ambiguity concerning the meaning of health can pose several issues. First, the pursuit of health without reflection can lead to the exclusion or demonization of members of society who are unwilling or unable to strive for wellness or healthy living (Hanc et al., 2019), that is, the 'wellness syndrome' (Cederström and Spicer, 2015). Hence, work environments should be inclusive in supporting people who are less able to take care of their health, empowering them to work or engage in social activities and be a part of society despite their limitations (Huber et al., 2016).

The second reason for need of clear definitions is that narrow health definitions can lead to design strategies focused on risk removal, while positive health approaches would also support active and positive coping with stressors, i.e., a sense of coherence (Miedema, 2020; Miedema et al., 2017). This need for better clarification in definitions is of special interest to the built environment community (Miedema, 2020), ensuring a clear and unambiguous definition of well-being to provide insights to design and manage healthy buildings (Hanc et al., 2019).

Last, in the absence of a clear conceptualization of health as a positive concept, future research, building legislation and public health policies may perpetuate the pathogenic paradigm. This possibility is problematic as it is now recognized that the absence of disease and illness does not necessarily imply that one is healthy. Considering the 'Health in All policies' (World Health Organization, 2014) and the acknowledgment that health care systems alone can make only a limited contribution to health improvements, a solid body of evidence on the health-promoting features of the built environment can support the creation of building legislation that puts people and their health at the center of decision-making processes.

The proposed sense of coherence framework facilitates a holistic perspective on healthy offices and the exploration of a range of design characteristics, from the causes of negative outcomes to resources for effective coping and adaptations. The framework is particularly relevant for recent developments in work practices, that is, the rise of hybrid work. In this sense, the salutogenic approach is vital, as Antonovsky considered 'change' as a normal state of life to be understood and managed by finding resources to cope with it in everyday life (Eriksson, 2017). In using the

analogy of 'health in the river of life', Antonovsky suggested that people not only need to build bridges to avoid falling into the river but also need to learn how to swim (Antonovsky, 1996). Accordingly, a healthy activity-based office, which encompasses the framework of sense of coherence, focuses on characteristics that enable 'swimming in the river'. Thus, healthy activity-based offices are not static solutions but moving projects in which users are provided resources and opportunities to codesign an environment that enables them (i) build meaningful social relationships, (ii) manage visual and acoustic distractions, (iii) read and comprehend workspaces, and (iv) receive support from management in their daily work.

5.7 Reflections on salutogenesis in relation to other theories

The concept of resources and deficits in salutogenesis can be compared with other theories from the field of organizational psychology such as person-environment fit theory (PE-fit) and job-demands resources theory (J-DR). PE-fit theory refers to the alignment between an individual and their work environment (Caplan, 1987; Edwards et al., 2006). The theory originally examined constructs such as employee needs and work-related rewards, employees' abilities and job demands, and personal and organizational values (Edwards et al., 2006), which do not address the physical environment. In recent years, few studies have applied PE-fit to activity-based offices. Gerdenitsch et al. (2018) applied a variant of the theory (need-supply) to study distractions, social interactions, and satisfaction. Hoendervanger (2021) applied PE-fit theory in his doctoral thesis to examine how employees' job characteristics, tasks, behaviors, psychological needs, and demographic characteristics are related to their perceived fit. While these studies provide valuable contributions to understanding individual and workplace factors that affect perceived fit, the physical office environment is often reduced to office type or level of enclosure. Whereas this thesis shows that the nuanced design characteristics play a critical role in users' perceptions of activity-based offices.

The JD-R model (Bakker and Demerouti, 2017; Demerouti et al., 2001) is widely applied in work stress research and can be compared with the salutogenic-pathogenic classification of stressors. The model classifies job characteristics into two categories: job demands and job resources. Demands are job characteristics that impair health through exhaustion and eventually lead to burnout and other work-related negative work outcomes. Resources are defined as job characteristics that promote work engagement, leading to increased motivation and other positive work-related outcomes. Finally, the JD-R model also refers to the role of job crafting, i.e., proactive strategies that users employ to change the nature of their work, relationships with colleagues and clients, and their appraisal of their work (ibid). The demands and resources studied in the empirical JD-R literature have focused largely on personal, social, and organizational

factors, with little reference to the physical environment (exceptions include Hakanen et al., 2005; Morrison and Macky, 2017).

Furthermore, these theories focus on assessing how well work-related activities and the work environment fit together to achieve higher performance and thus other work-related goals. However, the sense of coherence theory goes beyond the work-related factors and concerns the abilities/characteristics found within an individual or their environment that can be used to counteract the stressors of everyday life and create coherent life experiences (Vaandrager and Kennedy, 2022).

Although the sense of coherence theory does not directly address with the physical environment, its holistic perspective allows it to become an overarching theory that encompasses a wide range of theories, including JD-R, PE-fit theory, place attachment, biophilic design, flourish model, etc., most of which are gathered in 'A Handbook of Theories on Designing Alignment between People and the Office Environment' edited by Appel-Meulenbroek and Danivska (2021).

5.8 Reflections on the research approach

Within each research project, certain methodological choices must be made that influence the findings. In this section, the theoretical perspectives and the methodological approach adopted in this thesis are discussed.

Study 1 (paper A) adopted a scoping review. The scoping review described by Arksey and O'Malley (2005) provided an overview of a specific topic area (office design concepts), i.e., it served to capture recurring themes and research gaps related to design concepts and health, without the intention of assessing the quality of the included literature (Antman et al., 1992). In addition, a scoping review can help quickly familiarize the reader with the topic (Arksey and O'Malley, 2005; Mays et al., 2001). Scoping was particularly useful in the beginning of the research project to gain an overview of the field and to study such a multidimensional topic. The results may have been influenced by the keywords and synonyms used. Nonetheless, the terms used were chosen because of ongoing discussions within the research team, which had experience in both scoping reviews and design for office and health, and with university librarians. Therefore, the terminology was broad to include a wide set of literature.

It has been suggested that combining a variety of methods in the studies of office often leads to more interesting results than using singular methods (Jensen and van der Voordt, 2015). For Studies 2 and 3 (papers B, C, and D), a variety of qualitative and quantitative methods were used, including interviews, observations, questionnaires, card sorting, and layout analysis. Mixed-method approaches allowed me to obtain more complete and informed results, to balance the

shortcomings of one method with the advantages of another, and to explore information not accessible through a single approach (Creswell and Plano Clark, 2017). For example, the questionnaire results in Study 3 showed a contrast between the perceptions and design information on spatial density. Explanations were found only in the rich qualitative data from open-ended questions. Another example is the positive perception of the diverse workspaces in the interviews, which were found to be underutilized during the observations. This divergence between perceptions and actual use was possible to capture only with a mixed-method approach.

The questionnaire, interviews and card sorting enabled mapping of how and why diverse design characteristics were perceived as satisfactory and important by users and thus related to their sense of coherence. The observations and layout analysis provided objective information of the design circumstances to be contrasted with users' perceptions. Future studies can employ other user research methods (Babapour Chafi and Cobaleda-Cordero, 2020), such as spatial walkthroughs, experience curve mapping, or focus group interviews to explore temporal changes and collective experiences of activity-based offices. Ideally, these methods can be combined with to gain a holistic understanding of different facets of perceptions and use. However, integrating such methods requires a long period of time and multiple researchers to collect and analyze data, which was not feasible in this work. Nevertheless, measures were adopted to ensure the quality of the research.

Triangulation of multiple data sources and methods was adopted to ensure reliability and transferability of the findings. Strategies to ensure reliability included (i) a thorough description of the research questions and their relationships to the research approach and theory, (ii) collaborative discussions about data collection strategies and data analysis among publication coauthors, and (iii) ongoing feedback through discussions with research colleagues and supervisors, presentations at seminars and conferences, and peer review. Transferability was ensured through (i) studies in real office settings that take into account the complexity of the real-world context (Yin, 2014), (ii) presentation of preliminary results to participants to obtain their feedback and confirmation, and (iii) detailed description of the research approach to make it comparable and replicable with equivalent studies in the field.

Some consideration of the methodological approach is noteworthy for future studies. First, the research approach of the thesis could not apply the validated survey instruments of sense of coherence, including the 'orientation to life questionnaire' by Antonovsky (1987) or 'work-sense of coherence' developed by Vogt et al. (2013), as the questions barely refer to the physical (office) environment. In the absence of validated survey instruments, a pragmatic research approach was adopted to better understand the design characteristics of the office environment that promote or impede comprehensibility, manageability, and meaningfulness for office users. Thus, theoretical

references from the fields of health, psychology, facilities management, and architectural design were combined to best serve the purpose of this research on healthy offices. The research approach adopted in this thesis may assist future research in developing survey instruments to assess the sense of coherence in the context of activity-based office design (cf. the salutogenesis framework evaluation criteria by Mazzi, 2021). For instance, to measure the effectiveness of a particular design feature for each sense of coherence component in the office environment.

Second, the questionnaire questions used in Study 3 did not address the different workspaces and their design characteristics, making it difficult to identify the specific workspaces mentioned in users' responses. It is recommended that future research develops methods to evaluate design characteristics of workspaces within activity-based offices.

Finally, the work presented here can be categorized as 'design for research', that is, providing a conceptual framework and design implications that can facilitate the practical use of a sense of coherence and improve design practices (Forlizzi et al., 2009). Future research is recommended to apply the framework of this thesis during planning processes to map and evaluate design decisions with respect to users' sense of coherence in activity-based offices. Future work also includes dissemination of the findings on various platforms, such as the development of summaries for practitioners and presentations of the findings to various stakeholders (e.g., architects, facility managers, corporate real estate owners, building users and occupational health professionals). Future studies on healthy activity-based offices may benefit from developing methods to gather data from multiple angles:

- Objective design information: Methods should be developed to analyze the quantities and qualities of workspaces in activity-based offices. Workspace quantities can be measured with respect to density (e.g., the number of users per workstation/seat/room) and the ratios of concentrative and collaborative zones. For design quality, it is more challenging to evaluate e.g., wayfinding, spatial transparency, control possibilities over the environment, and technical solutions. Space syntax methods may be useful to capture some of these spatial qualities.
- Survey instruments: Questionnaires can be developed for investigating sense of coherence in the context of the physical office environment. Additionally, qualitative user research methods are needed to complement the quantitative data and gain a richer understanding of the 'whys' and 'hows' of users' experiences of office environments.
- Data about use and behavior: Studies can benefit from using wearable devices and electronic communication servers to capture empirical data on user behavior.

Observation tools are also useful to gather contextualized insights on how employees use and adapt to spaces:

- Information on contextual factors: Previous office type, organizational culture, individual preferences, and activity profiles are important factors to understand and explain conflicting results from different office studies. Additionally, for future adaptations, there is a need for information about motivations for working in the office.

5.9 Implications for practice

This section describes the implications of the findings of this thesis for office design practices. Although architects and designers cannot control the level of stress people from other sources, their design solutions should focus resources that support users to cope and craft a supportive environment. It may be beneficial to create a feedback loop to inform architects and designers about how workspaces are being used and perceived post-relocation to improve design solutions and avoid repeating design mistakes.

In today's environment, as organizations face a return to the office and increasing demand for hybrid work, the sense of coherence framework in the office context appears to be more crucial than ever to make spatial adjustments to encourage people to return to offices. The identified risks and benefits of activity-based offices for users' sense of coherence are outlined in Figure 19 to provide an overview of the influences on the sense of coherence for office designers and potentially other stakeholders involved in activity-based office relocations (e.g., facilities managers, team managers, real estate owners, occupational health professionals).

To achieve long term health outcomes, organizations may benefit from investing in resources to (i) collect information on new work routines and expectations, (ii) establish new work model policies and communicate them with employees, (iii) work with employees in participatory processes to develop office design strategies, and (iv) introduce new spatial adaptations.

	BENEFITS	RISKS	RECOMMENDATIONS
COMPREHENSIBILITY 	• Visual overview of the organizational structure and information due to spatial openness and transparency	• Losing a grip on information due to spatial disperse and lack of spontaneous interactions • Feelings of uncertainty about availability of a supportive workspace/workstation • Deficient zoning and difficulties reading the spatial use and expected behavior • Clutter and mess due to incompliance with rules	• Use spatial cues and enclosure to signal expected behavior • Soundproof quiet rooms and zones
MANAGEABILITY 	• Access to diverse workspaces • High level of autonomy and control thanks to flexible working and the variety of workspaces • Flexibility due to the use of flexible furniture	• Lack a sense of control over visual and acoustic stimuli due to spatial openness and transparency • Disturbance by automated systems due to the lack of the sense control and malfunction • Limited user involvement in the design/change processes and subsequent mismatches between the workspaces and user needs • Difficulties adjusting furniture • Underutilization of workspaces	• Provide opportunities for user participation in design/change processes • Provide noise canceling headphones • Provide dividing screens between workstations and also for individuals to use when needed • Provide enclosed quiet rooms for different types of quiet activities, e.g. lounge settings for reading, and fully equipped workstations for computer work
MEANINGFULNESS 	• Visual proximity to others • Opportunities to meet nonteam members • Abundance of daylight due to spatial openness and transparency • Provision of diverse breakout and lounge spaces • Modern and neutral look	• Difficulties finding team members and the subsequent feelings of isolation • Lose grip on the team members • Lack of a feeling of belonging to the community • Feelings of anonymity due to lack of personalization • Impersonal and sterile look	• Allocate breakout areas to teams • Provide a platform for locating teammates (voluntarily) • Schedule collective activities such as coffee breaks • Organize collective personalizations of workspaces • Provide fully equipped workstations in collaboration zones for side-by-side teamwork

Figure 19. Risks and benefits of activity-based office design for sense of coherence.

Chapter 6 Conclusions

This thesis explored the interrelations between the design characteristics of activity-based offices, users' perceptions of them, and users' sense of coherence. A framework based on the salutogenic theory was developed and applied which maps the design characteristics of office environments with regard to comprehensibility, manageability and meaningfulness. The framework aims to facilitate the practical use of the sense of coherence theory for office designers as well as for the design community. The framework is also intended to open a dialog about how to evaluate salutogenesis in design. A new conceptualization of healthy activity-based offices was developed to support discussions concerning health, activity-based design, participation, adaptability, and active coping in activity-based offices:

“A healthy activity-based office is not a static solution, but a ‘moving project’ in which office users are provided resources and opportunities to codesign an environment which enables them (i) build meaningful social relationships, (ii) manage visual and acoustic distractions, (iii) read and comprehend workspaces, and (iv) receive support from management in their daily work”.

The following section highlight the findings of this thesis with respect to the research questions and summarize its contributions.

RQ1. In what ways do office design concepts relate to health and healthy offices?

- The design concepts included health-focused, user-focused and office concepts.
- Health was not defined but referred to, in terms of outcomes related to wellbeing, physical and mental health, and salutogenic health through design characteristics and contextual factors.
- Design concepts represented diverse levels and foci and thus diverging design strategies.

- No holistic design concept covered all design aspects.
- Contextual aspects were not addressed by most design concepts.

RQ2. What are the (short-lived and long-lasting) interrelations between users' perception of design characteristics in activity-based offices and users' sense of coherence?

- Spatial openness and transparency contributed to a better overview of the office environment and thus improved comprehensibility in the office. However, deficient zoning, lack of behavioral rules, and an unresponsive maintenance system/procedure to fault reports generated feelings of uncertainties and ambiguities about the office environment and thus limited comprehensibility.
- Access to adjustable furniture and technical equipment as well as the high level of work autonomy supported users to manage their work. However, a lack of sense of control over visual and acoustic distractions and the impossibility to adjust the automated shades and climate system made the activity-based office less manageable for users.
- Large windows and balconies offered daylight and views onto nature, which created inspiration and positive mood and were associated with positive meaning. However, difficulties locating colleagues and discouragement to personalize workspaces led to feelings of isolation and anonymity, a lack of a sense of belonging to the community, and thus reduced meaningfulness.
- The influence of the office on users' perceptions and thus their sense of coherence changed over time: (i) novelties wore off, (ii) negative influences caused by poor design characteristics were not resolved over time, and (iii) eventually worsened. All this reduced comprehensibility and meaningfulness for users, but manageability was (somewhat) stable.

RQ3. How do the design characteristics of activity-based offices relate to users' perceptions of them?

- The relationships between the design characteristics and users' perceptions of them was influenced by diverse interrelated design characteristics and contextual aspects.
- Higher number of enclosed and open meeting spaces per person did not lead to better perceptions of social interactions.
- Higher number of workstations per person in enclosed workspaces did not lead to better perceptions of privacy.

- In addition to spatial enclosure and density, other nuanced design characteristics were found to influence users' perceptions, including spatial transparency, zoning, furniture, soundproofing, furniture, and technical equipment.
- Workspaces were used for multiple purpose that often diverged or contradicted the intended use.
- Users were not always aware of the provided facilities in the activity-based offices (e.g., bike facilities and changing room).
- The diverse workspaces intended for different activities were appreciated but underused.
- Standardized design solutions led to suboptimal workspace design that were underutilized.
- In the denser activity-based office (fewer square meters per person) users had a more negative experiences of belonging to the community and isolation.

RQ. What are the interrelations between the design characteristics of activity-based offices, users' perceptions of them, and users' sense of coherence?

- One design solution to improve one component of the sense of coherence may have positive effects on other components.
- Design characteristics can have conflicting effects on users' perceptions and sense of coherence.
- Design characteristics impact user perceptions in combination and therefore should be considered with attention to contextual aspects.
- Activity-based office environments are complex. The need to consider this complexity highlights the importance of holistic research approaches to the study of activity-based offices.

From an architectural design perspective, designing for healthy activity-based offices requires dealing with these complex interrelations. This complexity necessitates contextual inquiries into nuanced design characteristics, users' activities, preferences, previous office types, and organizational culture.

6.1 Contributions of the work

The goal of the thesis was twofold: (i) contribute to conceptualizations of healthy activity-based offices and (ii) facilitate practical use of the sense of coherence theory for office designers. The

main contribution of the work is connecting two topics that have rarely been connected: salutogenesis and activity-based office design.

The first contribution is the development of a new conceptualization for healthy activity-based offices that emphasizes (i) the changing and diverse needs of office users, (ii) distractions as ubiquitous elements of the office environment, (iii) support for active coping, (iv) codesign instead of ready-made solutions, and (v) the dynamic nature of design instead of a static and final design.

The second contribution is a sense of coherence framework in the office context that provides an overview of the interrelations between the design characteristics and sense of coherence. This framework may contribute to better-informed discussions about healthy, activity-based office design, discerning which components of sense of coherence should be prioritized and which components are underrepresented. In addition, the framework can support architects in exploring how their buildings can support these different components.

Third, the thesis can not only contribute to the conceptualizations of activity-based offices but also support building design in other areas, such as schools or administrative workplaces in health care. However, to compare different environments, contextual and disciplinary differences must be considered.

Finally, the thesis has helped me better understand architectural research in relation to other disciplines. To understand and benefit from the potentials of design research and the multidisciplinary nature of architecture, I learned to navigate between different theories and disciplines. I also learned that there are tremendous opportunities for architects to contribute to the development of healthier built environments in a variety of settings. I hope that this work will introduce them to salutogenesis and motivate them, as it has inspired me, to further investigate the power of design in promoting community and societal health.

Chapter 7 References

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