

Social and Psychological Adaptation to Open-Plan Workplace Designs

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Abstract

The association between office design and occupant outcomes has been widely examined. In general, people working in more open or shared offices report poorer outcomes on a range of psychological, productivity and environmental satisfaction measures. However, not all studies and occupants report negative experiences. Accordingly, the overarching aim of this thesis was to examine some of the reasons for individual differences, with a particular focus on variations in work type and factors such as personality. The thesis commenced with a systematic review of the existing literature which examined the office design – occupant outcome association to provide context for the empirical review that followed. The second part of this thesis presented the findings of a survey study on knowledge workers experiences working in different office configurations. These findings are set out in four studies.

The primary aims of these four studies were: 1) To determine how office design relates to occupant outcomes (i.e., health, work, and social); 2) To determine the extent to which the type of work (i.e., cognitively demanding work) moderated the association between office design and occupant outcomes (i.e., health, work, and social); 3) To explore how perceived importance of collaboration to complete work is related to social outcomes in the workplace; 4) To explore the extent to which personality (introversion / extraversion) moderated the association between office design and occupant outcomes (i.e., health, work, and social).

An online cross-sectional survey collected 714 responses from knowledge workers in various office configurations in relation to their health (physical and psychological), work (productivity, job satisfaction, satisfaction with work environment), and social outcomes, as well as possible office protocols and adaptive behaviours.

Findings from the first two studies indicated that, the type of work completed was found to moderate the relationship between office design and occupant outcomes, i.e., people who completed more “cognitively demanding” work in open-plan work environments reported worse health and occupational outcomes than those whose work is less cognitively demanding. The findings from the third study suggested that occupants will collaborate with others at work if they perceive it to be important, regardless of their office configuration. The findings from the fourth study indicated that compared to extraverts, introverts scored lower on a range of measures of productivity, satisfaction and social interactions in open-plan workplace designs. Furthermore, introverts were found to utilise fewer adaptive behavioural

strategies and to be less aware of office protocols than extraverts in open-plan work environments.

Finally, the concluding paper in this thesis explored innovative office designs from the last decade and how the current global pandemic, COVID-19, is influencing how and where people work now and into the future.

Findings from this thesis point to the complex and multifactorial nature of the office design – occupant outcome association. It is clear that no single office configuration is suitable for all organisations. Instead, it is essential that the individual needs of the occupants and organisation (based on both work type and individual differences) are considered in order to maximise both occupant and organisational outcomes.

Declaration

I certify that this work contains no material which has been accepted for the award of any other degree or diploma in my name, in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text. In addition, I certify that no part of this work will, in the future, be used in a submission in my name, for any other degree or diploma in any university or other tertiary institution without the prior approval of the University of Adelaide and where applicable, any partner institution responsible for the joint-award of this degree.

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Signed:

Olivia Isabel Shirley James (Candidate)

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1 Introduction

Overview

An important topic in the field of organisational psychology is the association between work environments and the health, work and social outcomes of employees. One of the important elements of work environments which has become of central importance during the COVID-19 pandemic is the physical structure of workplaces. In particular, there is interest in understanding whether differences in office design have implications for psychological and organisational outcomes. As will be discussed in this thesis, most modern office workplaces have undergone considerable transformation over the last few decades from a more modular or single office design to newer shared or open-plan designs. In these designs, multiple workers are co-located in the same physical work area, often to achieve particular organisational objectives and based on various architectural assumptions about the potential impacts on human behaviour. These assumptions are that such designs will give rise to greater social interactions and collaboration, will enhance productivity and reduce office costs.

In the thesis which follows, I will examine the veracity of these claims in a major review of the existing literature as well as the presentation of a series of papers based on an international survey of office workers. The thesis will show how researchers have attempted to understand the relationship between office design and occupant health. It will be shown that there has been considerable interest amongst researchers, policy makers and business decision makers about the role of the physical office and building design on occupants' psychological and social wellbeing. There is now recognition that employment outcomes have many dimensions and that, in line with broader definitions of health and broader frameworks (e.g., such as those promoted by the WHO) that research and policy have to extend beyond narrow definitions of employment outcomes and adopt a more 'holistic' approach. Such approaches encourage a multi-dimensional appraisal of employment outcomes that extend beyond output metrics, staff turnover or absenteeism rates to encompass physical, psychological, and social functioning within work environments.

As I will show: research to date has utilised numerous theoretical approaches in an attempt to explain the different behaviours exhibited by occupants in both single-occupant enclosed offices and open-plan work environments. Due to the complex nature of the phenomena, no single theory can be used to fully explain the office design – occupant outcome association. Theories of particular relevance to the office design – occupant

outcome association include social interaction and behaviour, cognition, personality, and person-environment fit theories. It will be shown that outcomes from studies in open-plan or shared work environments have produced varying results. Some people appear to do well in open-plan or shared work environments, whereas many do not. This has led to the understanding that the association between office design and occupant outcomes is likely to be complex and influenced by a range of factors. Many of these factors are likely to be psychological or at an individual level and therefore make it a topic suitable for investigation in organisational psychology. In addition, consideration has to be given to the type of work undertaken, with the expectation that certain types of work, e.g., intensive “knowledge-based” work that requires more individual attention (high cognitive load) are more likely to be influenced by open office environments than other more collaborative project-based work.

The thesis will show that businesses have endeavoured to overcome the many challenges associated with open-plan and shared workplace environments through the design of innovative work environments. It will also be argued that the COVID-19 pandemic has forced much of the debate concerning modern office designs into the forefront of public debates. Subsequent lockdowns and social distancing requirements have resulted in many businesses adopting remote work modes and, as a result, numerous businesses are in the process of reassessing the need and purpose of their office spaces. These changes have resulted in fundamental shifts in thinking about how and where people work.

For these reasons, it is now very timely to review and examine the influence of office design and other individual factors (e.g., type of work and individual differences) and how any proposed office solutions arising from the COVID-19 pandemic are tailored to maximise occupant outcomes and that the negative impact on occupants’ health, work and other social interactions are minimal. For these reasons, further investigation of the office design – occupant outcome association with a range of potential moderating factors (e.g., type of work and individual differences), as well as addressing some of the limitations of previous research in the field, is likely to contribute to knowledge that has the potential to inform both businesses and occupants. In effect, it is important to learn what has worked well and not so well in the past in guiding the future nature of workplace designs.

1.1 Thesis Aims

The overarching aim of this thesis was to explore the relationship between open-plan or “shared” office designs and health (physical and psychological), work and social outcomes in knowledge workers. Specifically, this thesis aims to address the following questions:

1. How is office design related to occupant outcomes (including health, work, and social)?
2. To what extent does the type of work (i.e., cognitively demanding work) moderate the association between office design and occupant outcomes (including health, work, and social)?
3. How does perceived importance of collaboration to complete work relate to social outcomes in the workplace?
4. To what extent does personality (introversion / extraversion) moderate the association between office design and occupant outcomes (including health, work, and social)?
5. How is the global pandemic, COVID-19, influencing how and where people work now and into the future?

1.2 Thesis Outline

This thesis is organised into a series of chapters. Chapter 2 provides background information and definitions of office configurations and knowledge work as well as a brief overview of studies that have examined the association between office design and occupant outcomes. This chapter also includes a discussion of the major theoretical contributions underpinning the link between office design and psychological, work and social outcomes. This chapter concludes with a brief overview of the global pandemic, COVID-19, and its influence on how and where we work.

Chapter 3 contains a published systematic review arising from this thesis. The paper reviews workers’ health, satisfaction, productivity, social and other outcomes examined in the literature which has directly compared open-plan office designs to a clearly defined single occupant enclosed office. The paper primarily aims to summarise the existing research to assist informed decisions by showing how office design is associated with a range of outcomes which may outweigh any potential cost-benefits.

Chapter 4 introduces a survey study in which data was collected on knowledge workers experiences working in different office configurations from major Western

countries. The four papers arising from this data collection are included in Chapter 5. The first paper presents results from analyses examining the relationship between open-plan office designs and occupants' health (physical and psychological) and social outcomes. This study also examines whether workers' outcomes in their current office configuration is associated with the type of office they most previously worked in. The second study replicates the first paper's methodology to examine occupant work outcomes (i.e., productivity, job satisfaction, and work environment satisfaction). The third study examines the role of occupant's perception of collaboration as a potential moderator of the relationship between office type and social outcomes. The fourth study examines the role of individual differences (introversion / extraversion) in open-plan office workers' outcomes (health, work, and social). This paper also explores whether individual differences (introversion / extraversion) play a role in the adaptive behaviours and office protocols utilised by workers in open-plan office designs.

Chapter 6 contains a narrative review which aims to explore the future of office design. The paper examines how organisations have implemented "innovative" office designs in an attempt to overcome many common issues associated with open-plan office designs. The paper then introduces the global pandemic, COVID-19, and presents two ways organisations have adapted their work environment. The paper concludes with a discussion about how COVID-19 is influencing how and where people work now and into the future.

Finally, a general discussion of the key findings and contributions of this thesis to the broader literature is presented in Chapter 7. A summation of the potential theoretical and practical implications, the key research limitations, and possible future directions is also provided.

2 Background, Literature and Theory

2.1 Background and Definitions

For most organisations, the provision of a work environment is their second largest expense after salaries/wages (Pole & Mackay, 2009). As a result, considerable attention is directed towards office design because any changes will have implications for an organisation's profitability. Such changes can occur when organisations choose to downscale their operations to reduce costs, but also when there are changes to the nature of the work being undertaken (Davis et al., 2011) or the technology required to maintain effective operations (Joroff, 2002). For example, the introduction of greater computerisation and the availability of the Internet has had a significant influence on how work is undertaken (Joroff, 2002). Work has also become more technically complex (Smith, 2005) and can now be completed from remote locations outside of the office (Vuokko et al., 2015).

In the past, workplaces were often based in multi-story buildings arranged in terms of cellular offices on each side of corridors. In such environments, an office's location on the corridor as well as the building's floor was symbolic of status and job title (Sundstrom et al., 1980). By contrast, the current era is characterised by architectural schools and development styles that favour the replacement of the cellular office with new office concepts. These new designs are typically open-plan or "shared". Although no single definition exists, open-plan offices are usually characterised by large office spaces filled with multiple desks in various arrangements and a lack of physical barriers (Brennan et al., 2002; Oldham & Brass, 1979). These broad categories generally encompass a range of designs that can be differentiated based on characteristics such as: the number and height of partitions, overall size, spatial density, openness and architectural accessibility (Brennan et al., 2002; Hongisto et al., 2016).

In the US, the International Facility Management Association and Corenet Global estimated that over 70% of office workers occupy open-plan offices, with few or no partitions (Congdon et al., 2014). A key reason for this is that they are approximately 20% cheaper to build and maintain than traditional offices (Brennan et al., 2002). Such savings have been considered attractive to business, but it has also been recognised that open-plan offices may have 'hidden costs' that are not always captured in official accounting documents (Roper & Juneja, 2008; Smith-Jackson & Klein, 2009). Thus, it is possible that, despite initially appearing cheaper, open-plan workspaces may cost far more in the long run.

Moreover, decision makers are now faced with an array of choices when it comes to office design and must manage complex trade-offs when deciding which features to include in their physical work environments (Elsbach & Pratt, 2007). It is proposed that tensions may arise between or within the various instrumental (i.e., performance relevant); symbolic (i.e., meaning relevant); and aesthetic (i.e., sensory relevant) functions of the different physical objects and arrangements that may be included in an office design (Elsbach & Pratt, 2007). The play-out of such tensions may partially explain why there is no consistent link between specific office features and worker outcomes (Elsbach & Pratt, 2007). Furthermore, research on the connection between office design and employees' attitudes, behaviours, processes, and outcomes suggest that the following four features of open-plan workspaces are critical in the provision of "affective events" that could in-turn, influence office workers' outcomes: (1) personal space, (2) spatial density/crowding, (3) workplace personalisation and identity, and (4) task/workflow interdependence (Ashkanasy et al., 2014). Thus, to help minimise the occurrence of unintended consequences, decision makers should consider a multitude of factors when designing a work environment.

Another putative benefit of open-plan offices is that they can increase communication and collaboration between workers (Maher & von Hippel, 2005). Given the increased complexity of tasks, and the rise in knowledge work, collaboration has become an important concept for businesses wanting to encourage workers to share skills and ideas. Collaboration is generally defined as 'working together' (Heerwagen et al., 2004, pp. 511). Accordingly, many workplaces have been redesigned to minimise physical barriers in order to facilitate people working together which, in-turn, is argued to improve morale and productivity (Brennan et al., 2002).

Observation of actual workplaces has demonstrated that effective collaboration comprises a combination of interactive group-work and individual-focused work (Heerwagen et al., 2004). Thus, it has been argued that in-order to encourage 'effective' collaboration, workspaces should be designed to facilitate quiet independent work, interactive group-work, and the transition between both (Heerwagen et al., 2004). Such views have led to the development of activity-based workplaces. Activity-based workplaces are regarded as the next-generation of office design because they aim to create an environment that facilitates different types of work while maximising space (Wohlers & Hertel, 2017). Although based on the principles of open-plan design, they also include specialised spaces for particular purposes (Wohlers & Hertel, 2017). These spaces include: large open spaces filled with desks or long tables, meeting rooms, and small capsule rooms which can be used when employees

require quieter working environments (Appel-Meulenbroek et al., 2011). As a result of the popularity of workplace redesign, many workers have recently relocated to new work environments – mainly open-plan and activity-based workplace designs. Nevertheless, little research has investigated how workers deal with and adapt to changing work circumstances, and why some workers report positive experiences, while others do not.

The following review summarises the various office configurations broadly categorised as open-plan, the changing nature of work, the role of technology, and the key benefits of open-plan workplace designs. A particular focus is on the combining of all shared office configurations into open-plan, the importance of the type of work being done in- regards to whether a particular office design is suitable, and the influence of technology on our changing workplace designs – as demonstrated by our adaptation to COVID-19. This summary provides the basis for a research investigation that examines how individual differences, with a particular focus on variations in work type and individual differences such as personality influence the office design – occupant outcome association.

2.1.1 Office configurations

Offices can be designed and configured in a variety of different ways. At the most basic level, offices can be distinguished by their number of rooms and occupants. A single-occupant enclosed office (also referred to as a cellular office) is unique in that a room with full height walls and a closable door is only occupied by a single occupant (Boutellier et al., 2008). Moreover, most amenities are found within the single occupant's office (Bodin Danielsson & Bodin, 2008). Nonetheless, single occupant offices vary by both their size and the materials used to construct their walls and door. Beyond the distinguishable definition of a single occupant office, there is a lot of overlap between designs. The last few decades have seen a rise in new office designs and most notably the sharing of office spaces by multiple occupants (Brunia et al., 2016). Offices vary by a range of factors including: number and height of walls and partitions, number and positioning of desks, desk size, amount of space between desks, number of occupants per space, amount of space allocated per occupant (m²) and fixed or temporary desk arrangement (Brennan et al., 2002; Hongisto et al., 2016). While these designs all have common features, i.e., occupied by more than one occupant and shared amenities, no single agreed upon definition appears to constitute each of the various types of office configurations. Nevertheless, researchers have attempted to define and distinguish these various shared office configurations.

One of the most commonly cited categorisations of different office configurations was produced by Bodin Danielsson and Bodin (2008). Bodin Danielsson and Bodin's (2008) definition considers both the architectural and functional characteristics of different office spaces. While spatial organisation is the most dominant architectural feature, the actual work taking place inside the office are defined as functional features (Bodin Danielsson & Bodin, 2008). Seven broad categories were deciphered with variation both between and within the various office types: 1) cell office; 2) shared room office; 3) small open-plan office (4-9 people); 4) medium-sized open-plan office (10-24 people); 5) large open-plan office (>24 people); 6) flex office; and 7) combi office. Example architectural and functional features of each office type as defined by Bodin Danielsson and Bodin (2008) have been presented in Table 2.1. Importantly, the cell office can be clearly distinguished from all other office types because all other office types require the workspace and amenities to be shared between employees to varying degrees (Bodin Danielsson and Bodin, 2008). Furthermore, the current global pandemic, COVID-19, has exemplified the fundamental differences between single occupant enclosed offices and all other shared office designs. Many shared work environments, including enclosed offices with only two occupants, have required modification because their shared amenities and higher occupant densities pose a heightened risk of infection and potentially violate social distancing requirements (Wilson, 2020), whereas single-occupant enclosed offices have not.

Despite these definitions, it is clear that people categorise offices differently and what one may classify as one design, another may classify as something else. Furthermore, it becomes difficult to distinguish between minute differences between the configurations and it is challenging to ascertain whether offices are being classified consistently by different respondents. This is problematic because it limits the ability to compare respondent responses both within and across studies on different office designs.

Table 2.1. Architectural and functional features for the seven office types defined by Bodin Danielsson and Bodin (2008)

Office type	Architectural features	Functional features
Cell office	• 1 occupant in a single room office • Every room has a window	• Most amenities located within the office • Office work is independent and concentrated
Shared room office	• 2-3 occupants share a room • Can have screens between workstations • Roommates share window/s	• Most amenities located outside office • Often teams completing similar work • Interactive project work
Small open plan (4-9 occupants)	• Fixed workstations • Can have screens between workstations • No individual windows	• Amenities can be found at individual workstations • Shared amenities in office • Mainly independent work that is routine-based and requires low levels of interaction between occupants
Medium open plan (10-24 occupants)		
Large open plan (>24 occupants)		
Flex office	• No individual (fixed) workstations • Typically, open-plan design • “Backup spaces” for concentrated work, private phone calls, meeting etc. • Expects <70% of workforce in the office at once	• Employees select workstation based on task • Shared amenities in common spaces • Cannot personalise space • Most flexible office type

Office type	Architectural features	Functional features
Combi office	• Employees spend >20% of their time at workstations other than their “own” team-based work • Contains individual desks in open-plan or individual offices and a range of shared “backup” spaces for work that cannot be completed at personal workstations	• Teams access shared facilities when needed, and work at their own individual desks at other times • Office work is a combination of independent and interactive teamwork • Shared common amenities

2.1.2 Knowledge work

The nature of work has changed over time and this has influenced office design. Most notably work has become increasingly complex as machines and technology replace simple labour and tasks require more specialised skill sets (Greene & Myerson, 2011; Smith, 2005). The future of work is also likely to continually evolve and require additional specialised skill-sets due to the rise in robotic and AI technology (Ayoko and Ashkanasy, 2020). Some argue that, because of the increased complexity of work, tasks are now more likely to require the collaboration of multiple experts to complete (Kaarlela-Tuomaala et al., 2009) with occupations such as architecture, design, marketing, and information technology often singled out as examples. In such organisations, experts in different areas come together to contribute their specialist knowledge to a project. It is argued that traditional offices are not suited for such collaborative work styles because workers are physically segregated by walls and closed doors, impeding their ability to communicate (Oldham & Brass, 1979). A question arises, however, as to whether such logic can be extended to other occupations, particularly those that are less technical and require a predominance of independent ‘knowledge-based’ work that involves conditions conducive to independent thought and writing (Kaarlela-Tuomaala et al., 2009). Examples include the work of lawyers, academics and policy-writers.

The term ‘knowledge workers’ was first coined by Drucker in 1959 (Heerwagen et al., 2004) and refers to workers who use their expertise, education or experience to create, distribute and apply knowledge (Tom Davenport, 2005 as cited in El-Farr, 2009). Such workers were predicted to become the most valuable asset of 21st century organisations, as machines and technology gradually replaced manual labour (Drucker, 1999). Originally, only a few occupations were classified as involving knowledge work: doctors, lawyers, scientists, and academics (Greene & Myerson, 2011). Later, Drucker extended his term to include ‘knowledge technologists’ – occupations that combine formal knowledge and process work, i.e. computer technicians, laboratory analysts, paralegals and software designers (Greene & Myerson, 2011). In this sense, knowledge workers are not a homogenous group but encompass a range of occupations as well as roles and needs (Greene & Myerson, 2011). The variety of roles and needs of knowledge workers has posed a challenge for organisations that may have assumed that all knowledge workers have the same workplace needs when designing office workspaces (Greene & Myerson, 2011). Drucker (1999) argued that, unlike manual workers, knowledge workers should be considered a capital asset rather than a cost. This is because knowledge is the means of production, and is owned by the worker (Drucker, 1999). In other words, this knowledge is considered to be portable in the sense that, when workers leave an organisation, so does their knowledge and related productivity. As a result,

organisations 'need' knowledge workers more than the worker needs them (Drucker, 1999). Therefore, it can be argued that organisations should endeavour to encourage their top knowledge workers to remain with them and the provision of appropriate workspaces is one way in which employee retention could be encouraged.

Another consideration in workplace design has been the growth of multidisciplinary work (Hassell, 2014), particularly in the health and research sectors. This has been greatly influenced by the recent trend for funding bodies to offer large grants for multidisciplinary research projects (Pinder et al., 2009). Given that research is predominantly dictated by the ability to obtain funding, these grants can influence and change the way research is done. Multidisciplinary projects involve the convergence of multiple different fields, knowledge and ideas to solve a larger problem. As a result, many buildings have been restructured or purposely built to enable different disciplines to work in proximity to one another (Pinder et al., 2009).

2.1.3 Role of technology

Technology has not only changed the nature of work; it has also greatly influenced the way work is done. Readily available Internet access, portable electronic devices and mobile phones mean that work is no longer restricted to the office (Joroff, 2002). This has enabled businesses to offer more flexi-work and work-at-home arrangements. As a result, many offices and desks are unoccupied during business hours. Consequently, office utilisation was estimated to peak at 42% on any given day by Strategy Plus, a consulting and design firm (Waber et al., 2014). Many businesses have chosen to adopt an open-plan workspace design as the solution.

Furthermore, as early as the turn of the 21st century, researchers have argued that eventually, offices will no longer be required (Luff et al., 2000). This prediction has been exemplified by how businesses have adapted to COVID-19. Forced office lockdowns and social distancing requirements due to COVID-19 has rapidly accelerated the global uptake of remote work and work from home arrangements (Bick et al., 2020). Fundamentally, the ability for businesses to adapt and swiftly transition their entire operations to a remote working model was enabled by the increased capability of technology (AlphaBeta, 2020). As technology and our comfortability to operate it continues to increase, more jobs may become redundant and more people will work off-site (Cascio & Montealegre, 2016). This has raised several important questions concerning the future value of offices altogether and the possible implications this would have on organisations, workers, and the wider community.

2.1.4 Key benefits of open-plan workplace designs

Three benefits of open-plan design are readily cited in the literature: cost-effectiveness, flexibility, and encouraging communication and collaboration (e.g., Davis et al., 2011). It is argued that open-plan workspaces are more cost-effective than traditional cellular offices for a number of reasons (Davis et al., 2011). First, open-plan designs are more space efficient. They maximise expensive office real estate because more people can fit in a space, and the number of unoccupied desks and offices during business hours are reduced (Kim et al., 2016). This is evident when the average space required per employee of 17-20m² for cellular offices is compared to 7-9m² for activity based ‘non-territorial’ open-plan workspaces (Hassell, 2014). Second, some argue that open-plan offices are cheaper to build because the elimination of walls, doors and individual spaces means lower material and construction costs (Brennan et al., 2002).

Due to their lack of fixed structures, open-plan workspaces are also flexible (Brennan et al., 2002). This enables the physical workspace to adapt to changes in the corporate world (Davis et al., 2011). Unlike cellular offices, organisations with open-plan workspaces are not limited by the number of offices when employing staff (Brennan et al., 2002). Instead, the workspace can be modified to accommodate additional staff for the duration of a project and can then be rearranged for the next project (Becker & Sims, 2001).

A main driver for the swift uptake of open-plan workspaces is that they encourage communication and collaboration between workers (Davis et al., 2011). The first office designed specifically around flows of communication was the Burolandschaft in Germany in the 1960s (Hassanain, 2006). The Burolandschaft comprised ‘organically’ grouped desks in a large open floor plan with no walls, and used plants for partitions (Hassanian, 2006; Walsh, 2015). Nowadays, some advocate that the removal of all physical barriers including walls, doors and even partitions will facilitate social interaction between workers because people are more likely to communicate with others in close proximity (Oldham & Brass, 1979). It is hoped that open-plan workspaces will increase the number of ‘chance’ encounters, and that the collaboration of employees with different skills, views and thoughts will lead to new innovative ideas (Goldstein, 2006; Waber et al., 2014). Nonetheless, there is little empirical evidence to support the notion of increased communication and collaboration in open-plan workspace designs (Bonetta, 2003; Kaarlela-Tuomaala et al., 2009; Smith-Jackson & Klein, 2009).

2.2 Legal Obligation to Provide Safe Work Environments

Businesses have an obligation to ensure they provide work environments which are safe for all employees. In Australia, this is ensured through the provision of Government rules and legislations. In 2011, Safe Work Australia (2020d) produced a model set of work health and safety (WHS) laws which have been implemented by all Australian states and territories, except Victoria and Western Australia. Fundamentally, these laws stipulate that businesses have a responsibility to protect workers and other persons from harm by the elimination or minimisation of risk (Safe Work Australia, 2020d). It is important to note that WHS laws cover both physical and psychological health, and extend to the physical work environment. For example, Safe Work Australia (2011) stipulates that floor layouts must provide adequate space for employees to move about without strain and to evacuate in the case of an emergency. Moreover, businesses also have a requirement to ensure that their work environments meet all workstation, lighting, air quality and thermal regulations, and have adequate access to welfare facilities such as drinking water and toilets (Safe Work Australia, 2011). The influence of WHS laws to protect office workers in open-plan work environments is particularly evident during the COVID-19 pandemic whereby businesses around Australia have been mandated by law to modify their physical work environments to fulfil social distancing requirements, and to ensure adequate hygiene provisions to reduce employees' risk of contracting COVID-19 at work (Safe Work Australia, 2020e; see Chapter 2.5 for more information). Businesses are regularly audited with compliance checks, and those found to be breaking WHS laws can face harsh penalties including significant fines and in extreme cases, prosecution and forced closure (e.g., Queensland Government, 2020a; Queensland Government, 2020b). Moreover, businesses may be accountable to pay for any treatment and lost income associated with a work-related health claim, e.g., pay workers compensation (Fair Work Ombudsman, n.d.). Thus, “getting it wrong”, can have extremely costly consequences for a business.

2.3 What are the Dimensions of Health which are Important?

Health is far broader than just physical. The World Health Organisation (WHO) recognises the multidimensionality of health and has defined health in its 1948 constitution as “Health is a state of complete physical, mental and social wellbeing and not merely the absence of disease or infirmity” (World Health Organisation, 2020a). Too often this multidimensional definition of health is forgotten in favour of just considering physical health outcomes. It is essential that the psychological and social dimensions of health are also considered as they have significant impacts on an individual's overall wellbeing, as well as considerable costs associated with them. In fact, the cost of mental ill-health in Australia was

stated to be \$60 billion by the National Mental Health Commission in 2016 (Cook, 2019). Nonetheless, it is unclear whether occupants' psychological and social wellbeing are necessarily considered by those responsible for the new office designs.

All three multi-dimensions of health are examined in this thesis. The relationship between office work environment, moderating factors, and key physical, psychological, and social wellbeing outcomes examined in this thesis have been presented in Figure 2.1*. Figure 2.1 is followed by a brief summary of the key studies and findings relating to each of the different dimensions of health depicted by the World Health Organisation (2020a).

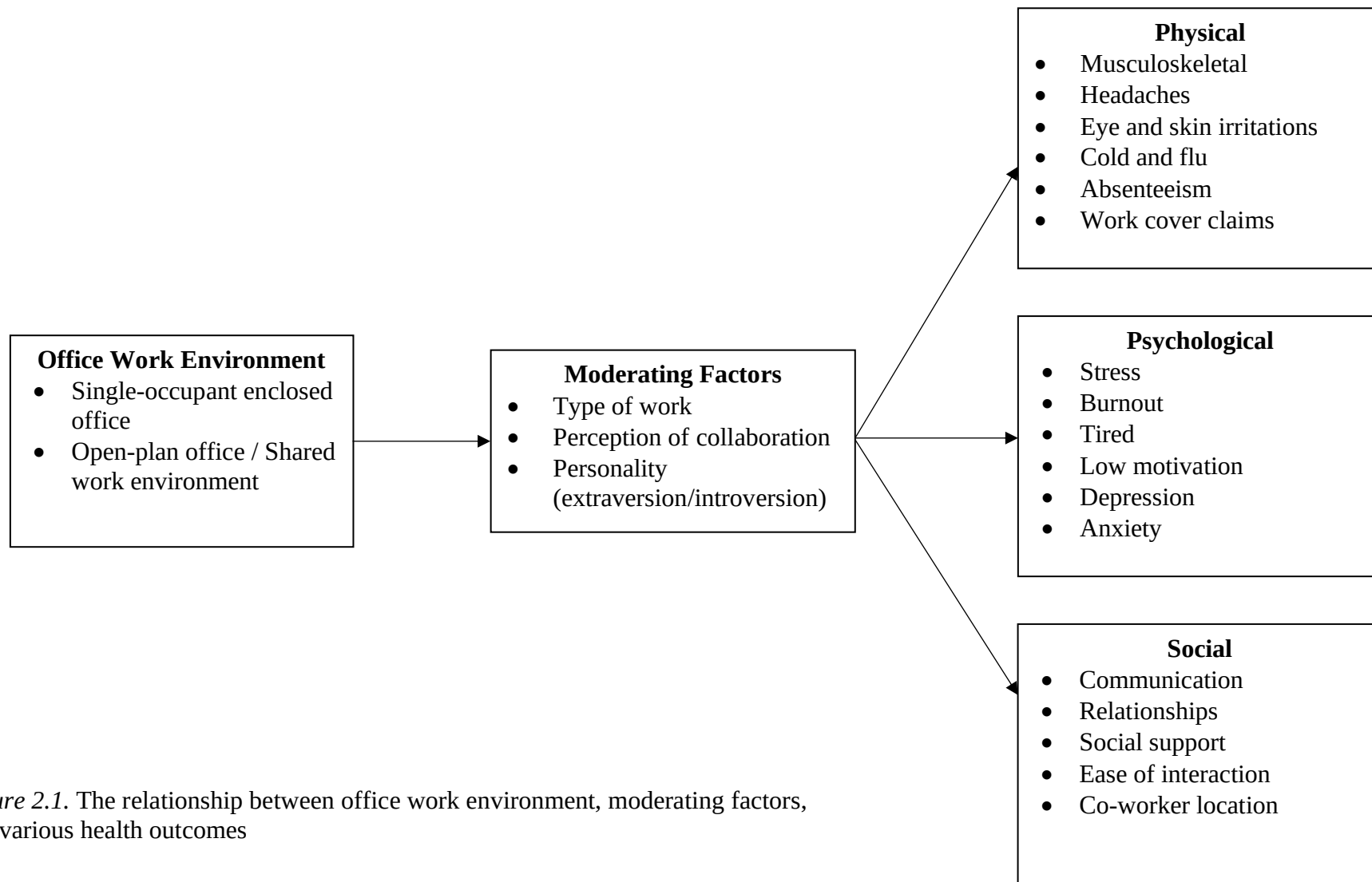


Figure 2.1. The relationship between office work environment, moderating factors, and various health outcomes

*Note: Figure 2.1. depicts a moderation model and should not be interpreted as a mediation model.

2.3.1 Physical health

The physical health of office workers is a significant area of concern and responsibility for businesses and senior executives. Under WHS laws, businesses have a legal obligation to ensure they do everything possible to eliminate or minimise anything that poses a risk to their staff's physical health (Safe Work Australia, 2020c). For example, ergonomic assessments of work environments are utilised in an attempt to reduce musculoskeletal injuries (Luttmann et al., 2003). There are several dimensions to physical health which relate to our physical work environment and these have been presented in Figure 2.1. Numerous studies have examined the relationship between different office designs and occupant physical health outcomes (e.g., Helland et al 2008; Kaarlela-Tuomaala et al 2009; Shahzad et al., 2016). Importantly, many of these studies have found that compared to single-occupant enclosed offices, open-plan work environments are negatively associated with a range of physical health outcomes. In particular, a 2008 literature review of open work environments in healthcare settings identified the following physical health issues associated with open work environments: acquiring flu, physical exhaustion, musculoskeletal problems, and increased blood pressure levels (Oommen et al., 2008). Moreover, open-plan work environments have also been associated with increased sick-building syndrome symptoms (Kim & de Dear, 2013), and increased short-term (1-7 days) sick leave (Danielsson et al., 2014). A broader examination of the physical health outcomes associated with open-plan office designs has been conducted in the systematic review presented in Chapter 3.

2.3.2 Psychological Health

Much like physical health, Safe Work Australia (2020c) mandates that “under WHS laws, you must eliminate or minimise the risk to psychological health and safety arising from the work carried out by your business or undertaking as much as you reasonably can”. Thus, there has been a substantial rise in businesses' awareness and concern for occupants' psychological health. Consequently, recent years has seen the introduction of accredited mental health first aid officers in workplaces (Mental Health First Aid Australia, 2019). Unlike, physical first aid officers, these officers are trained to notice the early signs of a mental health problem, encourage colleagues to speak about their mental health, and facilitate appropriate triage (Mental Health First Aid Australia, 2019). Figure 2.1 highlights several dimensions to psychological health associated with our physical work environment.

Poor psychological health is a rising problem and affects all Australian's either directly or indirectly (Productivity Commission, 2020). It is estimated that each year one in five Australian's will experience a mental illness (ABS, 2008). Thereby, it is plausible that a proportion of the working population also have a mental health condition. Moreover, high rates of burnout have also been reported by the working population (Lambert, 2020; Wigert & Agrawal, 2018). The extent to which this burnout can be attributed to the physical work environment is still to be determined. Nonetheless, research to date has consistently found significantly higher levels of stress in workers working in open-plan work environments than in single-occupant enclosed offices (e.g., Seddigh et al., 2014; Helland et al., 2008; Kaarlela-Tuomaala et al., 2009; Haapakangas et al., 2018). These heightened levels of stress are also found to coincide with higher levels of noise, distraction and concentration difficulties in open-plan work environments (e.g., Seddigh et al., 2014; Kaarlela-Tuomaala et al., 2009). Research to date has not investigated whether the effects of such environments are worse for workers who complete more cognitively demanding work. The relationship between office type, type of work completed, and psychological outcomes has been explored and presented in Chapter 5. Furthermore, a more thorough examination of the associations between office design and psychological health outcomes has been conducted as part of a larger systematic review presented in Chapter 3.

2.3.3 Social Wellbeing

Example dimensions of social wellbeing have been presented in Figure 2.1. Humans are inherently social creatures and our innate need for social interaction has never been more evident than during the present global pandemic, COVID-19. COVID-19 has at-times seen public health authorities need to prioritise the public's physical health above both psychological and social health. This is evident by the widespread lockdowns, forced quarantine, and social distancing measures implemented around the world (Le et al., 2020). While people have endeavoured to find new ways to remain socially connected with others (e.g., phone and video calls), many have still reported feeling socially isolated and disconnected from their friends, families, and wider communities (Lim et al., 2020). This has had a significant impact on individual's psychological and overall wellbeing with reports of people experiencing heightened levels of loneliness, difficulty sleeping, stress, anxiety, depression, and in some extreme cases, suicide, during the pandemic (Lim et al., 2020; Sher, 2020).

Furthermore, there are significant individual differences in people's preferred amounts and types of social interactions. At the most basic level, individual differences in social interactions can be divided into introverts and extraverts (Eysenck, 1967). Introverts prefer to develop deep and meaningful connections with a few people, with time and space to themselves afterwards to rejuvenate (Yadegari & Alinaghi, 2020). In-contrast, extraverts are typically energised from social interactions with many people (Yadegari & Alinaghi, 2020). Nonetheless, research has found that all humans require social interactions and that our connection with others is at the core of our overall health (Baumeister & Leary, 1995). Accordingly, the creation of physical spaces which allegedly promote social interaction has been a topical issue and a key driver for shared work environments. In-particular, it has been hypothesised and advocated by architects and designers that the removal of physical barriers between staff would facilitate increased social interactions and collaboration, positively affecting open-plan/shared office occupant's social wellbeing (Oldham & Brass, 1979; Waber et al., 2014). However, the research to date suggests that shared environments may actually be counterproductive to occupants' social wellbeing (e.g., Oldham & Brass, 1979; Brennan et al., 2002; Morrison et al., 2017). In particular, a 2017 study examined the relationship between shared work environments and occupants' social interactions (Morrison et al., 2017). Utilising the Job Demands-Resources (JD-R) model, the authors found that as workspaces became more shared, demands (i.e., distractions, uncooperative behaviours, distrust, and negative relationships) increased, but the resources either did not improve (i.e., co-worker friendships) or decreased (i.e., supervisor support) (Morrison et al., 2017).

In-addition to Morrison et al's (2017) findings, previous research has also highlighted the following key elements as being negatively associated with open-plan work designs: fewer friendship opportunities, lower interpersonal satisfaction, decreased supervisor feedback (Oldham & Brass, 1979); more chances of workplace conflict (Oommen et al., 2008); increased feelings of crowding (Sundstrom et al., 1980); and an inability to conduct private conversations (Oldham & Brass, 1979; Sundstrom, 1986). It is clear that a link exists between office design and occupants' levels of social interaction and wellbeing. Given the lack of empirical and consistent evidence, the interaction between office workplace design and occupants' social wellbeing should be further investigated as it is likely to have a significant impact on occupants' overall health and wellbeing.

2.4 Theoretical Perspectives

A number of theoretical perspectives have been utilised to explain the office design – occupant outcome association. However, due to the complex nature of this relationship, it is plausible that this association cannot be fully explained by any single theory. Broad psychological theories of social interactions and cognitive capacities applied from an organisational and human factors perspective are needed in order to explain the complex interplay of factors that contribute to occupant outcomes in various work environments. Accordingly, this section predominately focuses on perspectives that capture key individual aspects of the office design – occupant outcome association including social facilitation theory, distraction-conflict theory, cognitive load theory, belongingness and social connection, and person-environment fit theories.

2.4.1 Working alone versus with others

Numerous psychological theories have endeavoured to explain why people exhibit different behaviours when they are alone compared to when they are accompanied by at-least one other person. One of the most widely known and cited psychological theories to explain why human behaviour is different when others are around is Zajonc's (1965) social facilitation theory. Social facilitation theory states that performance is influenced by the presence of others (Zajonc, 1965). This theory would imply that workers may feel compelled to get on with their work, because their colleagues and management can see what they are doing. Thus, some argue that open-plan workspaces increase productivity, partly due to social facilitation theory (Boje, 1971; Pile, 1978 as cited in Brennan et al., 2002). However, it is important to acknowledge distraction-conflict theory, which states that people perform better on simple and well-rehearsed tasks, and worse on complex and less known tasks in the presence of others (Sanders & Baron, 1975; Baron et al., 1978). As a consequence, open-plan workspaces may actually hinder worker's performance on complex tasks.

2.4.2 Cognitive load / distracting work environment

A common complaint of open-plan work environments is that they are noisy and distracting (Kaarlela-Tuomaala et al., 2009). This can be particularly problematic when trying to focus and complete work that is cognitively demanding (e.g., reading, writing, and analysing complex materials) (Banbury & Berry, 2005; Haka et al., 2009; Smith-Jackson & Klein, 2009; Virjonen et al., 2007). Humans have a limited cognitive capacity to process information (Marois & Ivanoff, 2005). John Sweller (1988) introduced the concept of cognitive load which built on Richard Atkinson and Richard Shiffrin's (1968) widely

accepted model of human information processing and working memory model. Cognitive load theory acknowledges that our working memory has a limited capacity and that our ability to encode, assimilate, and retain information is affected by the accumulation of a range of factors which compete for our attention (Klepsch et al., 2017). A person's cognitive load is increased by factors which either distract us from the stimulus we are trying to pay attention to, or make learning unnecessarily complex (Sweller, 1988). Essentially, the higher one's cognitive load, the harder it is to learn. This is because it becomes more difficult to pay attention to, rehearse and remember information (Sweller, 1988).

There are three types of cognitive load: 1) intrinsic cognitive load; 2) extraneous cognitive load; and 3) germane cognitive load (Klepsch et al., 2017). In particular, extraneous cognitive load is produced from the demands placed on the learner by extraneous forces that are not directly linked to the task (Klepsch et al., 2017). These extraneous demands provide either distracting information or make the task more complex than necessary (Sweller, 1988). Interestingly, the influence of the physical environment on cognitive load was not considered in the early research nor classified as an extraneous demand (Choi et al., 2014). Nonetheless, researchers have hypothesised that the physical environment (e.g., noise, lighting conditions etc.) could influence humans' cognitive load and learning (Choi et al., 2014). To this end, Choi et al. (2014) proposed an extended model of Cognitive Load Theory which includes the physical learning environment as a distinct causal factor of cognitive load. This extended model will require further empirical research to assess its accuracy (Choi et al., 2014). Nonetheless, decision makers should consider the potential demands from the physical environment on occupant's cognitive load when designing office spaces.

This notion of cognitive load aligns with studies which have suggested that people who complete more complex jobs in dense workplaces experience more negative effects (e.g., Block & Stocks, 1989; Zalesny & Farace, 1987). Furthermore, research has found noise, particularly irrelevant but audible speech, to disturb and negatively affect performance on tasks requiring cognitive processing (Banbury & Berry, 2005; Haka et al., 2009; Smith-Jackson & Klein, 2009; Virjonen et al., 2007). Thus, it is plausible that occupants who complete more cognitively demanding tasks may be subject to more problems when occupying noisy and distracting work environments. Given this, open-plan work environments could be more problematic for workers whose work is predominately knowledge based, cognitively demanding and has a high need for concentration. Consequently, further investigation is needed to examine the relationship between office

type, type of work, and a comprehensive range of occupant outcomes (i.e., health, work, and social).

2.4.3 Importance of connectedness and a sense of belonging

Humans are social beings with a fundamental need to feel connected and experience a sense of belonging (Baumeister & Leary, 1995). ‘Belongingness’ is comprised of three components: ‘connectedness’, companionship, and affiliation (Lee & Robins, 1995). Social connectedness is considered to be a personal attribute that enables us to identify with others because it reflects how socially connected people feel they are with their community and surrounding environment (Lee et al., 2001). People who are socially connected are argued to be more likely to interact and identify with other people, and to share their ideas and concerns with others (Lee et al., 2001). In contrast, a person with ‘low’ social connectedness is argued to feel different and distant from others and the world, and in general may feel misunderstood (Lee et al., 2001). Consequently, it is argued, the person may continue to distance themselves from others as they struggle to accept social roles and responsibilities (Lee & Robins, 1995). People with low connectedness are also argued to experience other negative emotions including loneliness, anxiety, jealousy, anger, depression, and low self-esteem (Baumeister & Leary, 1995). In general, research on these outcomes has been limited because the majority of research has focused on other psychological constructs (i.e. attachment styles and loneliness) that only capture aspects of social connectedness (Lee et al., 2001). This has been a consistent complaint in the literature, with researchers attempting to create a number of different types of scales to measure social connectedness (i.e. Lee et al. 2001; Van Bel et al., 2009).

Employee social connectedness and sense of belonging has implications for workplace design. It may be important, for example, that employees feel socially connected, and that they belong, in the workplace. Research has reported that employees with ‘high quality’ relationships with co-workers more freely shared ideas and solutions, felt valued by others, and connected with their co-workers (Carmeli et al., 2009). This, in turn, was argued to help workers overcome challenges and deal with uncertainty (Carmeli et al., 2009). Researchers has also argued for a direct link between an employee’s sense of belonging and their commitment to and retention in an organisation (Vischer, 2008). This is important because both have direct implications for businesses’ operations and costs (Vischer, 2008).

Given the importance of social connection, businesses have endeavoured to find ways to increase employees' communication, collaboration and their sense of belonging within the organisation. A key way in-which has been through the redesign of the physical office with the removal of physical barriers between workers (Waber et al., 2014). However, the impact of these open spaces on occupants' social connections still needs a thorough investigation (Kaarlela-Tuomaala et al., 2009).

2.4.4 Person-environment fit

The suitability of a work environment depends on both the occupant and the environment. Person-environment fit theory focuses on the interaction between the person and their environment (Holmbeck et al., 2008). The person-environment fit is a two directional relationship, whereby the person and environment influence each other (Holmbeck et al., 2008). A person's motivation, behaviour, and mental health can all be influenced by the suitability of the person-environment fit (Eccles et al., 1993). Thus, when the fit is "optimal", the environment facilitates the person's functioning and helps them experience more positive outcomes (Holmbeck et al., 2008). On the other hand, the theory stipulates that stress arises when there is a misfit between the person and the environment (Edwards et al., 1998). This can result in the person experiencing decreased levels of function due to the person and environment being unsuitable for each other.

Person-environment fit theory has been applied to organisational contexts, i.e., person-organisation fit (Kristof, 1996). Accordingly, person-environment fit theory may help us understand why some people are well suited and consequently perform well in certain workplace environments while others struggle to adapt. A variable which is related to person-environment fit is personality (Roberts & Robins, 2004). At the most basic level, personality differences in social preferences can be divided into introversion and extraversion (e.g., Eysenck, 1967). People who score high on introversion often prefer to complete solitary activities (Oseland, 2009). In contrast, someone who scores high on extroversion is typically more gregarious, excitement-seeking and enjoys social settings (Oseland, 2009; Seddigh et al., 2016). Anecdotal reports suggest that personality differences can influence the person-environment fit of people in different office spaces (e.g., Umoh, 2018). For example, an open-plan office with lots of social interactions may be suitable for someone who scores high on extraversion. Consequently, an extravert may find themselves functioning at a higher level in such spaces as they are able to bounce ideas of their colleagues and are running off the buzz of their frequent social interactions. In contrast, someone who scores high on introversion may struggle in an open-plan environment and find that the busy and social

environment exhausts them overtime. This could lead to suboptimal performance because they do not have access to an environment which provides them with space and solitude (Oseland, 2009; Umoh, 2018). Further investigation is needed to empirically examine the role of person-environment fit with personality and other factors (i.e., task complexity) which potentially influence the office design – occupant outcome association.

2.5 COVID-19

At the time of writing this thesis, the world was in the midst of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) global pandemic – commonly referred to as COVID-19. Originating in December 2019 in Wuhan, China, COVID-19, a type of coronavirus transmitted from human to human through both contact and airborne droplets, was quickly spreading around the world (World Health Organisation, 2020b). COVID-19 was declared a global pandemic by the World Health Organisation on March 11th, 2020 (World Health Organisation, 2020c). Due to the infectious nature of the virus and the absence (until recently) of an effective vaccine, the most effective methods to minimising the spread of COVID-19 has been through comprehensive hygiene practices and social distancing (World Health Organisation, 2021). People have been requested to remain physically distant from each other with many countries around the world implementing social distancing rules (Le et al., 2020). For example, the Australian Government has required everyone to remain at-least 1.5m away from each other (Safe Work Australia, 2020b). Furthermore, many countries have implemented tough lockdown and stay-at-home orders to help stop the spread of COVID-19 (Dubey & Tripathi, 2020). These restrictions have resulted in the modification and in some cases, closure of office buildings around the world (Le et al., 2020; Thomas et al., 2020; Wilson, 2020). As a result, the pandemic has greatly transformed how and where people work, with many people speculating how the pandemic and our experiences will influence office design into the future.

There are two key ways in which businesses have adapted their work environments to COVID-19: 1) work environment modification to abide with local Government regulations; and 2) adopt remote work/work from home. Some businesses have modified their shared work environments to stay open during COVID-19 (Wilson, 2020). In order to remain open, businesses must ensure that their office is designed in accordance with the rules and regulations set by the relevant governing authority. In Australia, these restrictions and requirements depend on the industry and vary across Australia's states and territories (Safe Work Australia, 2020b). Workplaces have been adapted in numerous ways and example

modifications include: physical distancing between occupants (e.g., 1.5m+ between people) and density requirements (e.g., 2 or 4 m² per person); room capacity limits; lift limits; staggered work times; increased cleaning; provision of hand sanitiser and disinfectant wipes; one-way office traffic; signage requirements; keeping records of contact details to assist contact tracing; and limits and restrictions on operations, including some types of businesses or facilities remaining closed and limitations placed on activities (Safe Work Australia, 2020b; Safe Work Australia, 2020e). Moreover, workers are taught to spot the symptoms of COVID-19 (fever, cough, sore throat and shortness of breath); told not come to work if they are unwell; and trained how to fit and use personal protective equipment appropriately (Safe Work Australia, 2020e).

Alternatively, many businesses have taken advantage of increased technological capabilities and have adopted remote work for all or some of their business. Furthermore, due to tough lockdowns, many businesses around the globe have been forced to close their physical offices, with remote work the only option for the businesses to operate (Blick, 2020). Whilst many businesses may have previously considered work from home arrangements, with some already offering this remote option; COVID-19 has resulted in many businesses quickly adapting, and many employees working from home for the first time (Bick et al., 2020). Pre COVID-19, some managers were apprehensive about adopting remote work options due to concerns around staff productivity, managing remote employees, work health and safety regulations, and technology (Colley & Williamson, 2020a). However, remote work during COVID-19 has frequently shown to be successful, with many people reporting increased productivity and countless staff saying that they do not want to return to the office fulltime or at all (AlphaBeta, 2020; Boland et al., 2020; Dahik et al., 2020; Lambert, 2020).

Finally, in order to remain open with a reduced office capacity, many businesses have adopted a combination of office modifications and remote work capabilities by allowing workers to work alternate days in the office/remote (Tadros, 2020; Wilson, 2020). It is as though COVID-19 has placed the world into a global experiment on remote work and has accelerated the transition of work to remote by one-two decades. There is no doubt that how and where we work is changing and that we are entering into a new era of office design.

The longer-term effects of the global pandemic on office design have been widely speculated and alternative office design models are already being suggested, e.g., 1) entirely remote; 2) combined remote/physical office (hybrid model); and 3) the “third space”. 1) The

successful uptake of remote work during COVID-19 has left some businesses questioning the need for their office, and whether they could remove their office expenses and complete all their business operations remotely (Thomas et al., 2020). 2) Another popular option, a hybrid model, is the combination of remote work with a physical office whereby workers can complete their independent and often more cognitively demanding tasks at home/location of their choice, and the physical office becomes a place for meetings and in-person collaborations (Kaufman et al., 2020; Ro, 2020). 3) Additionally, there has been discussions around the concept of a “third space” which is essentially a work location outside of the home and office (Kingma, 2016). The third space concept has been derived from coworking whereby individuals (traditionally entrepreneurs) work in a shared space to have the benefits of a physical workspace outside their home and to enable interaction with other entrepreneurs (Brown, 2017). There are multiple utilisations of the third space including: workers who work in a remote business but desire a workplace outside their home; workers who want to work in an office closer to their home on remote days; and remote businesses who occasionally need a physical workplace to conduct meetings. These are just a few of the alternative work designs available to businesses.

Ultimately, it is essential that businesses really consider the purpose of their office and design accordingly. Businesses should ask themselves why they have an office, what do they hope to gain from having an office, what is the benefit of having an office, and is another work design a more appropriate solution. A more detailed discussion around the influence of COVID-19 on office design has been presented in Chapter 6 of this thesis.

Finally, the shift away from physical offices to remote work and other alternative designs has considerable implications on businesses, communities and society more broadly. Fundamentally, work will become location independent as workers will no longer have to attend a physical workplace. This will mean that people will no longer need to live in expensive cities and businesses will be able to recruit based on talent, rather than location. Wide-reaching potentially affected areas include: rural communities; ability for families and communities to remain together; city, suburban and rural transport and infrastructure; hospitality and other businesses which rely on high levels of business traffic; business travel industry; competition for staff, goods and services; and International recruitment. These substantial changes also have implications for policy, taxation, and work health and safety legislation. There is no doubt that the effects of our new ways of working will be extensive and will require a thorough investigation beyond the scope of this thesis.

2.6 Summary

Office design and occupant outcomes are a prevalent concern for company executives, decision makers, architects and occupants alike. A considerable amount of literature attests to the link between more open or shared offices and poorer occupant outcomes across a range of psychological, productivity and environmental satisfaction measures; however less is known about why some occupants thrive while others struggle in these environments. Similarly, many architects and designers claim that open-plan environments facilitate communication and collaboration, yet currently little empirical evidence exists to support these claims. Furthermore, the current global pandemic, COVID-19, has drastically and rapidly influenced how and where people work both now and into the future. Numerous theoretical perspectives can be applied to help explain the causes and consequences of the office design-occupant association. It is important that the factors which could mitigate or exacerbate risk are identified, and a greater understanding of the underlying mechanisms responsible for influencing the office design-occupant association is developed. The health, social and economic consequences engendered by inappropriately designed office spaces are significant, so that investment in tailored and suitable office designs are, not only central to improving outcomes for occupants, but may also have implications for long-term business success.

3 Systematic Review of the Literature

This chapter contains the first paper contributing to this thesis. The paper is a systematic review of the office design – occupant outcome literature. This review specifically examines studies which have directly compared outcomes in different open-plan designs to a clearly defined single-occupant enclosed office. This paper was published in the journal, SAGE Open in 2021. The paper is presented in the format in which it was submitted for publication in SAGE Open and therefore reflects this journal’s required sections, style and language for publication.

3.1 Publication: A comparison of psychological and work outcomes in open-plan and cellular office designs: A systematic review

3.1.1 Statement of authorship

Statement of Authorship

Title of Paper	A comparison of psychological and work outcomes in open-plan and cellular office designs: A systematic review
Publication Status	☐ Published ☒ Accepted for Publication ☐ Submitted for Publication ☐ Unpublished and Unsubmitted work written in manuscript style
Publication Details	James, O., Delfabbro, P., & King, D.L. (2021). A comparison of psychological and work outcomes in open-plan and cellular office designs: A systematic review, SAGE Open, https://doi.org/10.1177/2158244020988869

Principal Author

Name of Principal Author (Candidate)	Olivia Isabel Shirley James
Contribution to the Paper	Conducted the systematic searches, tabulated and interpreted the findings, completed the review, and drafted the manuscript.
Overall percentage (%)	80
Certification:	This paper reports on original research I conducted during the period of my Higher Degree by Research candidature and is not subject to any obligations or contractual agreements with a third party that would constrain its inclusion in this thesis. I am the primary author of this paper.
Signature	Date 19/1/21

Co-Author Contributions

By signing the Statement of Authorship, each author certifies that:

- the candidate's stated contribution to the publication is accurate (as detailed above);
- permission is granted for the candidate to include the publication in the thesis; and
- the sum of all co-author contributions is equal to 100% less the candidate's stated contribution.

Name of Co-Author	Paul Delfabbro
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Signature	Date 19/1/21

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Contribution to the Paper	Assisted with the interpretation of the findings and provided critical feedback on the manuscript.
Signature	Date 19/1/21

Please cut and paste additional co-author panels here as required.

3.1.2 Abstract

A high percentage of information-based work is now conducted in open-plan offices as opposed to traditional cellular offices. In this systematic review we compare health, work and social outcomes as well as employee outcomes for workers in the two environments. From a total of 10, 242 papers reviewed, we identified 31 papers which met strict inclusion/exclusion criteria of allowing a direct comparison between the office types. The results showed that working in open-plan workplace designs is associated with more negative outcomes on many measures relating to health, satisfaction, productivity, and social relationship. Notable health outcomes included decreased overall health and increased stress. Environmental characteristics of particular concern included noise and distractions, poor privacy, lighting and glare, and poorer temperature control. Most studies indicated negative effects on social relationships and interactions. Overall, the findings showed that while, open-plan workplace designs may offer financial benefits for management, these appear to be offset by the intangible costs associated with the negative effects on workers. The study encourages further focused investigations into design factors as well as employee characteristics that might contribute to better outcomes in open-plan designs.

Keywords: Office design; open-plan; work outcomes; psychological effects; social relationships

3.1.3 Introduction

Office work environments have changed significantly over time. In the past, workplaces were often based in multi-story buildings arranged in the form of cellular offices on each side of corridors. In such environments, an office's location on the corridor as well as the building's floor was often symbolic of status and job title (Sundstrom et al., 1980). By contrast, the current era is characterised by architectural schools and development styles that favour the replacement of the cellular office with new office concepts. These new designs are typically open-plan. As a result, many workers have, in the last few decades, moved from traditional cellular offices to open-plan work environments. Indeed, it was estimated by the International Facility Management Association and Corenet Global that more than 70% of office workers in the United States of America work in an open-plan workplace design (Congdon et al., 2014).

It has been argued that three principal factors have influenced the shift towards open-plan workplace designs: the type of work being undertaken, changes in technology, and cost (Brennan et al., 2002). Work has become more knowledge based and increasingly complex as machines and technology replace simple labour and tasks require more specialised skill sets (Greene & Myerson, 2011; Smith, 2005). Major technological advancements over the last few decades, most notably readily available Internet and the introduction of portable computers and mobile phones, have meant that work is no longer restricted to the office because it can be completed virtually anywhere (Joroff, 2002). This has seen a rise in the number of workers working remotely, leaving many offices and desks unoccupied during business hours. Consequently, Strategy Plus, a consulting and design firm, estimated office utilisation to peak at 42% on any given day (Waber et al., 2014). Finally, it is argued that open-plan workspaces are more cost-effective than traditional cellular offices due to a range of reasons. Open-plan workplace designs can: 1) be more space efficient by fitting more people in a space, 2) reduce the number of unoccupied desks and offices by providing a lower desk to staff ratio, 3) be cheaper to build due to less walls and doors, and 4) have lower running and maintenance costs (Brennan et al., 2002; Kim et al., 2016). Notably, business' typically endeavour to systematically reduce the day-to-day operational and maintenance costs of offices, because the work environment is traditionally categorised in 'facility management' which is under pressure to minimise a business' operational costs (Duffy, 2000). Thereby, office designs are typically not interpreted holistically in return-on-investment (ROI) terms; as financial planners are limited by their financial documents which do not account for the associated 'people' investments (e.g., increased co-worker proximity)

and costs (e.g., increased sick leave; reduced job and occupancy satisfaction) of open-plan office designs.

Another putative benefit of open-plan offices is that they are advanced as ways to increase communication and collaboration between workers (Maher & von Hippel, 2005). Some argue that, because of the increased complexity of work, tasks are now more likely to require the collaboration of multiple experts to complete (Kaarlela-Tuomaala et al., 2009). Given the increased complexity of tasks, and the rise in knowledge work, collaboration has become an important concept for businesses wanting to encourage workers to share skills and ideas. Collaboration is generally defined as ‘working together’ (Heerwagen et al., 2004, pp. 511). Accordingly, many workplaces have been redesigned to minimise physical barriers in order to facilitate people working together which, in-turn, is argued to improve morale and productivity (Brennan et al., 2002). Other claimed social benefits, often advanced anecdotally by designers, architects and management consultants, has been that open plan designs allow for increased collaboration with a wider range of co-workers, greater information flow between co-workers and an increase in chance encounters that could spark innovative ideas (Goldstein, 2006; Waber et al., 2014). It is notable that many of these claims are based on anecdotal evidence, not empirical research (Bonetta, 2003; Kaarlela-Tuomaala et al., 2009; Smith-Jackson & Klein, 2009).

Although no single definition exists, open-plan workplace designs are usually characterised by large office spaces filled with multiple desks in various arrangements and a lack of physical barriers (Brennan et al., 2002; Oldham & Brass, 1979). More refined differences can be noted within the category ‘open-plan’, i.e. the number and height of partitions, overall size, spatial density, openness and architectural accessibility (Brennan et al., 2002; Hongisto et al., 2016). The lack of a precise definition, e.g., a clear definition of the physical characteristics, dimensions and number of occupants per space for ‘open-plan’ office spaces is problematic because it makes it more difficult to compare studies and study outcomes on different designs. For this reason, research has benefited from the development of definitions and typologies such as Bodin Danielsson and Bodin’s system which distilled seven named office types into three main categories based on their architectural and functional features (see Bodin Danielsson & Bodin, 2008). These definitions are the foundation for this review described in this paper in which a single occupant enclosed office is defined as an office enclosed by four full height walls with a door that is permanently occupied by a single worker. An open-plan workplace design is defined as an office workplace that is not separated by full height walls. This definition recategorises all of the

following office designs as defined by Bodin Danielsson and Bodin (2008) as a form of open-plan workplace design: shared-room office; small open-plan office; medium open-plan office; large open-plan office; flex-office; combi-office. On the other hand, cubicle offices with partitions of various heights are treated as a form of open-plan workplace design in this paper.

To date, considerable research has been conducted on the positive and negative aspects of these two main office configurations (open-plan vs closed office). These findings were well summarised by three systematic reviews: de Croon et al. (2005), Oommen et al. (2008), and Richardson et al. (2017). Oommen et al. (2008), for example, reviewed the positive and negative aspects of open work environments in healthcare settings. They identified the following positive aspects of open work environments: cost-effective design, equal space for all employees, enhanced communication, increased collaboration, flexibility to work in different areas, accommodates more employees, and more energy efficient heating and cooling design (Oommen et al., 2008). However, many negative aspects of open work environments were identified and these included: higher staff turnover; high level of noise; loss of concentration; low work productivity; job dissatisfaction; issues with privacy; lack of status; feeling of insecurity; more chances of workplace conflict; and various health issues including: prone to stress, acquiring flu, physical exhaustion, musculoskeletal problems, fatigue and increased blood pressure levels (Oommen et al., 2008). Moreover, a systematic review conducted by de Croon et al. (2005) found strong evidence to suggest that working in an open workspace reduces privacy and job satisfaction and also more modest evidence to suggest that it intensifies cognitive workload and worsens interpersonal relations. Finally, Richardson et al. (2017) review concluded that open-plan workplace designs were not beneficial to workers health.

To the authors' best knowledge, these three systematic reviews were the last major reviews conducted on the topic. Of which, the most recent review by Richardson et al. (2017) predominately focused on health outcomes. Over the last decade many papers have been published on the broad effects of workplace design. Some major reviews (e.g., Cochrane) are usually conducted every few years or when recently published research may have changed consensus on the topic. Therefore, it is timely for an update to include this new literature examining a range of outcomes, given that modern technology has arguably accelerated the ability for people to work remotely. This systematic review aims to build on Richardson et al. (2017) review which aimed to directly compare different open-plan workplace designs to individual offices. However, inspection of Richardson's et al. (2017) selected papers revealed

that some of their included studies used individual offices with more than one occupant as the comparative point. Therefore, as far as the authors are aware, no systematic review has been conducted that directly compares different open-plan workplace designs to a clearly defined single occupant enclosed office. This is a distinguishing feature of this review and is important given the amount of people being relocated from traditional single occupant enclosed offices to various types of open-plan workplace designs. Furthermore, it is possible that the effects may be greater, than between two different types of open-plan office designs due to the very different designs of traditional cellular offices and open-plan workplace designs. Finally, the authors propose that the identification of human aspects associated with different office designs could highlight the need for a more holistic evaluation process of the overall cost of office designs; for the intangible financial costs of the human resource may be greater than any recorded savings in the balance sheet.

The Present Review

This review aims to use a systematic approach to summarise all published quantitative peer-reviewed research conducted on the positive and negative effects that different office designs/configurations have on a range of different outcome measures, i.e. health, satisfaction, productivity, social interactions, and retention. In-particular this review aims to focus on comparing these effects in studies that have specifically compared both a clearly defined single occupant private enclosed cellular office with a type of open-plan workplace design. Compared to single occupant private enclosed cellular offices, negative associations are anticipated between open-plan workplace designs and measures of poorer health, satisfaction and productivity. A greater proportion of positive associations are expected between the open-plan workplace designs and measures relating to social relationships. This review is anticipated to provide the academic community with an updated summary of the literature and a specific comparison between open-plan and traditional offices. The findings could also benefit decision makers considering the positive and negatives of open-plan workplace designs.

3.1.4 Method

The present review focuses on papers that have used either a cross-sectional or longitudinal design to compare both single occupant enclosed offices with an open-plan office design. A systematic review of the literature was conducted across three databases: Scopus, Web of Science, and Emerald Insight. The search concluded on 30th June 2018. The search terms were adopted from de Croon et al.'s (2005) systematic review and activity-based workplace search terms were added to account for this new office design (see

supplementary material (section 3.1.8) for a full list of search terms). Articles that were not published in English were excluded.

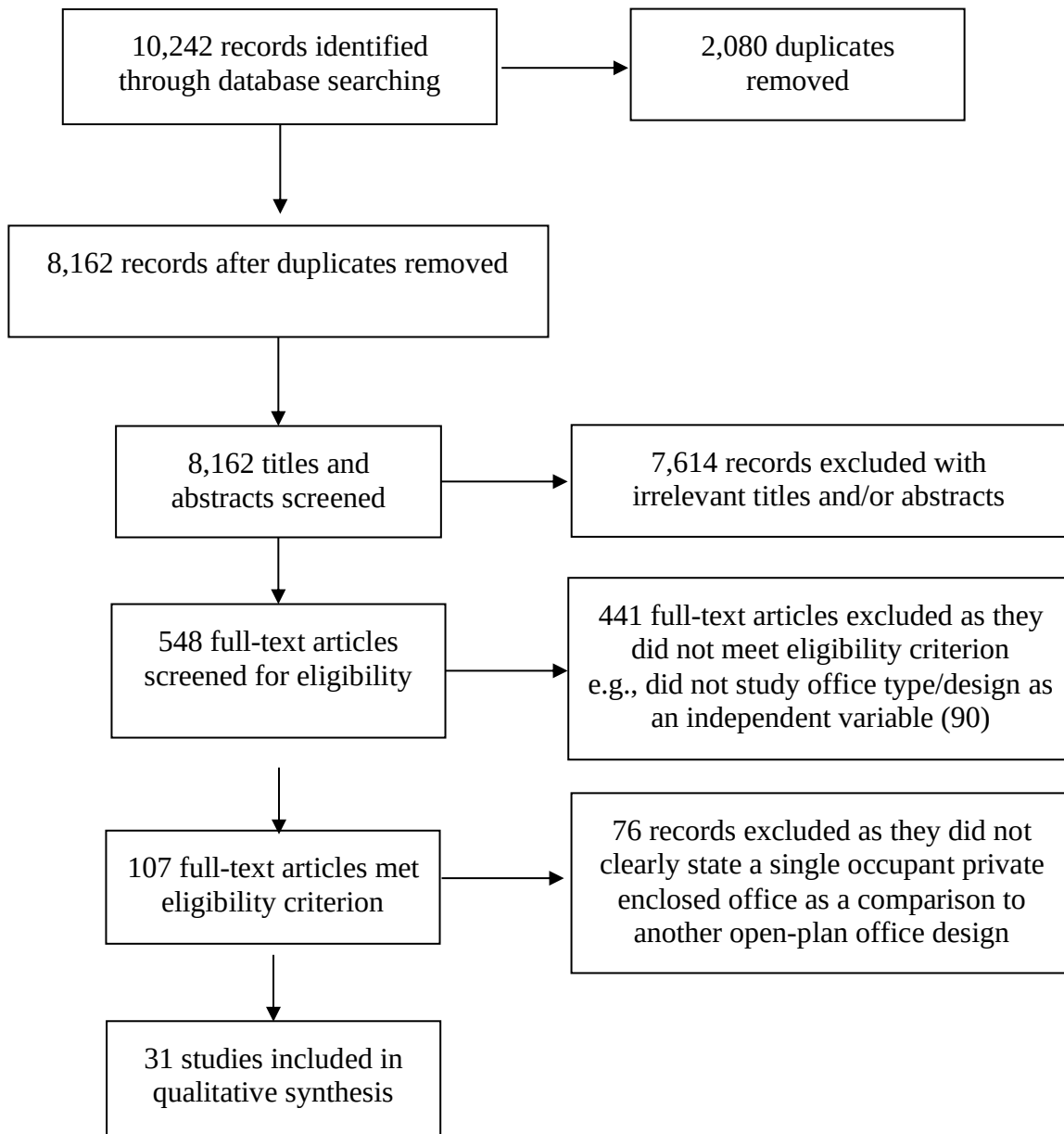


Figure 3.1. Flow chart showing identification, exclusion and inclusion of studies.

The flow of information from identification to inclusion of studies are presented in Figure 3.1. 10,242 papers were identified through database searching and the full-text of 548 papers was screened. Papers were excluded for the following reasons: not an original study i.e., review, summary, opinion piece, essay (137); conference papers (47); not published in a peer-reviewed journal (13); case-studies (6); did not study office type/design as an independent variable (90); inappropriate sample i.e., unpaid office workers, call-centre and factory workers, or not the office workers' opinion (21); did not examine biological, psychological and/or social outcomes as dependent variables (28); controlled studies of environmental manipulation (14); did not analyse quantitative data (32); focused on examining remote work (e.g., telework) (50); could not be found (3).

A total of 107 papers remained. These papers were rescreened to ensure they included a clearly defined single occupant private enclosed office as a comparison to another type of open-plan office design – through either a cross-sectional or longitudinal design. Overall, 31 papers (26 cross-sectional and 5 longitudinal) were selected for this review.

3.1.5 Results

Study Characteristics

The characteristics of all studies reviewed are presented in Table 3.1. For consistency between studies, all offices types have been categorised using Bodin Danielsson and Bodin's (2008) office definitions. Additional office types (8-10) have been added to account for office designs not defined by Bodin Danielsson and Bodin (2008). A summary of office definitions used in this review are summarised in Table 3.2. Single occupant private enclosed offices were compared to the following number of office designs: 20 shared-room office (2-3 people), 9 small open-plan office (4-9 people), 8 medium-sized open-plan office (10-24 people), 7 large open-plan office (>24 people), 7 flex-office/hot-desking, 8 combi-offices/activity-based/landscaped office, 11 cubicles with low partitions (<60"), 13 cubicles with high partitions ($\geq 60"$), 15 open-plan office with no or limited partitions (does not state number of occupants). The majority of research was conducted in the USA (10) and Sweden (8). The papers had highly variable, but generally satisfactory sample sizes (range N = 31 – 43 021) and most papers appeared to include a balance of male and female workers.

Table 3.1. *Study characteristics of the 31 studies*

Reference number (reference)	Follow-up in months	Office type	Final sample size	Male (%)	Country study conducted in	Outcome categories				
						H	Sa	P	So	O
Cross-sectional - 26										
1. Sundstrom <i>et al</i> 1982a	N/A	1, 8,9, 10	154	-	USA		Y			
2. Becker <i>et al.</i> 1983	N/A	1, 2, 9	456	62%	USA		Y	Y		
3. Crouch and Nimran 1989	N/A	1, 10	51	-	Australia		Y	Y	Y	
4. Jaakkola and Heinonen 1995	N/A	1, 2, 3	893	49.20%	The Netherlands	Y				
5. Olson 2002	N/A	1, 2, 10	-	-	USA		Y		Y	
6. Wells and Thelen 2002	N/A	1, 2, 8, 9, 10	234	24%	USA					Y
7. Pejtersen <i>et al.</i> 2006	N/A	1, 2, 3, 4, 5	2301	-	Denmark	Y	Y	Y	Y	Y
8. Bodin Danielsson and Bodin 2008	N/A	1, 2, 3, 4, 5, 6, 7	469	52.9%	Sweden	Y	Y	Y	Y	Y
9. Boutellier <i>et al.</i> 2008	N/A	1, 7	2,355 observations	-	Switzerland				Y	
10. Bodin Danielsson and Bodin 2009	N/A	1, 2, 3, 4, 5, 6, 7	469	52.9%	Sweden		Y		Y	Y
11. Lee 2010	N/A	1, 2, 8, 9, 10	3533	-	USA		Y	Y	Y	
12. Lee and Guerin 2010	N/A	1, 2, 8, 9, 10	3533	% per office type - Not an overall %	USA		Y	Y		
13. Pejtersen <i>et al.</i> 2011	N/A	1, 2, 10	2403	45%	Denmark	Y				

Reference number (reference)	Follow-up in months	Office type	Final sample size	Male (%)	Country study conducted in	Outcome categories				
						H	Sa	P	So	O
14. Frontczak <i>et al.</i> 2012	N/A	1, 2, 8, 9	43 021	36% - DNR (17%)	USA (78%); Australia (7%); Finland (6%); Canada (2%); Italy (1%); Unknown (6%)		Y		Y	
15. Bodin Danielsson <i>et al.</i> 2013	N/A	1, 2, 3, 4, 5, 6, 7	5,358	% per office type - Not an overall %	Sweden				Y	
16. Kim and de Dear 2013	N/A	1, 2, 8, 9, 10	42,764	36% - DNR (17%)	Australian authors, OS data		Y		Y	
17. Bodin Danielsson <i>et al.</i> 2014	N/A	1, 2, 3, 4, 5, 6, 7	1852	% per office type - Not an overall %	Sweden	Y				
18. Seddigh <i>et al.</i> 2014	N/A	1, 2, 3, 4, 5, 6	1,241	-	Sweden	Y	Y	Y		Y
19. Bodin Danielsson <i>et al.</i> 2015	N/A	1, 2, 3, 4, 5, 6, 7	5229	45.20%	Sweden		Y		Y	
20. Duncan <i>et al.</i> 2015	N/A	1, 2, 8, 9, 10	5531	30.80%	Australia	Y			Y	Y
21. Leder <i>et al.</i> 2016	N/A	1, 10	1: 779 2: 2545	51.50%	Canada & USA		Y			
22. Shahzad <i>et al.</i> 2016	N/A	1, 10	313 (264 all Qus)	-	Norway & UK	Y				
23. Haynes <i>et al.</i> 2017	N/A	1, 2, 8, 9, 10	220	71%	United Arab Emirates			Y		
24. Morrison and Macky 2017	N/A	1, 2, 6, 10	1000	45.00%	Australia		Y		Y	

Reference number (reference)	Follow-up in months	Office type	Final sample size	Male (%)	Country study conducted in	Outcome categories				
						H	Sa	P	So	O
25. Mullane <i>et al.</i> 2017	N/A	1, 8, 9, 10	478	27.60%	USA	Y				
26. Otterbring <i>et al.</i> 2018	N/A	1, 2, 3, 4	271	39%	Sweden	Y	Y		Y	
Longitudinal - 5										
27. Sundstrom <i>et al</i> 1982b	6 months pre-move, 6 weeks post-move	1 into 9	70	-	USA		Y		Y	
28. Helland <i>et al</i> 2008	10 months after relocation	1 into 7	34	100%	Norway	Y	Y		Y	
29. Kaarlela-Tuomaala <i>et al</i> 2009	2 months before & 4 months after relocation	1 into 8,9	31	70%	Authors from Finland, doesn't say office location	Y	Y	Y	Y	
30. Bergström <i>et al</i> 2015	1 month pre-relocation, 3, 6 & 12 months post-relocation	1 into 10	Baseline (71), 3 months (64), 6 months (59), 12 months (54).	Baseline (67.6%), 3 months (66.7%), 6 months (71.2%), 12 months (75.9%)	Sweden	Y	Y	Y	Y	Y

Reference number (reference)	Follow-up in months	Office type	Final sample size	Male (%)	Country study conducted in	Outcome categories				
						H	Sa	P	So	O
31. Haapakangas <i>et al</i> 2018	Before relocation, after relocation	1 into 7, 8, 9	Org A: 42; Org B: 49	Org A T1: 29.2%; T2: 38.5%. Org B T1: 37.5%; T2: 37.1%	Finland	Y	Y		Y	

Key: Outcome categories: H: health; Sa: satisfaction; P: productivity; So: social; O: other. Office type: (1) one person cell-office, (2) shared-room office (2-3 people), (3) small open-plan office (4-9 people), (4) medium open-plan office (10-24 people), (5) large open-plan office (>24 people), (6) flex-office/hot-desking, (7) combi-office/activity-based/landscaped office, (8) cubicles with low partitions (<60”), (9) cubicles with high partitions (≥60”), (10) open-plan office with no or limited partitions (does not state number of occupants). DNR: Did not respond.

Table 3.2. *Office definitions used in this review*

Office type	Definition
1. One person cell office	An office enclosed by four full height walls with a door, that is permanently occupied by a single person
2. Shared-room office	An office enclosed by four full height walls with a door, that is permanently occupied by 2-3 people
3. Small open-plan office	An open-plan office with no or limited partitions with 4-9 people
4. Medium open-plan office	An open-plan office with no or limited partitions with 10-24 people
5. Large open-plan office	An open-plan office with no or limited partitions with >24 people
6. Flex-office/hot-desking	An open-plan layout where employees lack a personal workstation
7. Combi-office/activity-based/landscaped office	No strict spatial definition. Defined by teamwork and the sharing of common facilities. Typically includes a variety of different workspaces that are chosen based on task need.
8. Cubicles with low partitions	Individual workstations with low partitions (<60")
9. Cubicles with high partitions	Individual workstations with high partitions (≥60")
10. Open-plan office with no or limited partitions (does not state number of occupants)	An open-plan office with no or limited partitions (same as 3-5), but does not state number of occupants

Note.

These definitions have been adapted from Bodin Danielsson and Bodin (2008).

Overview

Overall, 238 outcomes were measured by the 31 papers. Due to the lack of papers using identical measures, similar measures that measured the same concept were grouped together and organised into sub-categories under each of the five key categories. This resulted in the 238 outcomes being consolidated into 140 individual measures that were organised into 25 sub-categories within the five key categories. The five key categories were: health, satisfaction, perceived productivity, social, and other impacts. Outcomes that were not better suited to one of the first four categories were included in the other impacts category. The key categories measured by each paper are presented in Tables 3.1 and 3.3.

Table 3.3 shows the broad domains considered (e.g., health), the sub-categories that existed under this heading (e.g., type of health measure), and then specific measures referred to the articles in Table 3.1. For each specific variable, the table indicates whether a positive (POS) association or negative (NEG) association (i.e., poorer health) was measured in relation to open-plan office types vs. single occupant closed offices, with NIL indicating no association. Given the complexity of these data, it was decided to develop a parsimonious counting rule to aid readers. For each sub-category, studies relating to each specific variable could be: negative -1, positive +1, no association 0. All such outcomes were summed for each sub-category. If the overall count was negative, then – was written in the final column (e.g., ++, --- would be -1). If the total number of negative outcomes was also equal or greater than all other outcomes, then - - was written (overall negative AND the predominant finding). A similar system was followed for positive outcomes. For example:

1. Sleep / fatigue has three negative and four no association outcomes. It was marked with a single negative (–) because the number of negative outcomes was less than the number of no associations.
2. Overall productivity has nine negative and eight no association outcomes. It was marked using a double negative (- -) because the number of negative outcomes was greater than the number of no associations.
3. Mental health has one positive, five negative and five no association outcomes. The sum of the positive and negatives is -4. Therefore it was marked as a small negative (-) because the sum was negative and the number of negative outcomes was less than the number of all other outcomes.

A sub-category was only classified as mixed if it had an even distribution of positive and negative findings, i.e., its sum was zero. The overall conclusion for each sub-category is presented in Table 3.3.

Finally, the direction of an association was used to explain how the change/comparison would be widely regarded and not the correlation direction of the association measured in the study. This retains consistency between the findings and aids results interpretation.

Table 3.3. *Results of the synthesis of evidence with regard to the association of open-plan workplace designs compared to single occupant enclosed offices with regard to the five main categories: health, satisfaction, productivity, social, and other, each of their sub-categories and their individual measures.*

Main category	Sub-category (number of measures)	All measures included in that sub-category (reference number), concluded direction (POS, NEG, NIL, MF)	Overall conclusion for sub-category
Health (32)			
	Overall health / sick leave (5)	General / overall health (NEG: 8, 22, 30; NIL: 7, 18); short sick leave (NEG: 17); long sick leave (NIL: 8, 17); total sick leave (NEG: 13; NIL: 8, 17); risk of common cold (NEG: 4)	- -
	ENT and breathing problems (8)	Nose irritation (NIL: 7, 22); running or blocked nose (NIL: 7, 22); difficulties in breathing (NIL: 7); wheezing (NIL: 7); chest tightness (NEG: 22); throat irritation (NEG: 7, 22); cough (NIL: 7); hoarseness (NIL: 7)	-
	Other physical health issues (6)	Shoulder pain (NEG: 28; NIL: 29); neck & forearm pain (NIL: 28, 29); skin irritation, facial skin irritation, hands/arms irritation (NIL: 7); eye irritation (NEG: 7, 22, 28); headache (NEG: 7, 22; NIL: 28, 29); dizziness (NIL: 7)	-
	Physical activity (1)	Physical activity inc. sitting behaviour (POS: 25; NEG: 20 open-plan; NIL: 20 shared enclosed)	Mixed
	Mental health (6)	Mental / psychological health overall (POS: 8 small & large open-plan; NIL: 7, 8 all other); wellbeing (NEG: 26); stress (NEG: 18, 28, 29, 31); negative feelings such as displeased (NIL: 29); sadness & depression (NIL: 8); calm & harmony (NIL: 8)	-
	Sleep / fatigue (6)	Sleep quality (NEG: 8); tiredness & overstrain (NEG: 22; NIL: 29); fatigue (NEG: 8); energy (NIL: 8); exhaustion (NIL: 18); vitality (NIL: 7)	-
Satisfaction (31)			
	Overall satisfaction (3)	Satisfaction with work environment (NEG: 14, 16, 21, 29, 30, 31); job satisfaction (NEG: 7, 8, 10, 21, 26, 28); internal work experience (NEG: 30)	- -
	Office size and suitability (11)	Amount of space (NEG: 10, 16); cramped space (NEG: 7); availability of space (NEG: 14); general office equipment is easily accessible (NIL: 29); work space is pleasant (NIL: 29); no pleasant space for breaks (POS: 10 (flex-office); NEG: 10 (small, medium & large OP, shared)); no pleasant lunch areas (NEG: 10); workspace utility (NIL: 27); no good general physical work environment	- -

	(workstation) (NEG: 10); no good general physical work environment (office design) (NEG: 10); workstation design not supporting work (NEG: 10)	
Office feel (5)	Furniture adjustability and comfort (NEG: 14, 16); general comfort (ergonomics) (NIL: 10); work environment is cheerful & stimulating (NIL: 29); colours & textures of surroundings (NEG: 14, 16); cleanliness & maintenance (POS: 7 (7-28 occupant open-plan); NEG: 14, 16 (cubicles with low & high partitions) NIL: 14 (shared), 16 (shared & open-plan with no/limited partitions), 7 (3-6 & >28 occupant open-plan))	- -
IEQ (4)	Acoustic quality issues (NEG: 21, 27, 29); lighting, glare & visual discomfort (NEG: 7, 10, 12, 14, 16, 21, 28); reflections (NEG: 7); air quality overall (NEG: 7, 10, 12, 14, 16); thermal comfort & quality (NEG: 7, 14, 16; NIL: 10, 12, 21)	- -
Affected by others (8)	Noise (NEG: 2, 7, 10, 11, 14, 16, 19, 27, 29); noise sensitivity (NEG: 29); time wasted per due to the effects of all sounds (NEG: 29); ease to hear unnecessary speech (NEG: 29); distractions/disturbance (NEG: 2, 3, 5, 18, 24, 29, 31); interruptions (NIL: 2); privacy (NEG: 1, 2, 3, 10, 11, 14, 16, 21, 27, 29); there is enough peace to work (NEG: 29)	- -
Perceived productivity (38)		
Overall productivity (9)	Perceived productivity (NEG: 23); efficiency (NEG: 8 (small & medium open-plan); NIL: 8 (all other), 18); accuracy (NEG: 3 (small & med OP); NIL: 3 (all others)); task performance (NEG: 3, 11, 30); ability to complete work activities (NIL: 2); concentration (NEG: 7, 18, 29); memory (NIL: 29); motivation (NIL: 7, 29); goals at work (NIL: 8)	- -
Influences on perceived productivity		
Office design (14)	Storage (NEG: 23); crowding (NIL: 23); position to equipment (NEG: 23); position to colleagues (NIL: 23); proximity to manager (NIL: 23); formal meeting space (NIL: 23); informal meeting space (NIL: 23); quiet areas (NIL: 23); refreshment areas (NIL: 23); canteen (NIL: 23); physical comfort (NIL: 23); cleanliness (NIL: 23); colours & textures (NIL: 23); overall office layout (NIL: 23)	-
IEQ (4)	Acoustic quality enhancing job performance (NEG: 11); lighting (NEG: 12 (cubicles with high partitions), 23 (cubicles with low partitions); NIL: 12 (shared enclosed, cubicle with low partitions, bullpen), 23 (shared enclosed, cubicles with high partitions, open-plan with no partitions)); air quality (NEG: 12 (cubicles with low & high partitions), 23 (cubicles with low partitions); NIL: 12 (shared enclosed, bullpen), 23 (shared enclosed, cubicles with high partitions, open-plan with no partitions)); temperature (NIL: 12, 23)	-

Affected by others (5)	Interruptions (NIL: 23); privacy (NEG: 23); social interaction (NEG: 23 (low partition); NIL: 23 (all other)); work interaction (NEG: 23 (low partition); NIL: 23 (all other)); internal noise (NIL: 23)	No association (- for low partition)
Sounds disturbing concentration at work (6)	Voices & laughter from general areas, (e.g. corridor, cafeteria, meeting room) (NEG: 29); voices and laughter from neighbouring workstations (NEG: 29); telephone ringing tones (NEG: 29); movement in the corridor, footsteps, doors, lift, clatter (NIL: 29); voices and laughter from your own workstation (NEG: 29); shared office equipment (e.g. copiers) (NIL: 29)	- -
Social (26)		
Collaboration / communication (7)	Satisfaction with communication (NIL: 27); perceived collaboration (NEG: 31 (open-plan with few quiet rooms & alternative workspaces); NIL: 31 (open-plan with many quiet rooms & alternative spaces)); cooperation (NEG: 8 (medium open-plan), 24 (all other), 29; NIL: 8 (all other), 24 (shared enclosed)); information flows among colleagues (NIL: 10); FTF communication patterns (MF: 9); connectivity (POS: 20); learning from overhearing others (NIL: 5)	-
Relationships / getting along (9)	Co-worker relationships / friendships (NEG: 24); friendliness (NIL: 3); social support (NIL: 7); supportive work conditions (i.e., support and contact at work, colleagues to rely on) (NEG: 28 (6 years after relocation), 30 (3 months after relocation); NIL: 30 (6 & 12 months after relocation)); support of affinity (NEG: 10); workplace conflicts (NIL: 19); distrust of others (NEG: 24 (hot-desking); NIL: 24 (open-plan own desk & shared 1-2 others)); negative interactions and behaviours (NEG: 24); combined "social liabilities" term (inc distrust, uncooperative behaviour, distraction and negative relationships) (NEG: 24)	- -
Ease of interaction (5)	Work interaction and ease of interaction (NEG: 11, 14, 16, 26, 29); reinforcing interaction (POS: 10 (flex-office); NIL: 10 (all others)); ability to converse without raising voice (NEG: 29); ability to hold confidential conversations (NEG: 27)	- -
Location (2)	Co-worker visibility and co-worker proximity (POS: 20); ease for visitors to locate workers (POS: 27)	+
Leadership / supervisor (3)	Perceived managerial leadership (POS: 15 (medium open-plan); NEG: 17 (shared enclosed & all open-plan), 5 (shared enclosed & flex-offices); NIL: 15 (small & large open-plan, combi-office), 30); supervisor support (NEG: 24); relationship to closest supervisor (NEG: 8)	-

Other impacts (13)			
Independence (4)	Job control (NEG: 7; NIL: 30); autonomy (NEG: 20; NIL: 30); personalisation (NEG: 6, 10); depersonalisation (NIL: 18)		- -
Personal (4)	Time experience (NIL: 30); reorganisation (NIL: 30); self-realisation (NIL: 28)		No association
Work Tasks (3)	Quantitative demands (NEG: 7); work demands (too much to do) (NIL: 8); variation of the work task (NEG: 28)		-
Other (2)	Retention (NEG: 30); number of coping strategies used (POS: 29) (although possibly implies a negative thing)		Cannot draw conclusion

Key: POS: positive; NEG: negative; NIL: no association; MF: mixed findings; ENT: ear, nose and throat; IEQ: indoor environmental quality

Health

A total of 32 health outcomes were measured by 14 papers. Inspection of Table 3.3 shows that findings generally trended towards negative outcomes for open-plan offices as compared with single occupant closed ones. Negative outcomes were prominently observed for overall health / sick leave, mixed results were obtained for physical activity, and overall negative results were obtained for ENT issues, mental health and sleep and fatigue (although some non-significant or occasional results in the opposite direction were observed).

Satisfaction

A total of 31 measures of satisfaction with the workplace environment were evaluated in 21 papers. All of these outcomes showed negative results for open-plan work arrangements. Negative findings were not only the overall result based on the addition of outcome valences, but were the majority outcome. This was observed irrespective of whether one considered overall satisfaction, office suitability, office feel, IEQ or how people rated the impact of the social and physical environment around them.

Perceived productivity

Perceived productivity was measured in 10 papers and organised into two key sections: overall measures of productivity; and the perceived impact of different variables on productivity. For overall productivity, most studies showed a negative outcome for open-plan vs. single occupant closed offices, whereas other specific measures tended to be negative (when significant results were obtained). For example, the office design, the IEQ and sounds from the activity around them was seen as having a negative effect upon productivity.

Social

A total of 26 social outcomes were measured in 19 papers. These outcomes were organised into five sub-categories: collaboration / communication; relationships / getting along; ease of interaction; location; leadership / supervisor. The social category had the most individual positive findings, i.e., positive associations were found for the following measures by at least one study: communication patterns; connectivity; reinforcing interaction (flex-offices only); co-worker visibility and co-worker proximity; ease for visitors to locate workers; and perceived managerial leadership (medium open-plan offices only). Nonetheless, only one sub-category, location, was classified as positive overall. The other sub-categories: relationships / getting along; ease of interaction; and leadership / supervisor results were predominantly negative. For collaboration / communication the trend was towards the

negative, but this was not predominant due to one positive, six no associations and a mixed finding conclusion.

Other impacts

Nine papers measured 13 outcomes that were not better suited to any of the other main categories. These outcomes were organised within the other impacts category into four sub-categories: independence; personal; work tasks; and other. The majority of measures indicated either negative or no associations (see Table 3.3). Both independence and work tasks were concluded to have predominantly negative associations. I.e., People generally felt less independent when working in open-plan designs as opposed to single occupant closed offices. No association was observed for the personal sub-category. The other sub-category could not be summarised because the included measures are independent. Retention decreased and the number of coping strategies used in the open-plan work designs increased, although this could be interpreted as negative.

3.1.6 Discussion

Discussion on the associations of office design

The present review aimed to summarise the existing peer-reviewed literature relating to a range of outcomes arising from exposure to open-plan workplace designs, with single occupant enclosed offices used as the comparison work configuration. The outcomes fell into several categories: health, satisfaction, productivity, social and other impacts. The overall finding was that outcomes in open-plan offices were much more likely to be negative as compared to single occupant enclosed offices. For example, all studies measuring stress, satisfaction with work environment, job satisfaction, noise, distractions/disturbances, privacy, as well as acoustic, light, sound and air quality showed negative results for open-plan work environments as compared to single occupant private enclosed offices. Very few outcomes came out in favour of open-plan offices, with only one sub-category: location (i.e., co-worker proximity or accessibility) found to be superior in open-plan workplace designs.

Consistent with previous reviews, negative findings were concluded by the present review for health overall. Oommen et al.'s (2008) review found the following health complaints to be negative aspects of open-plan workplace designs: prone to stress, acquiring flu, physical exhaustion, musculoskeletal problems, fatigue and increased blood pressure. The present review supports the findings that open-plan workers are prone to stress, and are more likely to acquire respiratory illnesses and develop fatigue. However, Oommen et al.'s (2008) review finding, that musculoskeletal problems are a negative aspect of open-plan

offices could not be supported, because only one study on musculoskeletal outcomes (i.e., shoulder pain) was found to have a negative association. No associations were found for the remaining studies on musculoskeletal outcomes. This difference could be attributed to the different types of musculoskeletal outcomes examined in the respective reviews. In-addition to the negative health aspects identified in Oommen et al.'s (2008) review, the present review identified a number of studies that found negative associations with open-plan workplace designs and the following health outcomes: general / overall health; wellbeing; headaches; eye irritation; and throat irritation. These increased health risks could be explained by the increased ease of spreading infections in shared environments due to the close proximity to co-workers and use of shared equipment (Pejtersen et al., 2011), and the lack of individual control over aspects of open-plan work environments (e.g., furniture adjustment, personalisation, ventilation, and noise control) (Bodin Danielsson & Bodin, 2008; Kwon et al., 2018).

Overall, the findings suggest that while relocation to an open-plan workplace has very few potential health benefits, it does carry the risks of negative associations with employee's health. In-particular, the current global pandemic, COVID-19, has exposed the heightened health risks that shared work environments pose for their occupants. Furthermore, with the rise in legal responsibilities around worker's health, safety and wellbeing, businesses are now under a greater obligation to look after worker's health and wellbeing. Thereby, businesses should carefully consider the potential health risks of open-plan workplace designs before implementing a restructure. Finally, the considerable number of null findings across the individual health measures suggest that open-plan workplaces do not consistently affect workers' health. Research should investigate the particular features of these open-plan workplace designs so as to understand the ways in which these appear to avoid adverse effects on employee health.

Consistent with expectations and previous reviews, the review found negative evidence for the majority of satisfaction measures and concluded double negative (- -) evidence for all satisfaction sub-categories. This is consistent with de Croon et al. (2005) systematic review, which concluded strong negative evidence for job satisfaction in open-plan workplace designs, and Oommen et al. (2008) review which concluded job dissatisfaction as a negative aspect of open-plan workplace designs. The strength of the negative association between satisfaction in open-plan workplaces compared to single occupant enclosed offices was evidenced in this review by all 11 individual studies measuring overall satisfaction finding negative associations. It is anticipated that this figure

would have been even greater had the other papers which only measured individual items of satisfaction also included an overall measure of satisfaction.

The negative association between open-plan workplaces and satisfaction was further supported by the measures of satisfaction based on individual measures. A number of important findings are noteworthy. For example, as expected, the review revealed that open-plan office workers are dissatisfied with noise conditions, with all nine studies measuring noise obtaining results in favour of closed offices. This is unsurprising given noise is a major complaint in open-plan offices (Bodin Danielsson & Bodin, 2009; Kim & de Dear, 2013), with speech, laughter and telephone ringing noises the most distracting (Kaarlela-Tuomaala et al., 2009). The seven studies measuring satisfaction with distractions / disturbances and the 10 studies measuring privacy, all found negative associations. Increased noise, increased distractions / disturbances, and reduced privacy can all be attributed to the design characteristics of open-plan workplaces which emphasise reducing physical barriers and increasing people density (Kim & de Dear, 2013). This is evident when the average space per employee in an activity based 'non-territorial' open-plan office is just 7–9m² compared to open-plan and 17-20m² for a single occupant office with four solid walls and a door (Hassell, 2014). Thus it is not surprising that in all studies reviewed, open-plan workers consistently reported greater dissatisfaction on these three outcomes compared to people working in single occupant enclosed offices. Office designers should endeavour to reduce noise, limit distractions, and increase privacy in open-plan offices. Possible solutions include: (1) purposefully designed workspaces for collaboration and focused independent work; (2) the provision of easily accessible and available meeting rooms; and (3) the implementation of office protocols which outline noise levels and conditions for certain spaces.

The evidence also suggested that open-plan workplaces contribute to poorer productivity. This effect was observed using overall measures of productivity, and measures of individual factors on perceived productivity i.e., IEQ; affected by others (in low partition cubicles only); and sounds disturbing concentration at work. These findings are contrary to the belief that the reduction of physical barriers facilitates working together, which in-turn increases productivity (Brennan et al., 2002). In the present review, two papers examined the influence of open-plan workplace features on perceived productivity (i.e., Haynes et al., 2017; and Kaarlela-Tuomaala et al., 2009). The perceived influence of these individual features on productivity were compared to satisfaction ratings of the same variables measured by different papers in this review. Previous research by Leaman (1995), and Oseland and Bartlett (1999) suggested that those who were dissatisfied with their work environment

perceived this to have a negative effect on their productivity. This relationship was only found for sounds disturbing concentration at work, and some measures of office design and IEQ. For example, a negative association was found for both satisfaction with noise levels and the extent to which they broke people's concentration in open-plan workplace designs. Other measures with negative satisfaction ratings did not appear to have an impact on productivity. This pattern of results may arise from the fact that the two studies that measured the perceived impact of variables on productivity, did not also measure satisfaction with these variables. It is possible that in these particular studies, the open-plan office workers were satisfied with these aspects of their open-plan office, and thus did not perceive them to have a negative impact on their productivity. Further research should, therefore, endeavour to measure different variables for both satisfaction and their perceived impact on productivity to ascertain the relationship between satisfaction and productivity in different workplace designs.

The review also did not find evidence for the commonly claimed positive effects of open-plan workplace designs on a range of measures of social interaction, as often advanced anecdotally by architects. On the contrary, very few positive benefits of open plan designs were observed for social variables. Although workers were found to be more accessible in open offices, negative results were obtained for the remaining sub-categories, including: relationships / getting along; ease of interaction; and leadership / supervisor (all double negative) and collaboration / communication (single negative). These negative findings align with those of de Croon et al.'s (2005) systematic review which found limited evidence that open-plan workplaces worsen interpersonal relations. Furthermore, congruent with de Croon et al.'s (2005) conclusion of inconsistent evidence for communication, the current review's single negative conclusion for collaboration / communication was based on two positive, two negative, and five no associations. It is clear that workers have very different communication patterns in open-plan workplaces. While some evidence suggests that open-plan workplaces increases collaboration and communication (e.g., Oommen et al., 2008), others find the opposite effect. For example Brennan et al. (2002) suggests that open-plan workplaces do not facilitate communication among co-workers, reduce satisfaction with team member relations, and prohibit confidential conversations. In light of these inconsistent findings, more research should be conducted on communication behaviours in open-plan offices, particularly as increased communication and collaboration are often a major motivator for office restructures.

Finally, an aim of this review was to examine retention and staff turnover rates in open-plan workplace designs compared to single occupant enclosed offices. Oommen et al.'s (2008) review concluded a high staff turnover to be a negative aspect of open-plan workplace designs. Due to insufficient literature, this outcome could not be addressed in this review. Further research should be conducted into the relationship between open-plan workplace designs and staff retention due to the high costs and negative implications associated with high staff turnover.

Limitations / Scientific considerations

Although an attempt was made to encapsulate all relevant literature and to summarise findings in a systematic and objective way, it is important to acknowledge to what extent the methodology used might have influenced the findings. The study had to combine studies with slightly different outcomes measures in the same domains, with varying samples and methodologies and with some variation in the type of open-plan design. Further research may benefit from more refined comparisons between different types of open plan design. In addition, the strict inclusion/exclusion criterion resulted in many papers on the general effects of open-plan workplace designs being excluded from this review. Thus, it is possible that some conclusions, particularly those with limited or mixed findings, may have been different had these studies been included. Nonetheless, in defence of the approach adopted in this review, it is still likely that our comparative approach yielded meaningful findings given the consistency of findings observed across multiple and related variables in some domains. Open-plan offices, however defined, seemed to yield more negative results for a number of measures and it did not appear to make too much difference whether these were measured using more controlled / comparative or correlational research designs.

Practical implications

A major motivator for businesses to restructure to an open-plan workplace environment are the supposed social benefits, in-particular, the allure of increased communication and collaboration between workers. Unfortunately, many of these claims are based on anecdotal evidence, rather than empirical research. This systematic review found limited empirical research has been conducted on the social aspects of open-plan workplace designs compared directly to single occupant enclosed offices – much of which has produced mixed findings. Thus, open-plan offices may not offer the collaborative and communicative benefits often advocated by architects and designers, with some studies suggesting that open-plan designs are associated with deteriorated social outcomes. On the other hand, there is a strong trend towards negative findings on psychological health, worker satisfaction, and

productivity. Therefore, company directors and decision makers should consider the limited empirical research findings before redeveloping their cellular offices into open-plan workplace designs, particularly if their main motivator is to increase collaboration and communication between employees.

Furthermore, redevelopers should take note of the overwhelming evidence supporting the negative effects of open-plan work environments on worker's satisfaction and their productivity, the increased health risks, and the limited benefits for social interactions between workers. A business's bottom line is fundamental and arguably one of the key drivers in their decisions. Decision makers should weigh up the potential savings of more cost effective and space efficient open-plan office designs, with the potential risks of deteriorated health, decreased employee satisfaction and productivity, along with the possibility that social interactions between staff may not improve. Whilst office real-estate is often an organisation's second largest expense (Pole & Mackay, 2009), it is actually very small in comparison to the costs of human resources. In-fact a Buffalo Organization for Social and Technological Innovation (BOSTI) analysis of the primary costs of doing work in a US-based office building over a ten-year period, found that the staff cost was the largest at 82% of a business's costs (Olson, 2002). This is 16 times the cost of the physical workplace which is about 5% of a business's total cost (Olson, 2002). Moreover, businesses are beginning to see the benefits and important role that their staff, staff wellbeing and satisfaction play in their individual productivity and the overall profitability and competitiveness of their business (Harter et al., 2002). Given all of this, careful consideration about any office redesign should be made to ensure that any potential financial savings are not lost very quickly through decreased staff satisfaction and productivity.

Finally, the review revealed a number of negative and no association findings across all five key outcome groups: health; satisfaction; productivity; social; and other impacts. These mixed findings along with anecdotal evidence and public discourse suggest that there can be some variations in how people react to open-plan work environments. Furthermore, we know that some businesses have successfully implemented open-plan workplace designs, while others have ultimately failed. More research should be conducted to investigate the differences between the businesses and individuals who report positive experiences working in open-plan workplace designs on a range of general measures of health, satisfaction, productivity and social interaction, compared to those who report negative experiences. In turn, this could help improve the experiences of individuals working in open-plan workplace designs, and enable more businesses to reap the cost benefits of open-plan workplace designs,

whilst minimising the common negative effects on workers' health, satisfaction and productivity.

3.1.7 Conclusion

This systematic review provides a needed update on the reviews conducted by de Croon et al., (2005), Oommen et al. (2008), and Richardson et al. (2017) by including the literature published over the last decade and focusing on studies with a direct comparison to a clearly defined single occupant enclosed office. Consistent with previous reviews, open-plan workplace designs were found to be negatively associated with health, satisfaction and productivity. Significantly, very few positive effects were found throughout the entire review, with not a single study measuring productivity finding a positive effect. Furthermore, the empirical evidence does not support the anecdotal claims of increased collaboration and communication between open-plan office workers. Taken as a whole, the review's findings have important implications for decision makers deciding to restructure their single occupant enclosed offices into open-plan workplace designs. While open-plan workplace designs may offer many financial benefits for management, these appear to be offset by the intangible costs associated with the negative effects on workers' health, satisfaction, and productivity.

Despite the overall negative findings, it is also important to acknowledge that not every study yielded a positive result in favour of single occupant enclosed offices which may suggest that there is some individual variability in how people respond to open-plan environments. Accordingly, more research should be conducted into why some open-plan office workers experience few effects, while others (and it appears the majority) experience many negative effects. If these differences can be understood, then it is hoped that, if open-plan offices are required due to their cost, then design features could be implemented to reduce the negative impacts. Greater attention may also need to be directed towards the types of people, the mix of people, or the types of work-tasks that are co-located in these modern work environments. It may, for example, be possible to co-locate people who are engaged in more collective tasks that are amenable to noisier or more interactive environments (e.g., designing a marketing plan), whereas it may be important to ensure that people who are undertaking detailed analytical or written tasks are given quiet and more isolated work areas.

3.1.8 Online supplementary material

A comparison of psychological and work outcomes in open-plan and cellular office designs:
A systematic review

Supplementary material 1: Full list of search terms

TITLE-ABS-KEY ("Activity-related office" OR "Landscape office" OR "Virtual office"
OR "Lean office" OR "Office renovation" OR "Telework office" OR "Clean desk" OR
"New office" OR "Work* at home" OR "Cocona concept" OR "Innovative workplace"
OR "Private office" OR "Cocon office" OR "New office layout" OR "Open office" OR
combi-office OR "Closed office" OR "Concentration workplace" OR "Non-territorial
office" OR "Conventional office" OR "Dens* office" OR "Desk-sharing" OR "Open
plan office" OR "Crowd* office" OR "Wireless office" OR "Team office" OR "Enclos*
office" OR "Dynamic office" OR "Traditional office" OR "Spatial office" OR
"Experimental office" OR "Variety office" OR "Boundaries office" OR "Flexible office"
OR "Office transformation" OR "Distance office" OR "Flexible workplace" OR "Virtual
office" OR "Accessibil* office" OR "Shared office" OR "Innovative office" OR
"Visibility office" OR "Group office" OR "Workplace innovation" OR "Partition* office"
OR "Hotel office" OR "Shared workplace" OR "Noise office" OR "Innovative office"
OR "Office innovation" OR "Privacy office" OR "Innovative workplace concepts" OR
"Flexible office" OR "Traditional office" OR "Cellular Office" OR "Open-plan
workplace" OR "Open-plan work place" OR "Open-plan workspace" OR "Open-plan
work space" OR "Activity-based office" OR "Activity-based workplace" OR "Activity-
based work place" OR "Activity-based workspace" OR "Activity-based work space" OR
"Activity-related workspace" OR "Activity-related work space" OR "Activity-related
workplace" OR "Activity-related work place") AND (LIMIT-TO (LANGUAGE ,
"English"))

4 Methodology for the Social and Psychological Adaptation to Open-Plan Workplace

Designs project

This chapter will describe an online International survey project that was undertaken in order to address the principal aims outlined in Chapter 1. The chapter begins with an overview of the research methods used in previous office design – occupant outcome association studies. A detailed description of the Social and Psychological Adaptation to Open-Plan Workplace Designs project is then provided. This is followed by a summary of the sampling strategy, sample characteristics, and all included measures in the project. The studies produced from the data collected from the Social and Psychological Adaptation to Open-Plan Workplace Designs project are presented in Chapter 5.

4.1 Overview

A range of research methods have been used to measure the effects of different office designs. These methods have included: online and paper surveys, interviews, focus groups, observations, and diaries (e.g., Bodin Danielsson & Bodin, 2009; Boutellier et al., 2008; Creagh et al., 2017; Ekstrand et al., 2016; Kim & de Dear, 2013; Morrison & Macky, 2017). Of these, online surveys have been commonly used over the past decade to collect data relating to people's experience of working in offices (e.g., Haynes et al., 2017; Herbig et al., 2016; Morrison & Macky, 2017). Such methods are cost-effective, efficient, easy to administer, reach a broader sample and can be completed virtually anywhere (Wright, 2005).

In-addition to the array of research methods available, a range of research designs have been implemented to research and compare the effects of different office designs. These include: cross-sectional designs, longitudinal surveys during relocation (also referred to as dual pre- and post-occupancy evaluations, and prospective field designs), retrospective relocation surveys (i.e., post-occupancy evaluations), and longitudinal field experiments (i.e., 'traditional' longitudinal studies) (de Croon et al., 2005; Kaarlela-Tuomaala et al., 2009). A cross-sectional design is when two or more different offices are compared to each other at any given time (de Croon et al., 2005; Kaarlela-Tuomaala et al., 2009). A longitudinal survey during relocation is a research method which collects and compares data from the same occupants over the short-time frame of an office change, i.e., just before and after an office move (de Croon et al., 2005; Kaarlela-Tuomaala et al., 2009). In retrospective surveys, respondents are asked to reflect back and compare their present experiences to how they felt before the office move (de Croon et al., 2005; Kaarlela-Tuomaala et al., 2009). A longitudinal field experiment is one in-which the data is collected over multiple time periods from the same respondents (Kaarlela-Tuomaala et al., 2009). Each of these research methods has its own benefits and disadvantages.

Advantages of cross-sectional designs include: (1) Ease to recruit a large and diverse sample; (2) multiple independent variables can be compared at a given time point; (3) inexpensive compared to other research methods; and (4) less commitment for participants as they are only required to participate once (Sedgwick, 2014). However, disadvantages of cross-sectional designs include: (1) Participants are often recruited via convenience sampling methods which can result in an unrepresentative sample due to non-response bias; (2) effects over time are not examined as each respondent's data is only collected at a single point in time; and (3) causation cannot be inferred from cross sectional studies (Sedgwick, 2014).

Longitudinal survey during relocation (i.e. pre- and post-occupancy evaluations or prospective field designs) are advantageous to assess the changes in a new work environment as they enable a direct comparison of measures pre and post a workplace change with many factors remaining constant, e.g., participants, organisation, type of work etc. However, such studies are often limited to a single workplace (e.g., their norms, culture and provision of services) and this reduces the extrapolation of findings. Pre/post-occupation studies can also be difficult to recruit for as they often require the participation and cooperation from an organisation – which can be difficult to obtain.

Retrospective relocation surveys can be problematic and produce unreliable data because they rely on respondents' memory of their previous work environment and are not always asked in a timely manner (Kaarlela-Tuomaala et al., 2009).

Longitudinal field experiments can be useful in ascertaining a deeper understanding of the longer-term effects of an office design on the same sample and can account for any adjustment periods when moving into a new office (Bergström et al., 2015; Brennan et al., 2002). However, longitudinal studies are a long-term commitment and thus can be difficult to recruit a sufficiently large sample (Rajulton, 2001). Moreover, longitudinal studies are costly, time-consuming, can be affected by historical effects and can have high attrition rates (Farrington, 1991; Rajulton, 2001).

4.2 The Social and Psychological Adaptation to Open-Plan Workplace Designs project

An online survey with a cross-sectional design was chosen for this research. The online survey enabled a large varied sample to be collected with a variety of different types of knowledge work completed in a range of office designs. The cross-sectional design was selected for a range of reasons. First, the researchers wanted to compare the effects of multiple different office designs, in particular the different types of open-plan workplace designs. Second, a cross-sectional design was more practical as it enabled the researchers to: collect data from anyone who worked in an office; collect data on office workers who complete different types of knowledge work; the researchers did not have to find an organisation to participate in and approve the study; and the researchers were not limited to collecting data in one or a few organisations.

Nonetheless, the methodological limitations of cross-sectional designs and self-report studies must be acknowledged. As outlined above in Chapter 4.1, the key disadvantages of

cross-sectional designs include: (1) recruitment via convenience sampling methods; (2) single time point for data collection; and (3) the inability to infer causation from cross-sectional studies (Sedgwick, 2014).

First, the use of self-report questionnaires in organisational behaviour research has been widely scrutinised with some researchers sceptical about the quality of data collected from people answering about themselves and their jobs (Spector, 1994). In-particular, self-report measures have been criticised for their discrepancies to objective measures of the same behaviour (e.g., Kormos & Gifford, 2014). Nonetheless, it is generally agreed that self-report measures can be appropriate for measuring people's feelings and perceptions of their work and work environment as these experiences are personal to the respondent themselves (Spector, 1994). Hence the researchers feel the use of self-reporting in the survey is appropriate given the nature of the topic being examined.

Second, self-report measures are subject to social desirability bias – the propensity for someone to answer in alignment with what they believe is socially correct and expected, rather than with their own honest thoughts, beliefs and experiences (Nederhof, 1985). Survey questions which are sensitive in nature are more likely to be susceptible to social desirability bias than those that are less emotive or sensitive (Spector, 1994). The researchers do not believe that the questions contained in the survey are of an overly sensitive nature. Additionally, the survey was anonymous and conducted externally with no link to the respondents' organisation, nor were respondents asked to provide the name of their organisation. For these reasons, it is unlikely that social desirability bias had a significant influence on the quality of the data collected in the survey.

The majority of the previously conducted research on office designs has focused on the positive and negative effects of different office configurations (e.g., Oommen et al., 2008; Richardson et al., 2017). Very little research has looked into the reasons behind the variation in results and in office worker's experiences working in offices. Accordingly, this research aims to investigate why some people thrive in open-plan work environments, while others struggle. In-order to do this, this research aims to distinguish itself from the previously conducted studies in three key ways: 1) obtain previous office experience; 2) detailed breakdown of the type of work and tasks completed; and 3) possible adaptations to different office designs. Each of these distinguishing features will be discussed in turn.

First, much of the previously conducted research has only measured occupant's current office configuration. This study also captures people's previous office experience. It is hypothesised that people who have experienced working in an office on their own will be less satisfied if they are now working in an open-plan workplace environment, particularly if they most previously occupied a single-occupant enclosed office.

Second, most research has simply measured type of work by occupation and/or job title. In this study, a more refined methodology was implemented that tried to capture the specific type of work completed so as to identify the types of work which appears more or less amenable to different types of office design. The survey was designed to collect information on participants' type of work in four ways: (1) occupation and job title; (2) identification of specific tasks completed at work; (3) selection of up to three tasks which are allocated the most time; (4) identification of tasks that typically require working activity with others. It was anticipated that some types of work and individual work tasks are better suited to open-plan work environments than others.

Third, the research was designed to gain more detailed insights into why some people perform well, while others struggle in different office environments by measuring possible adaptive behaviours, and office protocols/expectations. To the author's best knowledge, very few studies have been conducted on these three areas in regard to worker's experiences in different office configurations. A measure of office protocols was created by Brennan et al. (2002) and this has been expanded on in this project. The present research was designed to explore the relationship between open-plan work environments, individual differences, and both adaptive behaviours and office protocols.

Finally, in contrast to many studies in the field, the survey will include a broad range of outcomes in the same study: health, satisfaction, productivity, and social. The inclusion of these outcomes will, not only enable the effects of different office configurations to be examined in detail, but also, they will facilitate comparison and replication of existing research findings across a range of studies that might have only focused on one of these dimensions.

4.3 Sampling Strategy

Participation was requested from participants aged 18 years and over who undertook office-based work in an office in Australia, New Zealand, The United Kingdom, The United

States of America or Canada. Participants needed to work at-least half-time (15 hours per week). Moreover, participants were required to have a sufficient level of English to comprehend the study. The study aimed to survey people working in information intensive work. Common examples of professions include: researchers, academics, public servants, architects, software design, computer programming and other similar professions. People were excluded from participating if they engaged in work which is more physical and technical; involves mainly private communication by its very nature; and/or is clerical in nature. Examples of people who would fall inside the exclusion criteria are people working as clinicians (medical and healthcare treatment/clinicians) who usually have private consultation rooms to meet privacy requirements; those who work in reception/administration offices for shops, stores and cafes, teachers working in classrooms, or those who are call centre and factory workers.

Two sampling methods were used to recruit participants: Convenience sampling and a paid panel recruitment service, Prolific. Convenience sampling was conducted through word of mouth and flyers. Flyers were advertised around the University of Adelaide (targeted locations outside both closed and open-plan offices), public locations (e.g., libraries), and on Facebook. The study was also advertised via the comment section of a trending video “What the devil is Hot Desking? ‘Senior’ correspondent Kitty Flanagan finds out” posted by The Weekly on Facebook (June 3rd, 2018). In-order to recruit both open and closed office workers, two participant recruitment flyers were created. One targeted at open-plan office workers, the other at office workers in general. A specialised flyer was created for open-plan office workers because a higher proportion of this sub-group was required, and it was hypothesised that a targeted flyer would create more interest.

Participants were also recruited via Prolific. Prolific is a United Kingdom based paid panel recruitment service which finds suitable participants to complete your survey. As Prolific has an International user base, participants were recruited from the following Western countries: Australia, New Zealand, United States of America, United Kingdom, and Canada. Participants recruited through Prolific received a small honorarium of four pounds for completing the survey. The use of online contract labour portals (i.e., crowdsourcing) to collect data for organisational psychology research has been supported by research which found the crowdsourced data to be at least as reliable as a “traditional” psychology research sample of University students (Behrend et al., 2011).

The survey could be completed anywhere with an internet connection. Participants were advised that it would take approximately 45 minutes to complete. Due to the survey's length, participants were informed that they could close and reopen the survey at any time, provided they used the same device and web browser. Reminders of "Taking too long? Exit at any time and return later using the same device and web browser" were placed throughout the survey to remind participants of this. At the conclusion of the survey, respondents who completed the survey via word of mouth and/or flyer recruitment (not Prolific) were invited to leave their contact details if they were interested in participating in any subsequent research. Participants were reassured that any identifiable data collected to participate in further research would be stored separately from their survey data to ensure confidentiality of their responses.

The survey underwent a range of pilot testing prior to the main data collection. For example, the survey was piloted with five people and feedback was requested to assess the wording, user friendliness, and general sensibility of the survey. The survey was then run with 50 cases and the responding was checked. Furthermore, the survey was checked by the candidate's supervisors.

The survey data for the Social and Psychological Adaptation to Open-Plan Workplace Designs project was collected at two major time periods: June 2018 and August 2019. Thus, the data analysed in Chapter 5 was collected prior to the global COVID-19 pandemic.

4.4 Sample Characteristics

A total of 985 survey responses were collected, from which 67 incomplete responses were removed. 196 responses were removed for completing excluded types of work. A further eight responses were removed for working less than 15 hours per week. In total, 714 complete responses were retained for data analysis. The majority of retained responses (N = 659; 92.3%) were recruited via the panel recruitment company, Prolific.

A variety of demographic information was collected for this study. A summary of the demographic characteristics of the sample is provided in Table 4.1. The majority of the sample was in the 25-34 and 35-44 age range and a slightly greater proportion of women completed the survey than men. The majority of the sample (N = 619; 86.7%) had completed some form of post-school qualification, with 302 (42.3%) having a bachelor degree as their highest level of completed education. 7.0% (N = 50) of the sample reported speaking a

language other than English at home. Respondents reported working between 15 and 80 hours of paid work each week, with an average of 38.25 hours. The most commonly reported number of paid work hours worked per week was 40 hours. Six respondents did not report how many paid hours they worked each week.

The majority of respondents (N = 514; 72.0%) spend at least 70% of their work-time in their main office configuration/workstation, with almost half the respondents (N = 330; 46.2%) reported spending at least 85% of their work-time in their main office configuration/workstation. On the other hand, only 61 (8.5%) respondents reported spending less than 50% of their work-time in their main office configuration/workstation. Respondents selected the following office configurations as most representative of their current main workspace: single occupant private enclosed office (N = 143; 20.0%); shared enclosed office (N = 145; 20.3%); open-plan (N = 286; 40.1%); cubicle (N = 52; 7.3%); hot-desk (N = 48; 6.7%); activity-based workplace/combi-office/flexible/creative/innovative space (N = 40; 5.6%).

The amount of time spent in current office configuration, regardless of occupation or organisation was measured. Almost half of the respondents (N = 351; 49.1%) had worked in their current office configuration for a year to less than 5 years. The majority of respondents (N = 536; 75.5%) reported having worked at least one year or more in their current office configuration.

Finally, the level of experience working in an enclosed office was reported, with 506 (70.9%) respondents indicating they had previously or currently work in an enclosed office. Of these, 203 (28.6%) had worked in an enclosed office alone, 246 (34.5%) had worked in an enclosed office shared with others, and 57 (8.0%) had worked in an enclosed office both on their own and with others. 70 (9.8%) respondents reported working in an enclosed office for at least 10 years.

Table 4.1. *Descriptive data for demographic variables*

	Total N (%)	Single Private Enclosed Office N (%)	Open-Plan Office N (%)
<u>Sex</u>			
Male	340 (47.6)	79 (11.1)	261 (36.6)
Female	372 (52.1)	64 (9.0)	308 (43.1)
Or specify	1 (0.1)	0 (0.0)	1 (0.1)
DNR	1 (0.1)	0 (0.0)	1 (0.1)
Total	714 (100.0)	143 (20.0)	571 (80.0)
<u>Age (years)</u>			
18-24	56 (7.8)	10 (1.4)	46 (6.4)
25-34	316 (44.3)	58 (8.1)	258 (36.1)
35-44	205 (28.7)	46 (6.4)	159 (22.3)
45-54	100 (14.0)	18 (2.5)	82 (11.5)
55-64	30 (4.2)	9 (1.3)	21 (2.9)
65+	4 (0.6)	2 (0.3)	2 (0.3)
DNR	3 (0.4)	0 (0.0)	3 (0.4)
Total	714 (100.0)	143 (20.0)	571 (80.0)
<u>Languages other than English at home</u>			
Yes	50 (7.0)	22 (3.1)	28 (3.9)
No – Only English	663 (92.9)	121 (16.9)	542 (75.9)
Total	713 (99.9)	143 (20.0)	570 (79.8)
<u>Highest Education Level</u>			
Less than Year 12	14 (2.0)	0 (0.0)	14 (2.0)
Year 12	76 (10.6)	10 (1.4)	66 (9.2)
Other post-school qualification (e.g. VET/TAFE certificate,	133 (18.6)	19 (2.7)	114 (16.0)

apprenticeship, diploma)			
	Total N (%)	Single Private Enclosed Office N (%)	Open-Plan Office N (%)
Bachelor Degree	302 (42.3)	65 (9.1)	237 (33.2)
Higher than Bachelor Degree	184 (25.8)	48 (6.7)	136 (19.0)
DNR	5	1	4
Total	714 (100.0)	143 (80.0)	571 (20.0)
<u>Country</u>			
Australia/New Zealand	77 (10.7)	12 (1.7)	65 (9.1)
United Kingdom	461 (64.6)	65 (9.1)	396 (55.5)
United States of America	160 (22.4)	59 (8.3)	101 (14.1)
Canada	8 (1.1)	6 (0.8)	2 (0.3)
Europe (exc. UK)	5 (0.7)	0 (0.0)	5 (0.7)
Japan	3 (0.4)	1 (0.1)	2 (0.3)
Total	714 (100.0)	143 (80.0)	571 (20.0)

Key: Or Specify: Option for respondents who do not identify as male or female; DNR: Did not respond.

4.5 Selection of Measures

The survey was divided into 11 key sections: Demographics, office configuration, type of office work, personality, health, satisfaction, social, irritations, adaptations, protocols/expectations and open-ended questions. The survey design was guided by the available published peer-reviewed research. Where available, a previously tested measure was used. In some cases, an existing measure was modified to increase its suitability for the study. These instances have been outlined below. Where an appropriate existing measure could not be found, the researchers specifically designed a measure, guided by the literature. This was particularly the case in new areas, where research has not been widely conducted (i.e., detailed characteristics of different office designs, specific features of type of work, and adaptations). The following sections detail all measures included in the survey (see appendices 9.1 for a copy of the survey). Note the survey contained measures beyond the scope of this thesis, and thus not all measures presented below have been analysed in the papers in Chapter 5.

4.5.1 Independent variables

4.5.1.1 *Demographics*

Demographic information was categorised into the following four categories: basic demographic data; basic work data; duration in occupation and/or organisation; previous office experience and duration. The following demographic data was collected. Basic demographic data: Age, sex, English as a first language, languages other than English spoken at home, highest level of completed education. Basic work data: approximate hours of paid work completed each week, occupation title (e.g., lawyer), and job title. Occupation and organisation experience and duration: time worked in current occupation (regardless of company/organisation), time worked in current company/organisation (regardless of occupation). Previous office experience and duration: time worked in current office configuration (regardless of occupation and company), approximate percentage of work-time spent in main office configuration/workstation, last office configuration (not current one), duration in last office configuration, previous enclosed office experience, how long ago worked in an enclosed office configuration, total time worked in an enclosed office and current office configuration.

4.5.1.2 *Office configurations and characteristics*

Information on office configuration was collected in two parts: (1) Descriptive office configurations which participants could endorse; (2) Detailed questions about individual aspects of the selected office configuration presented on a continuum, answered on a slider scale. First, respondents were asked to select the office configuration that best represents their “current workspace”. Respondents who worked in multiple workspaces, were asked to select the one that best represents their main workspace. Response options were: enclosed office, open-plan, cubicle, hot-desk, and activity-based workplace/combi-office/flexible/creative/innovative space. Respondents were asked to think about this workspace configuration when answering the remainder of the survey.

Second, to gain a deeper understanding of respondents’ actual office configuration, respondents were presented a list of characteristics specific to their selected office configuration. Each characteristic was presented along a continuum, and respondents were asked to indicate the characteristic for their office on the slider scale. Each slider scale was scored 0 to 100 in increments of 10, with 50 as the mid-point. For example: In enclosed offices, shared was measured from “shared with more than 10 people” (0) to “not shared with anyone” (100). In open-plan offices, partitions were measured from “no partitions” (0) to “full height partitions (cannot see over when standing)” (100). The list of characteristics was slightly different for each of the office configurations selected in the previous question. Respondents working in flexible workplace designs were asked two sets of characteristic slider questions: (1) about their flexible work environment overall and (2) about the workplace they most commonly use.

For all office configurations, a higher score was indicative of a more private and spacious work environment. For the flexible office designs (i.e., activity-base workplace and hot-desk), a higher score was also indicative of a better designed and utilised flexible work environment characterised by a range of different workstations that are readily available and used for the appropriate tasks. Nonetheless, analysis of the individual office characteristics data was beyond the scope of this thesis, and has been collected for use in future research.

4.5.1.3 *Flexible work environment utilisation*

A measure to ascertain utilisation frequency of different workspaces in a flexible work environment (i.e. activity-based work environment and hot-desking) was developed specifically for this study. This measure was only administered to respondents who selected

that their main work configuration was either an activity-based work environment or hot-desk. Nine items focused on the features of finding and using different workstations in flexible work environments were included, such as: “choose your workspace based on your needs”, “stay at the same workstation all day” and “easily find a suitable space when needed”. Respondents indicated their frequency during the past 4 weeks, on a five-point Likert type scale scored: 1 (never), 2 (seldom), 3 (sometimes), 4 (often), 5 (always). Items “stay at the same workstation all day” and “prefer to use the same workstation everyday” were reverse scored. All responses were averaged. Scores ranged from 1 to 5. A high score indicated that the respondent frequently uses different aspects of their flexible work environment. Note, due to the small proportion of respondents who selected a flexible work environment (N = 88; 12.3%), this data was not analysed in this thesis.

4.5.1.4 *Identifying types of office work*

Three measures were specifically developed for this research to gain a deeper understanding of the types of office work respondents complete in their office. Prior to completing these measures, respondents were explained the difference between ‘routine’ tasks (i.e., basic emails, routine meetings (staff meetings), clerical work (photocopying), and non-routine tasks. It was explained that the following measures focus on the non-routine tasks that can occur in offices.

The first measure used to identify the types of office work completed has been referred to as the “type of work” measure. This measure was inspired by Parkin et al. (2011) breakdown of work in different work activities such as: “undertaking quiet, concentration work”, “engaging in creative work”, and “holding telephone conversations”. In the “type of work” measure in this survey, respondents were presented with a list of 15 non-routine tasks which they may complete in their office, such as: “quiet, conceptual work involving design” and “planning work and projects”. Respondents were asked “to what extent are these important features of the work you need to do as part of your profession?”. Responses were collected on a five-point Likert type scale scored: 1 (not at all), 2 (not very important), 3 (moderately important), 4 (important), 5 (very important feature).

The next measure was developed to better understand the type of work that respondents allocate the most time. Respondents were asked to “indicate up to 3 non-routine tasks (e.g., core tasks associated with the job) to which you allocate the most time”. The response options were the 15 core tasks presented in the previous “type of work” measure

(e.g., “Quiet, concentrated work involving reading and writing”, “Complex computational work (e.g., statistical analysis/mathematics, computer programming)” and “Confidential conversations (in-person & phone)”).

Finally, to gain insights into the potential importance of social connections/co-worker interactions, respondents were asked to “indicate the tasks you complete which mostly involve working actively with others”. Respondents were asked to select all that apply from the 10 items that were used in the “type of office work” measure, that do not strictly involve at least two people. For example: “quiet, concentrated work involving reading and writing” and “engineering/technical design work”. Each selected item was scored 1, and non-selected items were scored 0. The total number of selected items was calculated. A high score is indicative of the respondent completing more office work that requires working activity with others to complete, even though they are not strictly at least two people work forms.

4.5.1.5 *Collaboration important to complete work*

A single item was developed to ascertain the importance of collaboration for respondents to complete their work. Respondents were asked to “indicate the extent to which collaboration with others in your workplace is important to complete your work”. Responses were collected on a five-point Likert type scale scored: 1 (not at all important) to 5 (very important). Scores ranged from 1 to 5. A high score is indicative that collaboration in the workplace is important to complete work.

4.5.1.6 *Personality*

Personality was measured using an abbreviated form of the revised Eysenck Personality Questionnaire (EPQR-A) (Francis et al., 1992). The EPQR-A is derived from the 48-item short form EPQR and consists of four six-item scales. It has been tested for its reliability, validity and has good correlations with both the short form EPQR and the original EPQ (Francis et al., 1992). The EPQA-A was chosen for this research because of its short length, yet good psychometric properties. Only the six-item extraversion scale was used for this study. Participants were asked to respond either yes (1) or no (0) to six statements. Items “do you tend to keep in the background on social occasions?” and “are you mostly quiet when you are with other?” were reverse scored. Scores ranged from 0 to 6. A high score on this scale is indicative of a high level of extraversion.

4.5.2 Outcome measures

An overview of all outcome measures included in the survey for the Social and Psychological Adaptation to Open-Plan Workplace Designs project (see appendices 9.1 for a copy of the survey) have been presented in Table 4.2. For each outcome measure, Table 4.2 outlines: the number of items; scale; score range; whether the measure was used in its original format, modified, or developed for the purpose of this research; the reference for all original and modified measures; and the chapters that the measure was analysed in. Details on the specific measures used within each publication are detailed within the associated manuscript in Chapter 5. The survey also included measures which were beyond the scope of this thesis. These measures have been labelled as “not analysed” in the chapter column of Table 4.2.

Table 4.2. *Overview of all outcome measures included in the Social and Psychological Adaptation to Open-Plan Workplace Designs project*

Measure	Number of items	Scale	Score Range	Original / Modified / Developed	Reference	Chapter
<u>Health</u>						
Kessler Psychological Distress Scale (K10)	10	1 (none of the time) to 5 (all of the time)	10 to 50	Original	Kessler et al. (2002)	5.1; 5.4
Total Health Problems	12	1 (never) to 5 (always)	12 to 60	Developed		5.1; 5.4
Sickness absence / leave (short leave)	1	Open response	Open response	Original	Bodin Danielsson et al. (2014)	Not analysed
Sickness absence / leave (long leave)	1	Open response	Open response	Original	Bodin Danielsson et al. (2014)	Not analysed
Sickness absence / leave (Total)	1	1 (not at all) to 5 (91 days or more)	1 to 5	Original	Bodin Danielsson et al. (2014)	5.1
Job Stress Scale	13	1 (strongly disagree) to 5 (strongly agree)	1 to 5	Modified	Original – Parker and De Cottiis (1983) Modified – Jamal (2011)	5.1

<u>Productivity</u>						
Perceived Productivity	1	1 (strongly disagree) to 5 (strongly agree)	1 to 5	Original	Parkin et al. (2011)	5.2; 5.4
<u>Satisfaction</u>						
Office space adequacy	5	1 (strongly disagree) to 5 (strongly agree)	1 to 5	Original	McElroy and Morrow (2010)	5.2
Department layout	6	1 (strongly disagree) to 5 (strongly agree)	1 to 5	Original	McElroy and Morrow (2010)	5.2
Meeting space adequacy	3	1 (strongly disagree) to 5 (strongly agree)	1 to 5	Original	McElroy and Morrow (2010)	5.2
Comfort with work visible to supervisor/boss	1	1 (strongly disagree) to 5 (strongly agree). A (0) N/A option was provided for respondents whose work is not visible to their supervisor or boss.	0 to 5	Developed		Not analysed
Enjoy working in office building	1	1 (strongly disagree) to 5 (strongly agree)	1 to 5	Original	Parkin et al. (2011)	5.2

Office building is a stimulating place to work	1	1 (strongly disagree) to 5 (strongly agree)	1 to 5	Original	Parkin et al. (2011)	5.2
Satisfaction with work environment suitability to complete work-related activities	15 (Items individually examined)	1 (very dissatisfied) to 5 (very satisfied). 0 (N/A – Do not complete that type of work)	0 to 5	Developed		Not analysed
Noise and privacy	3	1 (very dissatisfied) to 5 (very satisfied)	1 to 5	Original	Parkin et al. (2011)	5.2
Disturbance	5	1 (low) to 3 (high)	1 to 3	Original	Parkin et al. (2011)	5.2; 5.4
Noise and privacy conditions support work	5	1 (very dissatisfied) to 5 (very satisfied)	1 to 5	Original	Parkin et al. (2011)	5.2; 5.4
Facilities and amenities support work	8	1 (very dissatisfied) to 5 (very satisfied). 0 (N/A – Work environment did not contain that facility)	0 to 5	Original	Parkin et al. (2011)	Not analysed
Lighting, temperature, airflow/circulation, and overall ambience satisfaction	4 (Items individually examined)	1 (very dissatisfied) to 5 (very satisfied)	1 to 5	Developed		5.2

Commitment to the workplace	4	0 (To a very small extent), 25 (to a small extent), 50 (somewhat), 75 (to a large extent), 100 (to a very large extent)	0 to 100	Original	Copenhagen Psychosocial Questionnaire (COPSOQ) Kristensen et al. (2005)	Not analysed
General job satisfaction	3	1 (strongly disagree) to 7 (strongly agree)	3 to 21	Original	Michigan Organisational Assessment Questionnaire Survey Research Center (1975)	5.2; 5.4
General turnover	2	1 (strongly disagree) to 7 (strongly agree)	2 to 14	Original	Michigan Organisational Assessment Questionnaire Survey Research Center (1975)	5.2; 5.4
Internal turnover	1	1 (strongly disagree) to 7 (strongly agree)	1 to 7	Original	Michigan Organisational Assessment Questionnaire	5.2; 5.4

Survey Research Center (1975)						
Office recommendation	1	1 (strongly not recommend) to 5 (strongly recommend)	1 to 5	Developed		5.2; 5.4
Overall satisfaction with work environment	1	1 (very dissatisfied) to 5 (very satisfied)	1 to 5	Developed		5.2; 5.4
Organisational (affective) commitment	6	1 (strongly disagree) to 5 (strongly agree)	1 to 5	Modified	Three-Component Organisational Commitment Questionnaire Meyer and Allen (1990)	5.2; 5.4
Satisfaction of flexible work environment	6	1 (very dissatisfied) to 5 (very satisfied)	1 to 5	Developed		Not analysed

<u>Social</u>						
Social support	4	0 (To a very small extent), 25 (to a small extent), 50 (somewhat), 75 (to a large extent), 100 (to a very large extent)	0 to 100	Original	Copenhagen Psychosocial Questionnaire (COPSOQ) Kristensen et al. (2005)	5.1; 5.3; 5.4
Social relations	3	0 (To a very small extent), 25 (to a small extent), 50 (somewhat), 75 (to a large extent), 100 (to a very large extent)	0 to 100	Original	Copenhagen Psychosocial Questionnaire (COPSOQ) Kristensen et al. (2005)	5.1; 5.3; 5.4
Sense of community	3	0 (To a very small extent), 25 (to a small extent), 50 (somewhat), 75 (to a large extent), 100 (to a very large extent)	0 to 100	Original	Copenhagen Psychosocial Questionnaire (COPSOQ) Kristensen et al. (2005)	5.1; 5.3; 5.4
Colleagues to provide social support	1	Open response	Open response	Developed		Not analysed

Team member relations	5	1 (strongly disagree) to 5 (strongly agree)	1 to 5	Modified	Brennan et al. (2002)	5.1; 5.3; 5.4
Team leader location	1	In a different building; in a separate office/workspace connected to my work area; on a different floor; at their own desk in my work area; on my floor BUT not connected to my work area; hot-desks with us	-	Developed		Not analysed
Frequency of team leader movement around office	1	1 (never), 2 (less than weekly), 3 (1-3 times per week), 4 (4-5 times per week), 5 (multiple times per week)	1 to 5	Developed		Not analysed
Enjoy team leader co-location	3	1 (strongly disagree) to 5 (strongly agree). 0 (N/A – Do not have team leaders located in or around their work area, and/or who are not visible)	0 to 5	Developed		Not analysed

Collaborative culture	5	1 (strongly disagree) to 5 (strongly agree). 0 (N/A – Work does not involve any collaboration)	0 to 5	Original	McElroy and Morrow (2010)	5.1; 5.3; 5.4
Collaboration frequency	7	1 (never), 2 (less than weekly), 3 (1-3 times per week), 4 (4-5 times per week), 5 (multiple times each day)	1 to 5	Developed		5.1; 5.3; 5.4
Collaboration important	1	1 (not at all important) to 5 (very important)	1 to 5	Developed		5.1; 5.3 (Independent variable); 5.4
Difficult to hold a conversation in office area	1	1 (strongly disagree) to 5 (strongly agree)	1 to 5	Original	Parkin et al. (2011)	5.1; 5.3
Co-worker satisfaction	4	1 (strongly disagree) to 5 (strongly agree)	1 to 5	Modified	Spector (1997)	5.1
Staff morale	1	1 (very poor) to 5 (very good)	1 to 5	Developed		5.1; 5.3; 5.4

Adaptations, protocols / expectations, irritations, and open-ended questions

Adaptations	37	0 (do not use in office/workspace) to 1 (use in office/workspace)	0 to 37	Developed		5.4
Protocols / Expectations	13	0 (no established expectation in work area) to 1 (established expectation in work area)	0 to 13	Modified	Brennan et al. (2002)	5.4
Irritations	22	0 (not irritating) to 1 (irritating)	0 to 22	Developed		Not analysed
Open-ended questions	4	Open response	Open response	Developed		Not analysed

5 Studies arising from the Social and Psychological Adaptation to Open-Plan Workplace Designs project

In this chapter, the analyses based on the data from the Social and Psychological Adaptation to Open-Plan Workplace Designs project discussed in the previous sections are presented in four individual papers. The first study examined whether the type of work (cognitively demanding work) moderates the relationship between office type and reported health and social outcomes; and whether this relationship is influenced by most recent previous office experience. The second paper expanded on the first paper by exploring work outcomes – perceived productivity and satisfaction with different aspects of workers' work and work environment. The third paper aimed to explore the relationship between an office workers' perception of collaboration being important to complete their work and their social interactions at work. The fourth paper examined the role of individual differences in introversion – extraversion and how different office workers adapt to their shared work environments. Due to the four papers in Chapter 5 using the same data set from the Social and Psychological Adaptation to Open-Plan Workplace Designs project, there was some cross over of methods in the method sections of each of the papers.

The first paper was written for the purpose of publication in this thesis. The second and fourth papers have been submitted for publication and are currently under review. The third paper is due to be submitted for publication. These papers are presented in the format in which they were submitted for publication in their respective journals and therefore reflect each journal's required sections, style and language for publication.

5.1 Publication: Health and social outcomes in open-plan and shared work designs: The moderating role of work type and previous office experience

5.1.1 Statement of authorship

Statement of Authorship

Title of Paper	Health and social outcomes in open-plan and shared work designs: The moderating role of work type and previous office experience		
Publication Status	☐ Published ☐ Accepted for Publication ☐ Submitted for Publication ☒ Unpublished and Unsubmitted work written in manuscript style		
Publication Details			

Principal Author

Name of Principal Author (Candidate)	Olivia Isabel Shirley James		
Contribution to the Paper	Conceptualised and designed the study, collected the data, completed the data analysis, interpreted the results and drafted the manuscript.		
Overall percentage (%)	80		
Certification:	This paper reports on original research I conducted during the period of my Higher Degree by Research candidature and is not subject to any obligations or contractual agreements with a third party that would constrain its inclusion in this thesis. I am the primary author of this paper.		
Signature		Date	19/01/21

Co-Author Contributions

By signing the Statement of Authorship, each author certifies that:

- the candidate's stated contribution to the publication is accurate (as detailed above);
- permission is granted for the candidate to include the publication in the thesis; and
- the sum of all co-author contributions is equal to 100% less the candidate's stated contribution.

Name of Co-Author	Paul Delfabbro		
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Contribution to the Paper	Assisted with the interpretation of the findings and provided critical feedback on the manuscript.		
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Please cut and paste additional co-author panels here as required.

5.1.2 Abstract

The last few decades have seen a rise in knowledge-based work completed in open-plan office designs. The paper is the first part of a larger two-part study. The paper aims to investigate whether the type of work (cognitively demanding work) moderates the relationship between office type and reported health and social outcomes; and whether this relationship is influenced by most recent previous office experience. The study analyses 714 responses, predominantly from Australia, New Zealand, United States of America and United Kingdom, collected in an online cross-sectional survey which compared single occupant enclosed offices and various open-plan workplace designs experiences working in their office in relation to their work (measured by 15 tasks), health and social outcomes. Data was analysed with independent sample t-tests, factorial ANOVAs, 2 office type x 2 work type factorial ANOVA, and ANCOVA. Findings suggested that office workers who worked in more cognitively demanding work and in open-plan office configurations, experience significantly worse health outcomes than open-plan office workers who complete fewer tasks that require greater cognitive absorption or concentration. Moreover, most recent previous office experience did not appear to significantly influence the relationship between office type, more cognitively demanding work, and health and social outcome measures. Decision makers should consider the type of work conducted in the workplace when designing offices to ensure their suitability and to increase worker's health outcomes.

5.1.3 Introduction

Office designs continue to evolve over time. Long gone are the days of multi-story buildings filled with long corridors of traditional floor to ceiling cellular offices. Nowadays architects and redevelopers advocate for the demolition of the traditional cellular office in-favour of new, innovative office concepts. These new concepts are typically based around open-plan designs. Although no single definition exists, open-plan offices are usually characterised by large office spaces filled with multiple desks in various arrangements and where there are fewer physical barriers between work spaces (Davis et al., 2011). The term open is also usually applied to office designs where workspaces are separated by partitions of various heights, but it can also apply to situations where multiple people may be co-located in a single smaller room (Bergström et al., 2015). Some authors have noted finer differences (or subcategories) under the broader category of ‘open plan’ as based on the number and height of partitions, spatial density, openness and architectural accessibility (Brennen et al., 2002; Oldham, 1988; Oldham & Rotchford, 1983). Such analyses suggest that there are a variety of terms used to describe open plan designs and that authors may differ in what is considered truly open (e.g., whether there are partitions or not). However, it is generally agreed that one can differentiate the broad category of ‘open-plan’ from the category of single-occupant enclosed office, where a single worker has surrounding walls and a door that allows them to gain some separation from other workers in the office (Bodin Danielsson & Bodin, 2008). Such offices can be within the context of a larger open plan design (e.g., a manager with enclosed office that looks out over an open-plan area, a private practice, study or chambers or an office positioned next to a collection of other similar enclosed offices).

Considerable research has investigated the effects of different work environments on office workers (see reviews de Croon et al., 2005; James et al., 2021; Oommen et al., 2008; Richardson et al., 2017). Despite the managerial attraction of open-plan work environments because of their lower costs and visually attractive architectural design features in marketing brochures; research has identified an array of negative effects associated with open-plan work environments. These include: decreased job satisfaction (e.g., de Croon et al., 2005; Oommen et al., 2008); decreased satisfaction with work environment (e.g., Bergström et al., 2015; Kim & de Dear, 2013); lower work productivity (e.g., Oommen et al., 2008); reduced privacy (e.g., de Croon et al., 2005; Oommen et al., 2008); increased noise (e.g., Bodin Danielsson & Bodin, 2009; Lee, 2010); increased disturbance (e.g., Kaarlela-Tuomaala et al., 2009; Seddigh et al., 2014); decreased concentration (e.g., Pejtersen et al., 2006; Seddigh et al., 2014); intensified cognitive workload (de Croon et al., 2005); an inability to conduct private

conversations (Oldham & Brass, 1979; Sundstrom, 1986); and, higher staff turnover (Oommen et al., 2008). In addition to these environmental concerns, it has been found that open-plan designs are associated with increases in negative health outcomes. These have included: increased reported stress; greater spread of contagious conditions such as the common cold and the flu; greater physical exhaustion; musculoskeletal problems; increased fatigue and blood pressure levels (Oommen et al., 2008); increased short-term (1-7 days) sick leave (Danielsson et al., 2014); and, increased sick-building syndrome symptoms (Kim & de Dear, 2013). Nonetheless, despite these findings, the popularity of open-plan workplace designs continues to increase (Smith-Jackson & Klein, 2009) with over 70% of office workers in the United States of America working in an open-plan workplace design (Congdon et al., 2014).

The emergence of open-plan workplace designs has been influenced by several key factors. Apart from the perceived cost advantages of open-plan designs in construction and ongoing overheads, there have also been major changes in technology and in the nature of work over the last few decades (Cascio & Montealegre, 2016). In many industries, work has become increasingly more technology-based and complex as machines and technology replace simple labour and tasks require more specialised skill sets (Greene & Myerson, 2011; Smith, 2005). Some argue that, because of the increased complexity of work, tasks are now more likely to require the collaboration of multiple experts to complete (Kaarlela-Tuomaala et al., 2009) with occupations such as architecture, design, marketing, and information technology often singled out as examples. In such organisations, experts in different areas come together to contribute their specialist knowledge to a project (Greene & Myerson, 2011; Smith, 2005). It is argued that traditional offices are not suited for such collaborative work styles because workers are physically segregated by walls and closed doors, impeding their ability to communicate. However, a question arises as to whether such logic can be extended to other occupations, particularly those that are less technical and require a predominance of independent ‘knowledge-based’ work that involves conditions conducive to independent thought and writing (Kaarlela-Tuomaala et al., 2009). Examples include the work of lawyers, academics and policy-writers.

The term ‘knowledge workers’ was first coined by Drucker in 1959 (Heerwagen et al., 2004) and refers to workers who use their expertise, education or experience to create, distribute and apply knowledge (Tom Davenport, 2005 as cited in El-Farr, 2009). Such are often identified as being the valuable asset of 21st century organisations as machines and

technology gradually replaced manual labour (Drucker, 1999). In the past, only a few occupations were classified as involving knowledge work: doctors, lawyers, scientists, and academics (Greene & Myerson, 2011). However, Drucker subsequently extended his term to include ‘knowledge technologists’ – occupations that combine formal knowledge and process work, i.e. computer technicians, laboratory analysts, paralegals and software designers (Greene & Myerson, 2011). In this sense, knowledge workers are not a homogenous group but encompass a range of occupations as well as roles and needs (Greene & Myerson, 2011). A potential difficulty with Drucker’s approach is that it would appear to capture a very broad range of professions, some of which would often involve a lot of collaboration between workers on project work (e.g., software design), but others that would often require greater solitary work. Accordingly, for greater insights to be obtained into the impact of office designs, using just job titles to classify work may be less useful than examining the specific type of work being conducted in the workplace and each worker’s individual task requirements. It could be reasonably hypothesised that open-plan workplace designs might be more suitable to some types of work than others where more collaboration and less private ‘informational’ work is required, and that more traditional knowledge of information jobs (e.g., academic or legal work) may benefit from more enclosed office designs. Thus, given the wide variety of roles and needs of knowledge workers, it may be that research will be more informative for organisations when it better captures the interaction between work type and office design, because it may be that the assumption that all knowledge workers have the similar workplace needs is not a valid assumption (Greene & Myerson, 2011).

Previous research has investigated the relationship between different work features and office configurations (e.g., Block & Stokes, 1989; Fried et al., 2001; Seddigh et al., 2014; Sundstrom et al., 1980; Zalesny & Farace, 1987). In-particular, Seddigh et al. (2014) designed a study to investigate the relationship between perceived need for concentration on the job, office configurations and the following health outcomes: cognitive stress, burnout, and general health. Need for concentration was measured with the single item “To what extent do you have individual tasks that require concentration?” answered on a five-point Likert scale, categorised 1-4 (low need); 5 (high need) (Seddigh et al., 2014). The study found that respondents who perceived their work to have a high need for concentration, experienced significantly greater levels of cognitive stress in all shared office types, except flex offices, compared to single-occupant cell offices (Seddigh et al., 2014). This suggests that features of work, beyond a simple measure of occupation title, influence the relationship between office type and health outcomes. Further research should be undertaken to

investigate whether this interaction extends to other job characteristics such as specific work tasks, as well as whether such interactions exist for social interaction outcomes.

The current study

The majority of the previously conducted research on office designs has focused on the positive and negative effects of different office configurations. By contrast, very little research has looked into the reasons behind the variation in office worker's experiences working in different offices. Accordingly, the aim of this study is to investigate why some people appear to report better outcomes working in open-plan work environments while others find it more difficult. In this paper, we aim to build on Seddigh et al.'s (2014) findings, to examine how open-plan environments appear to affect health outcomes and social interactions, with a particular focus on how the type of work (the level of cognitive absorption required) influences the association between office type and outcomes. Given that adaptation is also likely to be influenced by exposure to different office designs, the study also examines whether previous exposure to open-plan designs appears to be associated with adaptation effects in the form of better outcomes in these office configurations. This study is the first part of a larger two-part study, with the second part exploring the relationship with work outcomes. The specific hypotheses addressed in this paper were as follows: (a) It is hypothesised that the results will support previous findings concerning the relationship between office design and health outcomes using a comprehensive range of measures informed by a review of the existing literature; (b) It is hypothesised that those who are engaged in work requiring greater cognitive absorption or concentration are more negatively affected by open-plan designs; and (c) It is hypothesised that people who have previous open-office experiences will report better outcomes in open plan offices.

5.1.4 Method

Sample Characteristics

The study involved 714 respondents drawn largely from an international online panel as well as from the broader South Australian community completed the study. A summary of the demographic characteristics of the sample is provided in Table 5.1. As indicated, the majority of the sample was aged between 25 and 44 years of age and there was a slightly greater proportion of women in the survey. The majority of the sample (N = 619; 86.7%) had completed some form of post-school qualification, with 302 (42.3%) having a bachelor degree as their highest level of completed education. 7.0% (N = 50) of the sample reported speaking a language other than English at home. Respondents reported working between 15

and 80 hours of paid work each week, with an average of 38.25 hours. The most commonly reported number of paid work hours worked per week was 40 hours. Six respondents did not report how many paid hours they worked each week.

The majority of respondents (N = 514; 72.0%) spent at least 70% of their work-time in their main office configuration/workstation, with almost half the respondents (N = 330; 46.2%) reported spending at least 85% of their work-time in their main office configuration/workstation. On the other hand, only 61 (8.5%) respondents reported spending less than 50% of their work-time in their main office configuration/workstation. Respondents selected the following office configurations as most representative of their current main workspace: single occupant private enclosed office (N = 143; 20.0%); shared enclosed office (N = 145; 20.3%); open-plan (N = 286; 40.1%); cubicle (N = 52; 7.3%); hot-desk (N = 48; 6.7%); activity-based workplace/combi-office/flexible/creative/innovative space (N = 40; 5.6%). Respondents were subsequently classified into single-occupant private enclosed office (N = 143; 20.0%) and open-plan (N = 571; 80.0%) – any shared workspace with at least two occupants.

The amount of time spent in current office configuration, regardless of occupation or organisation was measured. The majority of respondents (N = 351; 49.1%) had worked in their current office configuration for a year to less than 5 years. Most respondents reported having worked at least one year or more in their current office configuration.

Finally, respondents' most recent previous office experience was reported, with 77 (10.8%) indicating they had no previous office experience, 528 (73.9%) reporting their previous office was open-plan; and 108 (15.1%) reporting their most recent previous office was a single-occupant enclosed office.

Study Procedure

An online cross-sectional survey was utilised because it enabled the researchers to: 1) collect data from anyone who worked in an office; 2) collect data on office workers who complete different types of knowledge work; 3) the researchers did not have to find an organisation to participate in and approve the study; and 4) the researchers were not limited to collecting data in one or a few organisations. Therefore, a larger more varied sample could be recruited. The survey was designed to obtain extensive detail concerning the type of work conducted in the workplace. Most research has simply measured type of work by occupation

and/or job title. In this study, a more refined methodology was implemented that tried to capture the specific type of work completed so as to identify the types of work which appears more or less amenable to different types of office design. The survey was designed to collect information on respondents' type of work in two ways: (1) occupation and job title; (2) identification of specific tasks completed at work. It was anticipated that some types of work and individual work tasks are better suited to open-plan work environments than others.

Respondents were invited to complete a 45-minute online survey on their experiences working in their office environment. Participation was requested from people aged 18 years and over who undertook at-least 15 hours of paid work a week in an office. Moreover, respondents were required to have a sufficient level of English to comprehend the study. The study aimed to survey people working in information intensive work. Common examples of professions include: researchers, public servants, architects, and computer programmers. People were excluded from participating if they engaged in work which is more physical and technical; involves mainly private communication by its very nature; and/or is clerical in nature. Examples of people who would fall inside the exclusion criteria are people working as clinicians (medical and healthcare treatment/clinicians); those who work in reception/administration offices, teachers working in classrooms, or those who are call centre and factory workers.

Respondents were recruited through word of mouth, flyers, and a paid panel recruitment service, Prolific. Respondents recruited through Prolific received a small honorarium of four pounds for completing the survey. The study was also advertised on social media. Data obtained from Prolific was carefully screened to ensure that the data quality was good. Those who completed the survey too quickly, did not meet the eligibility criteria, showed evidence of very incomplete, and/or patterned responding were excluded. The survey included questions that allowed for validity and attention checks (latent trap questions) that indicated that the person was not responding carefully.

Table 5.1. *Sample demographics*

	Single-Occupant		
	Total	Enclosed Office	Open-Plan Office
	(N = 714)	(N = 143)	(N = 571)
	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)
<u>Sex</u>			
Male	340 (47.6)	79 (55.2)	261 (45.7)
Female	372 (52.1)	64 (44.8)	308 (53.9)
<u>Age</u>			
18-24	56 (7.8)	10 (7.0)	46 (8.1)
25-34	316 (44.3)	58 (40.6)	258 (45.2)
35-44	205 (28.7)	46 (32.2)	159 (27.8)
45-54	100 (14.0)	18 (12.6)	82 (14.4)
55-64	30 (4.2)	9 (6.3)	21 (3.7)
65+	4 (0.6)	2 (1.4)	2 (0.4)
<u>Languages other than English at home</u>			
Yes	50 (7.0)	22 (15.4)	28 (4.9)
No – Only English	663 (92.9)	121 (84.6)	542 (94.9)
<u>Highest Education Level</u>			
Less than Year 12	14 (2.0)	0 (0.0)	14 (2.5)
Year 12	76 (10.6)	10 (7.0)	66 (11.6)
Other post-school qualification (e.g. VET/TAFE certificate, apprenticeship, diploma)	133 (18.6)	19 (13.3)	114 (20.0)

	Single-Occupant		
	Total	Enclosed Office	Open-Plan Office
	(N = 714) <i>n</i> (%)	(N = 143) <i>n</i> (%)	(N = 571) <i>n</i> (%)
Bachelor Degree	302 (42.3)	65 (45.5)	237 (41.5)
Higher than Bachelor Degree	184 (25.8)	48 (33.6)	136 (23.8)
<u>Country</u>			
Australia/New Zealand	77 (10.7)	12 (8.4)	65 (11.4)
United Kingdom	461 (64.6)	65 (45.5)	396 (69.4)
United States of America	160 (22.4)	59 (41.3)	101 (17.7)
Canada	8 (1.1)	6 (4.2)	2 (0.4)
Europe (exc. UK)	5 (0.7)	0 (0.0)	5 (0.9)
Japan	3 (0.4)	1 (0.7)	2 (0.4)

Measures

Office configurations

Respondents were asked to select the office configuration that best represented their “current” or “main” workspace. Response options were: 1) enclosed office; 2) open-plan; 3) cubicle; 4) hot-desk; and 5) activity-based workplace/combi-office/flexible/creative/innovative space. Enclosed office responses were subsequently classified as either single-occupant enclosed office or shared enclosed office based on whether the respondent selected that their office was “not shared with anyone”.

Most recent office experience

Respondents were asked to select the office configuration that best represented their “last office configuration”. Response options were: 1) no previous office; 2) private enclosed office; 3) shared enclosed office; 4) cubicle with high partitions; 5) cubicle with low partitions; 6) open-plan; 7) activity-based workspace; 8) hot-desk; and 9) other (please specify). Response options were subsequently classified into: no previous office experience (0); single-occupant enclosed office (1); and open-plan (2) which encompassed all remaining office configurations.

Identifying types of office work

The “type of work” measure, inspired by Parkin et al.’s (2011) breakdown of work in different work activities, was specifically developed to gain a deeper understanding of the types of office work respondents complete in their office, rather than just asking their occupation. Respondents were presented with a list of 15 non-routine tasks which they may complete in their office, such as: “quiet, conceptual work involving design” and “planning work and projects”. Respondents were asked “to what extent are these important features of the work you need to do as part of your profession?” Responses were collected on a five-point Likert type scale scored: 1 (not at all), 2 (not very important), 3 (moderately important), 4 (important), 5 (very important feature).

Health Outcomes

(a) Kessler-10

The Kessler Psychological Distress Scale (K10) was used to yield a global measure of psychological distress. It assesses 10 anxiety and depressive symptoms experienced in the last four weeks (Kessler et al., 2002). Scores ranged from 10 (low distress) to 50 (high distress).

(b) Total health problems

Respondents were asked how often “during the past 4 weeks” they had experienced a range of health conditions: 1 (never), 2 (seldom), 3 (sometimes), 4 (often), 5 (always). A list of 12 was used and examples included: headaches, stomach problems, colds/flu. Total scores could range from 12 to 60.

(c) Total sick leave

Total sick leave was assessed by an item developed by Bodin Danielsson et al. (2014). Respondents were asked “approximately how many days have you in total been on sick leave during the past 12 months? Leave for care of a sick child was excluded. Scores ranged from 1 (Not at all) to 5 (91 days or more).

(d) Total job stress

Job stress was measured using Parker and De Cottiis (1983) job stress scale. The original scale did not specify anchors and only had four points. Subsequent studies modified the scale to five points and specified anchors (e.g., Jamal, 2011). The scale included 13 items such as, “my job gets to me more than it should” and “I feel guilty when I take time off from my job”. Responses were collected on a five-point response framework: 1 (strongly disagree) to 5 (strongly agree). The items were averaged and scores ranged from 1 to 5. A high score is indicative of a high level of job stress.

Social Outcomes

(a) Social support

Social support was measured with the Copenhagen Psychosocial Questionnaire (COPSOQ) four-item social support subscale consisting of questions such as “Have you had help and support from your colleagues” and “Has your immediate superior been willing to listen to your work related problems” (Kristensen et al., 2005). Respondents indicated the frequency of perceived social support on a five-point scale scored: 0 (Never/Hardly ever), 25 (seldom), 50 (sometimes), 75 (often), 100 (always). The subscale was averaged with all four items weighted equally. Scores ranged from 0 to 100 with higher scores indicating a high level of perceived social support at work.

(b) Social relations

The three-item COPSOQ social relations subscale consisted of questions such as “Have you worked isolated from your colleagues” and “Have you been part of a group in

your work” (Kristensen et al., 2005). Respondents indicated their frequency of perceived social support on a five-point scale scored: 0 (Never/Hardly ever), 25 (seldom), 50 (sometimes), 75 (often), 100 (always). The first item, “Have you worked isolated from your colleagues” was reverse scored. The subscale was averaged with all three items weighted equally. Scores ranged from 0 to 100. A high score is indicative of a perceived high level of social relations at work.

(c) Sense of community

Sense of community was measured with the COPSOQ three-item subscale consisting of questions such as “Had a good atmosphere between you and your colleagues” (Kristensen et al., 2005). Respondents indicated the frequency of perceived sense of community in the workplace on a five-point scale scored: 0 (Never/Hardly ever), 25 (seldom), 50 (sometimes), 75 (often), 100 (always). The subscale was averaged with all three items weighted equally. Scores ranged from 0 to 100. A high score is indicative of a perceived high sense of community at work.

(d) Team member relations

A modified version Brennan et al. (2002) five-item measure of team member relations was used to measure team member relations in the workplace. The fourth item from Brennan et al. (2002): “I like having the team leaders located with the rest of the team” was removed from the measure because not all respondents will have team leaders located with their team. An additional item was created and added to the remaining four items: “I feel comfortable sharing ideas with team members”. Respondents indicated their level of agreement on a five-point Likert type scale scored: 1 (strongly disagree) to 5 (strongly agree). The score of all five-items was averaged. Scores ranged from 1 to 5. A high score is indicative of a high perception of team member relations.

(e) Collaborative culture

McElroy and Morrow’s (2010) five-item measure of collaboration was used to capture the perceived collaborative culture in their organisation. Example questions are “I confer with my co-workers to discuss work-related issues” and “co-workers in my office location seldom visit with one another about work-related issues” (reverse scored). Respondents gave ratings on a five-point Likert scale from 1 (strongly disagree) to 5 (strongly agree) their level of perceived collaborative culture. A NA (0) option was added for respondents whose work does not involve any collaboration. The score of all five-items were

averaged. Scores ranged from 0 to 5. A high score is indicative of employees perceiving their organisation to have a high level of collaborative culture.

(f) Collaboration frequency

A seven-item measure was created specifically for this study to assess collaboration frequency in the workplace. Example items were: “bounced ideas of co-workers” and “solved a problem working with a co-worker”. Respondents were asked to indicate their level of frequency for each item on a five-point Likert type scale scored: 1 (never), 2 (less than weekly), 3 (1-3 times per week), 4 (4-5 times per week), 5 (multiple times each day). The scores from all seven items were averaged. Scores ranged from 1 to 5. A high score is indicative of a high frequency of collaboration in the workplace.

(g) Collaboration important

An item was designed for this study to ascertain the importance of collaboration for respondents to complete their work. Respondents were asked to “indicate the extent to which collaboration with others in your workplace is important to complete your work”. Responses were collected on a five-point Likert type scale scored: 1 (not at all important) to 5 (very important). Scores ranged from 1 to 5. A high score is indicative that collaboration in the workplace is important to complete work.

(h) Difficult to hold a conversation in office area

Parkin et al. (2011) created a measure to broadly cover various aspects of working in an office. One item was used in this study: “It is difficult to hold a conversation in my office area”. Respondents indicated their level of agreement on a five-point Likert type scale scored: 1 (strongly disagree) to 5 (strongly agree). Scores ranged from 1 to 5.

(i) Co-worker satisfaction

Co-worker satisfaction was measured with Spector’s (1997) four item co-worker satisfaction sub-scale from his Job Satisfaction Scale. Items “I find I have to work harder at my job than I should because of the incompetence of people I work with” and “there is too much bickering and fighting at work” were reversed scored. Respondents indicated their level of agreement on a five-point Likert type scale scored: 1 (strongly disagree) to 5 (strongly agree). The response framework was modified from the original six-point Likert type scale to be consistent with the other measures used in this study. The average of all four items was

calculated. Scores ranged from 1 to 5. A high score is indicative of a high level of co-worker satisfaction.

(j) Staff morale

A single item to assess staff morale was created for the survey. Respondents were asked “how do you describe the morale of the staff in your workplace?”. Responses were collected on a five-point Likert type scale scored: 1 (very poor), 2 (poor), 3 (neutral), 4 (good), 5 (very good). Scores ranged from 1 to 5. A high score is indicative of a perceived high level of staff morale in the workplace.

Data Analysis

First, the descriptive statistics of each outcome measure was calculated to ascertain the overall means of health and social outcomes for all office configurations combined. Then, in-order to replicate the existing research on the various positive and negative effects of open-plan office configurations, current office type was organised into two categories: single-occupant enclosed office and open-plan. All offices that were shared by at-least two people were reclassified as open-plan, i.e., shared-enclosed office; open-plan; cubicle; hot-desk; and activity-based workplace/combi-office/flexible/creative/innovative space. Independent sample t-tests were used to compare any significant differences in means for each of the health and social interaction outcomes between single-occupant and open-plan office configurations. Although these comparisons were also captured as main effects in the factorial ANOVAs which followed, it was felt important to provide these simple effects to assist in future meta-analyses and to demonstrate that this study could replicate the principal main effects from other studies before introducing moderating factors.

Secondly, the effect of the type of work conducted in the office environment was investigated. From the list of 15 types of work, the following four activities were identified as indicating greater cognitive absorption or concentration: “Quiet, concentrated work involving reading and writing”; “Quiet, concentrated work involving design”; “Complex computational work (e.g., statistical analysis/mathematics, computer programming)”; and “Engineering / technical design work”. Each of these four items were dichotomised into either not important or important and dummy coded (coded 0 or 1). Original ratings of “not at all”, “not very important” and “moderately important” were coded 0 and classified as not important; “important” and “very important feature” were coded 1 and classified as important. The sum of these four dichotomised items was calculated with scores ranging from 0 to 4. Respondents were then classified into two work-type groups. A natural (close to 50% split)

was achieved by separating those who scored 2-4 of these elements as important (at least 50%) from those who scored on 0 or 1 of them. A 2 Office type x 2 Work type factorial ANOVA was conducted with office type (single-occupant / open-plan) and cognitively demanding work important (0-1 / 2-4 items classified as important) as independent variables, and all listed outcome measures as the dependent variables. Most recent office experience (none, open-plan, single-occupant enclosed office) was then entered as a covariate to test for interactions with the other two factors.

5.1.5 Results

Replication of health and social outcomes

The mean health outcomes and social interactions scores for all office types combined has been presented in Table 5.2. The results indicate that on average, the overall sample: is unlikely to be psychologically distressed; seldom experience health problems probably caused by their office conditions; sometimes experience social support at work; and have neutral to good morale.

Table 5.2. *M (SD) scores and ranges for health and social interaction outcomes for the entire sample*

Outcome measure	<i>M</i>	<i>SD</i>
<u>Health measures</u>		
K10	19.50	7.41
Total health problems	23.40	8.89
Total sick leave	1.86	0.83
Total job stress (ave)	2.64	0.90
<u>Social</u>		
Social support	58.29	22.46
Social relations	58.25	20.65
Community	69.02	21.49
Team member relations	3.72	0.74
Collaborative culture	3.74	0.72
Collaboration frequency	2.98	0.83
Collaboration is important to complete your work	3.85	0.98
Difficult to hold a conversation in office area	2.58	1.11
Co-worker satisfaction	3.74	0.77
Staff morale	3.56	0.97

Score range: K10 (10 – 50); Total health problems (12 – 60); Social support (0 – 100); Social relations (0 – 100); Community (0 – 100); All other measures (1 – 5).

Table 5.3 depicts the mean health outcomes and social interactions scores for single-occupant and open-plan offices. Compared to single-occupant offices, open-plan offices scored significantly worse on measures of psychological and physical health; i.e., K10 and total health problems. Further analyses of the individual health problems that were aggregated in the total health problems variable indicated that there were significant differences for respiratory problems, cold and flu, headache, and concentration difficulties were significantly worse in open-plan offices. Open-plan office workers scored significantly higher on the following social outcomes: social support, social relations, collaborative culture and collaboration frequency. By contrast, open-plan office workers scored significantly worse on measures of ease to hold a conversation in office area, and staff morale compared to single-occupant enclosed offices.

Table 5.3. *T-test comparison of the single-occupant enclosed offices vs open-plan offices on outcome variables*

Outcome measure	Single-Occupant	Open-Plan	t	Cohen's d
	Enclosed Office M (SD)	Office M (SD)		
<u>Health measures</u>				
K10	18.22 (6.84)	19.82 (7.52)	2.32*	0.22
Total Health Problems	21.99 (8.03)	23.76 (9.06)	2.14*	0.20
Total Sick Leave	1.79 (0.81)	1.88 (0.84)	1.22	0.12
Total Job Stress (ave)	2.54 (0.90)	2.66 (0.90)	1.47	0.14
<u>Social</u>				
Social support	53.96 (24.69)	59.37 (21.76)	2.39*	0.24
Social relations	45.98 (21.23)	61.33 (19.34)	8.32**	0.78
Community	66.55 (24.88)	69.64 (20.53)	1.37	0.14
Team member relations	3.67 (0.82)	3.73 (0.72)	0.79	0.08
Collaborative culture	3.57 (0.85)	3.78 (0.68)	2.70**	0.29
Collaboration frequency	2.79 (0.91)	3.03 (0.81)	3.14**	0.29
Collaboration is important to complete your work	3.59 (1.14)	3.92 (0.92)	3.18**	0.34
Difficult to hold a conversation in office area	2.05 (0.96)	2.71 (1.10)	7.18**	-0.62
Co-worker satisfaction	3.83 (0.79)	3.72 (0.77)	1.52	0.14
Staff morale	3.73 (0.84)	3.51 (0.99)	2.62**	0.23

Score range: K10 (10 – 50); Total health problems (12 – 60); Social support (0 – 100); Social relations (0 – 100); Community (0 – 100); All other measures (1 – 5).

*p<.05 **p<.01

Type of work

The results of a 2 Office type (single-occupant vs open plan) x 2 Work type (low vs high cognitive absorption required) factorial ANOVA for all health and social interaction outcomes are presented in Table 5.4. Significant interactions were found between current office type and cognitively demanding work important, and for both psychological health (K10) and total health problems. Further analyses of the individual health problems that were aggregated in the total health problems variable revealed significant interactions for headache and eyestrain. A significant interaction was only found for the social interaction outcome: difficult to hold a conversation in office area. These findings suggested that those who worked in more cognitively demanding work and in open-plan experience significantly worse health outcomes and find it more difficult to hold a conversation in their office area, than open-plan office workers who complete fewer tasks that require greater cognitive absorption or concentration.

Table 5.4. *Factorial ANOVA: health and social outcomes in relation to office and work type*

Outcome measure	Office type		Type of work (Imp Cog Tasks)		Office type x Type of Work	
	Main effect		Main effect		Interaction	
	F	n ₂	F	n ₂	F	n ₂
<u>Health measures</u>						
K10	3.53	.005	0.28	.000	6.06*	.008
Total Health Problems	3.95*	.006	1.20	.002	6.90**	.010
Total Sick Leave	1.13	.002	0.003	.000	1.00	.001
Total Job Stress (Ave)	2.41	.003	2.85	.004	2.15	.003
<u>Social</u>						
Social support	4.79*	.007	1.26	.002	0.77	.001
Social relations	67.19**	.087	0.01	.000	1.97	.003
Community	2.13	.003	0.03	.000	0.01	.000
Team member relations	0.18	.000	0.56	.001	0.09	.000
Collaborative culture	9.19**	.013	0.14	.000	1.39	.002
Collaboration frequency	9.94**	.014	0.28	.000	0.03	.000
Collaboration is important to complete your work	16.73**	.023	7.95**	.011	1.34	.002
Difficult to hold a conversation in office area	39.49**	.053	0.32	.000	4.78*	.007
Co-worker satisfaction	2.15	.003	0.04	.000	0.27	.000
Staff morale	3.80	.005	3.32	.005	0.11	.000
*p<.05 **p<.01						

Most recent previous office experience

The results of a 2 Office type (single-occupant vs open plan) x 2 Work type (low vs high cognitive absorption required) factorial ANOVA for all health and social interaction outcomes with most recent previous office experience as a covariate are presented in Table 5.5. When controlling for most recent previous office experience, significant interactions were found between current office type and cognitively demanding work important, and for psychological health (K10), total health problems, and difficulty to hold conversations in office area. Further analyses of the individual health problems that were aggregated in the total health problems variable revealed significant interactions for headache and eyestrain. These findings suggest that most recent previous office experience does not influence the interaction between office type, more cognitively demanding work, and health and social outcomes.

Table 5.5. *Factorial ANOVA: health and social outcomes in relation to office and work type with most recent previous office experience as a covariate*

Outcome measure	Office type		Type of work (Imp		Office type x Type	
	Main effect		Cog Tasks)		of Work	
			Main effect		Interaction	
	F	n ₂	F	n ₂	F	n ₂
<u>Health measures</u>						
K10	1.79	.002	0.34	.000	6.11*	.009
Total Health Problems	1.62	.002	1.01	.001	7.00**	.010
Total Sick Leave	0.55	.001	0.06	.000	1.14	.002
Total Job Stress (Ave)	0.85	.001	2.18	.003	2.35	.003
<u>Social</u>						
Social support	6.26*	.009	1.32	.002	0.81	.001
Social relations	60.17**	.078	0.01	.000	1.74	.002
Community	3.31	.005	0.02	.000	0.01	.000
Team member relations	1.20	.002	0.09	.000	0.07	.000
Collaborative culture	5.75*	.008	0.15	.000	1.39	.002
Collaboration frequency	6.42*	.009	0.25	.000	0.03	.000
Collaboration is important to complete your work	14.47**	.020	6.12*	.009	1.06	.002
Difficult to hold a conversation in office area	34.79**	.047	0.17	.000	5.00*	.007
Co-worker satisfaction	0.43	.001	0.02	.000	0.28	.000
Staff morale	0.81	.001	3.31	.005	0.10	.000
*p<.05 **p<.01						

5.1.6 Discussion

The aim of this study was to examine the perceived effects of working in more open or shared work environments as compared with closed offices, but taking into account the types of work involved. In particular, we wanted to investigate whether the relationship between office design and social and health outcomes was moderated by whether the respondents' line of work mainly involved more cognitive processes. The results showed that respondents who worked in open-plan offices reported having better quality of social interactions compared to single-occupant enclosed offices. However, those working in open plan environments scored lower on staff morale, reported greater difficulty to hold a conversation in their office area, and also scored significantly worse on a range of health outcomes. There was also some modest evidence to show that the type of work conducted in the office influences the office worker's experiences working in their office environment. In particular, it was found that respondents who completed more cognitively demanding work in an open-plan office experience significantly worse health outcomes than open-plan office workers who complete fewer tasks that require greater cognitive absorption. On the other hand, a significant interaction between the more cognitively demanding work tasks and office type was only found in relation to one social interaction outcome: difficulty to hold a conversation in office area. Finally, most recent previous office experience did not appear to significantly influence the relationship between office type, more cognitively demanding work, and health and social outcome measures.

The findings of the overall comparison between single-occupant enclosed offices and open-plan offices for a range of health and social outcomes are consistent with the existing literature. For example, previous studies have found colds and flu (Jaakkola & Heinonen, 1995), headache (Pejtersen et al., 2006; Shahzad et al., 2016), concentration difficulties (Kaarlela-Tuomaala et al., 2009; Pejtersen et al., 2006; Seddigh et al., 2014), and general / overall health (Bergström et al., 2015; Bodin Danielsson & Bodin, 2008; Shahzad et al., 2016) to be significantly worse in open-plan offices than single-occupant enclosed offices. However, fewer studies have directly compared single-occupant and open-plan office workers' overall mental health (i.e., Bodin Danielsson & Bodin, 2008; Pejtersen et al., 2006) and neither of these found any negative associations. To the author's best knowledge, this current study is the first to compare the relationship between single-occupant and open-plan offices, and mental health with a widely utilised and validated measure of psychological distress (K10). Given the large number of people who have relocated from single-occupant enclosed offices to open-plan work environments, and the high prevalence of mental illnesses

(ABS, 2008), the relationship between office configurations and mental health indicates that office design is a valid issue for consideration in relation to occupation health and safety.

On the other hand, we did not find any significant difference in stress levels between single-occupant and open-plan office configurations. Previous research has consistently found stress to be significantly worse in open-plan offices compared to single-occupant enclosed offices (e.g., Haapakangas et al., 2018; Helland et al., 2008; Kaarlela-Tuomaala et al., 2009; Seddigh et al., 2014). Furthermore, research has found cognitive stress to be significantly worse for people who work in shared work environments (except flex offices) and complete work that they perceive to have a high need for concentration (Seddigh et al., 2014). It is possible that this difference is due to the stress measure used in this paper, because the Job Stress Scale (Parker & De Cottiis, 1983) incorporates multiple facets of stress rather than simply asking if the respondent is stressed. Moreover, the findings around social interaction measures are consistent with those of Oommen et al. (2008) who concluded that open-plan workplaces enhanced communication and increased collaboration.

The results indicate that those who work in open-plan offices and complete more cognitively demanding work, experience significantly worse health outcomes for psychological distress (K10), headache, eyestrain, and total health problems, than open-plan office workers who complete fewer tasks that require greater cognitive absorption or concentration. These poorer health outcomes could be explained by the greater levels of noise and distraction, and decreased visual conditions in open-plan work environments. Noise, particularly co-workers irrelevant but audible and intelligible speech, is a common complaint in open-plan work environments (Kim & de Dear 2013), and has been shown to disturb and negatively affect performance on tasks requiring cognitive processing (Banbury & Berry, 2005; Haka et al., 2009; Smith-Jackson & Klein, 2009; Virjonen et al., 2007). Greater eyestrain difficulties could be related to the findings that compared to single-occupant offices, open-plan offices are negatively associated with poor lighting, glare and visual discomfort (e.g., Frontczak, et al., 2012; Pejtersen et al., 2006). This could be attributed to preliminary findings which suggest that more cognitively demanding tasks may be more negatively sensitive to lighting conditions (Huiberts et al., 2015). Moreover, the increased reports of headaches may result from the combination of the higher levels of noise and disturbance, and poor lighting conditions in open-plan work environments with the requirement to concentrate for long periods of time on tasks that require large amounts of cognitive effort and absorption.

Interestingly, no interaction was found between more cognitively demanding work, open-plan offices and concentration difficulties. It is possible that all open-plan office workers experience concentration difficulties regardless of the type of work they complete. This is supported by the general comparative results which found concentration difficulties to be significantly greater in open-plan offices compared to private enclosed offices, and the existing literature (e.g., Kaarlela-Tuomaala et al., 2009; Pejtersen et al., 2006; Seddigh et al., 2014).

A significant interaction was found for more cognitively demanding work tasks, office type and difficulty to hold a conversation in office space. Previous research has found that workspaces with more than one worker lack acoustic privacy for conversations (Bodin Danielsson & Bodin, 2009), and that both the presence and intelligibility of surrounding speech affect tasks involving conversation (Kaarlela-Tuomaala et al., 2009). Moreover, research suggests that noise is more likely to disturb tasks that require complex verbal processes than ones which are routine or relatively simple (Haapakangas et al., 2008), and that cognitive performance can be impaired by irrelevant sounds (Banbury et al., 2001). Thereby open-plan office workers who complete more cognitively demanding work may experience greater difficulties to hold a conversation in their shared work environment than people who complete less cognitively demanding work, because their conversations will likely require the discussion of complex problems in finer detail.

Finally, no significant interactions were found for more cognitively demanding work tasks, office type and the other measures of social interaction. It is possible that a potential relationship did not appear due to the combination of all shared and open office spaces. Social interactions in open-plan workplace designs may be influenced by the number of office occupants and office design features. For example, Bodin Danielsson and Bodin (2008) found that cooperation was worse in medium open plan offices (10 – 24 occupants), compared to six other office configurations. Furthermore, Haapakangas et al. (2018) longitudinal study found that perceived collaboration between workers only decreased for workers who moved from a private office to an open-plan office with few quiet workspaces, and not for those who moved into an open-plan office with accessible and varied quiet workspaces. Thus, it is plausible that social outcomes are influenced by specific design features and that any potential significant effects were offset through the combination of the different open-plan design configurations in the sample.

Contrary to our predictions, we found little evidence that a person's most recent previous office experience moderated the relationship between cognitively demanding work, office type and health and social outcomes. A possible reason for this is that many may have had time to adjust to their new office environment. In addition, there were relatively few cases where a person had moved from a closed office to an open work environment in recent times, so it may have been difficult to detect a significant interaction when the majority of cases were generally working in a type of office that was similar to their previous one.

Limitations / Strengths

An important limitation of this study is that it does not differentiate between types of open-plan and shared designs. Although there would appear to be validity in differentiating between single occupancy offices and other arrangements, it is plausible that major differences also exist between offices with two occupants to offices with 50 occupants, as well as differences with partition heights, m² per office worker, and having one's own desk versus a hot-desking style arrangement. Given the lack of research into moderating variables that influence people's experiences working in open-plan offices, the authors wanted to investigate the effect globally for all offices that contain at least two occupants. Nonetheless, subsequent research should endeavour to investigate the differences between the various configurations and dimensions of open-plan office designs with the influence of type of work. It must also be acknowledged that due to the use of a cross-sectional design, causation cannot be inferred from the results (Sedgwick, 2014).

A key strength of the present research is the type of work measure which captured the individual tasks that people complete in their work rather than just comparing respondents' occupations. This break down of work into 15 smaller tasks enabled the influence of specific work tasks to be analysed, and accounted for the fact that the same occupations can comprise of very different work requirements. Furthermore, this analysis of specific work tasks increases the generalisability of the study's findings as the results are not limited to specific occupations but rather can be utilised for all jobs that involve the analysed work tasks. The study also includes a range of measures for particular constructs to reduce concern that findings in an area (e.g., social or health) might be a function of a particular choice of measure.

Future Directions

This study provides support for the proposition that the type of work influences the association between work environment and the health outcomes of employees, but that a

similar effect is not observed for social relationships. In other words, if one's principal line of work involves cognitively demanding tasks (e.g., detailed analysis, reading and writing), an open plan office design has negative effects on people's physical and psychological health. At the same time, this type of worker does not necessarily report poorer social relationships in the workplace when placed in more open work environments. In future research, it would be useful to examine whether the interactions observed here between office design and work type also extends to work outcomes such as levels of productivity and satisfaction. In addition, replication studies should be conducted with a focus on the physical characteristics of different office designs to investigate the influence of various office types and configurations on the relationship between the type of work completed in the office work environment and employee's health, work and social outcomes. A better understanding of the moderating relationships between different types of work, office environments and office worker's experiences, will enable business managers and designers to better design workplaces that are tailored for the work being completed in them. This, in-turn, could help improve the experiences of office workers in their various office work environments and could assist the success of new office developments. At present, there is a danger that office designs are being more strongly influenced by assumptions about costs and social relationships, without reference to the different levels of cognitive demands or attention required of different types of work.

5.2 Publication: Work outcomes in open-plan and shared work designs: The moderating role of work type and previous office experience

5.2.1 Statement of authorship

Statement of Authorship

Title of Paper	Work outcomes in open-plan and shared work designs: The moderating role of work type and previous office experience
Publication Status	☐ Published ☐ Accepted for Publication ☒ Submitted for Publication ☐ Unpublished and Unsubmitted work written in manuscript style
Publication Details	James, O., Delfabbro, P., & King, D.L. (under review). Work outcomes in open-plan and shared work designs: The moderating role of work type and previous office experience

Principal Author

Name of Principal Author (Candidate)	Olivia Isabel Shirley James
Contribution to the Paper	Conceptualised and designed the study, collected the data, completed the data analysis, interpreted the results and drafted the manuscript.
Overall percentage (%)	80
Certification:	This paper reports on original research I conducted during the period of my Higher Degree by Research candidature and is not subject to any obligations or contractual agreements with a third party that would constrain its inclusion in this thesis. I am the primary author of this paper.
Signature	Date 19/01/21

Co-Author Contributions

By signing the Statement of Authorship, each author certifies that:

- i. the candidate's stated contribution to the publication is accurate (as detailed above);
- ii. permission is granted for the candidate to include the publication in the thesis; and
- iii. the sum of all co-author contributions is equal to 100% less the candidate's stated contribution.

Name of Co-Author	Paul Delfabbro
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5.2.2 Abstract

Objective: Office environments continue to change, with the past few decades characterised by knowledge workers moving from more traditional cellular office designs into open and shared work environments. Previous research suggests that people working in open-plan designs report poorer productivity and workplace satisfaction than those working in closed offices. However, less is known about whether this effect is moderated by the type of work and previous office experience. **Method:** In this study, 714 respondents predominantly from Australia, New Zealand, United States of America and United Kingdom completed an online survey to examine whether work outcomes varied depending upon whether people engaged in more cognitively absorbing work and had previous shared-office experiences. The data was analysed with Independent sample t-tests, factorial ANOVAs, 2 office type x 2 work type factorial ANOVA, and ANCOVA. **Results:** The findings suggested that office workers who work in open-plan office configurations, and complete more cognitively absorbing work, reported significantly poorer productivity and satisfaction outcomes than those who complete less cognitively demanding work in shared work designs. This relationship did not appear to be significantly influenced by most recent previous office experience. **Conclusion:** The findings highlight the importance of examining specific work-activities in office design and raise particular concerns around the negative effects of shared office environments for information-focused professions.

Keywords: Knowledge work; office design; open-plan; productivity; satisfaction; work outcomes

Key Points:

Already known:

- Open-plan offices are becoming increasingly common for knowledge based/information-focused professions.
- Open-plan offices have been associated with a range of negative work outcomes including lower productivity and decreased satisfaction.
- A common complaint of open-plan offices are their noisier acoustic environments.

This paper adds:

- Assesses type of work by the specific tasks being completed rather than by occupation/job title.
- Raises concerns for how suitable shared and open-plan work environments are for information-focused professions.
- Suggests that most recent previous office configuration does not appear to influence workers' work outcomes in shared work environments.

5.2.3 Introduction

The current era has seen a transformation of office designs from single-occupant enclosed offices to open-plan configurations characterised by large office spaces filled with multiple desks in various arrangements and a lack of physical barriers (Brennan et al., 2002). While single-occupant offices are widely defined as an office with four walls and a door occupied by one worker, no single definition exists for open-plan office designs. Nonetheless, open-plan offices can be clearly distinguished from single-occupant cellular offices due to their shared spaces, facilities and amenities (Bodin Danielsson & Bodin, 2008). The use of shared spaces and amenities has enabled open-plan office configurations to be more space efficient with an average of only 7-9m² required per employee for activity based ‘non-territorial’ open-plan workspaces compared to 17-20m² for cellular offices (Hassell, 2014). While such designs offer lower maintenance costs and decreased rents due to space saving strategies, it is possible that these financial benefits could be undermined by the negative effects associated with open-plan work environments.

The effects of different work environments on office workers have been widely investigated. Research suggests that there is an association between worker’s work environment and their work outcomes, with a number of studies having examined the effects of open-plan designs on productivity and employee satisfaction. Most studies show that, as compared to enclosed single-occupant offices, workers in open-plan work environments report decreased job satisfaction (e.g., de Croon et al., 2005; Oommen et al., 2008); decreased satisfaction with their work environment (e.g., Bergström et al., 2015; Kim & de Dear, 2013); and lower work productivity (e.g., Oommen et al., 2008). More specific analyses indicate that these overall effects are related to reduced feelings of privacy (e.g., de Croon et al., 2005; Oommen et al., 2008); increased noise (e.g., Bodin Danielsson & Bodin, 2009; Lee, 2010); increased disturbance (e.g., Kaarlela-Tuomaala et al., 2009; Seddigh et al., 2014); decreased concentration (e.g., Pejtersen et al., 2006; Seddigh et al., 2014); intensified cognitive workload (de Croon et al., 2005); and decreased task performance (e.g., Lee, 2010).

Coinciding with the change in office design have been changes to the nature of work and how it is completed. In recent years, there has been a shift from simple labour to work that is more cognitively complex, team based and collaborative (Greene & Myerson, 2011; Harris, 2015; Smith, 2005). As a result, there is often an increasing need for people with different areas of expertise to collaborate together on a single task where each contributes their specialised knowledge and skills (Kaarlela-Tuomaala et al., 2009). Occupations such as architecture, design, marketing, and information technology are often singled out as

examples. This changing nature of work has influenced office design, with some arguing that the removal of physical barriers would encourage and facilitate the free flow of ideas between workers with various skill sets and specialised knowledge (Oldham & Brass, 1979). This belief has led to an uptake in open-plan office designs which has seen the removal of physical walls and doors in the hope that this will facilitate the collaboration and knowledge transfer between employees (Goldstein, 2006; Waber et al., 2014). As a result, it is now estimated that over 70% of office workers in the United States of America work in an open-plan office (Congdon, 2013).

A question arises however, as to whether such logic can be extended to other occupations, particularly those that are less technical and require a predominance of independent ‘knowledge-based’ work that involves conditions conducive to independent thought and writing (Kaarlela-Tuomaala et al., 2009). Examples include the work of lawyers, academics and policy-writers. It may be that open-plan offices are unsuitable for professional workers whose work is principally individual in nature and where interactions with colleagues are necessary, but not a principal agent for producing the work outputs (e.g., Kaarlela-Tuomaala et al., 2009).

To investigate these issues, studies have examined the interaction between job features and different office environments (e.g., Block & Stokes, 1989; Fried et al., 2001; Seddigh et al., 2014; Sundstrom et al., 1980; Zalesny & Farace, 1987). The results suggest that people who complete more complex jobs in dense workplaces experience more negative effects (e.g., Block & Stocks, 1989; Zalesny & Farace, 1987). Furthermore, Fried et al. (2001) found that job complexity and organisational tenure length influences the relationship between office type and work outcomes: organisational commitment, job satisfaction, and co-worker satisfaction. In particular, respondents with high job complexity only experienced positive attitudes in high density environments when their tenure was short – possibly because their colleagues could provide them support when completing unfamiliar tasks (Fried et al., 2001). Seddigh et al. (2014) examined whether the need for concentration on the job influenced the relationship between six office types and the following work outcomes: personal efficiency, and distraction. A significant interaction was found for distraction but not performance, suggesting that respondents who perceive their work to have a high need for concentration, experience significantly more distractions in all shared office types compared to single-occupant cell offices (Seddigh et al., 2014).

A major complaint of open-plan work environments is the increased noise level (e.g., Kim & de Dear, 2013). This is unsurprising given the reduction or complete removal of physical barriers between workers and the decrease in average office space per worker – which has resulted in workers working in closer proximity to each other. Common open-plan noise complaints include constant background chatter – both work and non-work related; and other audible sounds such as people typing, telephones ringing, photocopiers and general movement around the office (Kaarlela-Tuomaala et al., 2009). In support of this view, a longitudinal study of workers in a company's engineering services and maintenance selling business units which moved from single-occupant private offices to an open-plan workplace revealed significant negative effects associated with the open-plan workplace's noisier acoustic environment (Kaarlela-Tuomaala et al., 2009). These included increased distraction, reduced privacy, increased concentration difficulties, and increased use of coping strategies (Kaarlela-Tuomaala et al., 2009). Moreover, respondents perceived their loss of work performance to have doubled as a result of their noisier environmental conditions (Kaarlela-Tuomaala et al., 2009). It is plausible that the negative effects of working in a noisy open-plan work environment could be even more detrimental for workers whose work is more cognitively demanding, as noise has been shown to disturb and negatively affect performance on tasks requiring cognitive processing (Banbury & Berry, 2005; Haka et al., 2009; Smith-Jackson & Klein, 2009; Virjonen et al., 2007).

The current study

The majority of the previously conducted research on office designs has focused on the positive and negative effects of different office configurations. By contrast, very little research has looked into the reasons behind the variation in office worker's experiences working in different offices. Accordingly, the aim of this study is to investigate why some people appear to cope well in open-plan work environments while others find it more difficult. The specific hypotheses addressed in this paper were as follows: (a) It is hypothesised that the results will support previous findings concerning the relationship between office design and work outcomes using a comprehensive range of measures informed by a review of the existing literature; (b) It is hypothesised that those who are engaged in work requiring greater cognitive absorption or concentration are more negatively affected by open-plan designs; and (c) It is hypothesised that those who have previous open-office experiences will report better outcomes in open-plan designs.

5.2.4 Method

Sample Characteristics

The study involved 714 respondents drawn largely from an international online panel as well as from the broader South Australian community. A summary of the demographic characteristics of the sample is provided in Table 5.6. As indicated, the majority of the sample was aged between 25 and 44 years of age and there was a slightly greater proportion of women in the survey. The majority of the sample (N = 619; 86.7%) had completed some form of post-school qualification, with 302 (42.3%) having a bachelor degree as their highest level of completed education. 7.0% (N = 50) of the sample reported speaking a language other than English at home. Respondents reported working between 15 and 80 hours of paid work each week, with an average of 38.25 hours. The most commonly reported number of paid work hours worked per week was 40 hours. Six respondents did not report how many paid hours they worked each week.

The majority of respondents (N = 514; 72.0%) spend at least 70% of their work-time in their main office configuration/workstation, with almost half the respondents (N = 330; 46.2%) reported spending at least 85% of their work-time in their main office configuration/workstation. On the other hand, only 61 (8.5%) respondents reported spending less than 50% of their work-time in their main office configuration/workstation.

Respondents selected the following office configurations as most representative of their current main workspace: single-occupant private enclosed office (N = 143; 20.0%); shared enclosed office (N = 145; 20.3%); open-plan (N = 286; 40.1%); cubicle (N = 52; 7.3%); hot-desk (N = 48; 6.7%); activity-based workplace/combi-office/flexible/creative/innovative space (N = 40; 5.6%). Respondents were subsequently classified into single-occupant private enclosed office (N = 143; 20.0%) and open-plan (N = 571; 80.0%) – any shared workspace with at least two occupants.

Respondents' most recent previous office experience was reported, with 77 (10.8%) indicating they had no previous office experience; 528 (73.9%) reporting their previous office was open-plan; and 108 (15.1%) reporting their most recent previous office was a single-occupant enclosed office. Moreover, most respondents (N = 536; 75.5%) reported having worked at least one year or more in their current office configuration, regardless of their occupation or organisation.

Study Procedure

An online cross-sectional survey was utilised because it enabled the researchers to: 1) collect data from anyone who worked in an office; 2) collect data on office workers who complete different types of knowledge work; 3) the researchers did not have to find an organisation to participate in and approve the study; and 4) the researchers were not limited to collecting data in one or a few organisations. Therefore, a larger more varied sample could be recruited. The survey was designed to obtain extensive detail concerning the type of work conducted in the workplace. Most research has simply measured type of work by occupation and/or job title. In this study, a more refined methodology was implemented that tried to capture the specific type of work completed so as to identify the types of work which appears more or less amenable to different types of office design. The survey was designed to collect information on respondents' type of work in two ways: (1) occupation and job title; and (2) identification of specific tasks completed at work. It was anticipated that some types of work and individual work tasks are better suited to open-plan work environments than others.

Respondents were invited to complete a 45-minute online survey on their experiences working in their office environment. Participation was requested from respondents aged 18 years and over who undertook at least 15 hours of paid work a week in an office. Moreover, respondents were required to have a sufficient level of English to comprehend the study. The study aimed to survey people working in information intensive work. Common examples of professions include: researchers, public servants, architects, and computer programmers. People were excluded from participating if they engaged in work which is more physical and technical; involved mainly private communication by its very nature; and/or was clerical in nature.

Respondents were recruited through word of mouth, flyers, and a paid panel recruitment service (Prolific). Respondents recruited through Prolific received a small honorarium of four pounds for completing the survey. The study was also advertised on social media. Those who completed the survey too quickly, did not meet the eligibility criteria, showed evidence of very incomplete, and/or patterned responding were excluded. The survey included questions that allowed for validity and attention checks (latent trap questions) that indicated that the person was not responding carefully.

Table 5.6. *Sample demographics*

	Single-Occupant		
	Total	Enclosed Office	Open-Plan Office
	(N = 714)	(N = 143)	(N = 571)
	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)
<u>Sex</u>			
Male	340 (47.6)	79 (55.2)	261 (45.7)
Female	372 (52.1)	64 (44.8)	308 (53.9)
<u>Age</u>			
18-24	56 (7.8)	10 (7.0)	46 (8.1)
25-34	316 (44.3)	58 (40.6)	258 (45.2)
35-44	205 (28.7)	46 (32.2)	159 (27.8)
45-54	100 (14.0)	18 (12.6)	82 (14.4)
55-64	30 (4.2)	9 (6.3)	21 (3.7)
65+	4 (0.6)	2 (1.4)	2 (0.4)
<u>Languages other than English at home</u>			
Yes	50 (7.0)	22 (15.4)	28 (4.9)
No – Only English	663 (92.9)	121 (84.6)	542 (94.9)
<u>Highest Education Level</u>			
Less than Year 12	14 (2.0)	0 (0.0)	14 (2.5)
Year 12	76 (10.6)	10 (7.0)	66 (11.6)
Other post-school qualification (e.g. VET/TAFE certificate, apprenticeship, diploma)	133 (18.6)	19 (13.3)	114 (20.0)

		Single-Occupant	
	Total	Enclosed Office	Open-Plan Office
	(N = 714)	(N = 143)	(N = 571)
	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)
Bachelor Degree	302 (42.3)	65 (45.5)	237 (41.5)
Higher than Bachelor Degree	184 (25.8)	48 (33.6)	136 (23.8)
<u>Country</u>			
Australia/New Zealand	77 (10.7)	12 (8.4)	65 (11.4)
United Kingdom	461 (64.6)	65 (45.5)	396 (69.4)
United States of America	160 (22.4)	59 (41.3)	101 (17.7)
Canada	8 (1.1)	6 (4.2)	2 (0.4)
Europe (exc. UK)	5 (0.7)	0 (0.0)	5 (0.9)
Japan	3 (0.4)	1 (0.7)	2 (0.4)

Measures

Office configurations

Respondents were asked to select the office configuration that best represented their “current” or “main” workspace. Response options were: 1) enclosed office; 2) open-plan; 3) cubicle; 4) hot-desk; and 5) activity-based workplace/combi-office/flexible/creative/innovative space. Enclosed office responses were subsequently classified as either single-occupant enclosed office or shared enclosed office based on whether the respondent selected that their office was “not shared with anyone”.

Most recent office experience

Respondents were asked to select the office configuration that best represented their “last office configuration”. Response options were: 1) no previous office; 2) private enclosed office; 3) shared enclosed office; 4) cubicle with high partitions; 5) cubicle with low partitions; 6) open-plan; 7) activity-based workspace; 8) hot-desk; and 9) other (please specify). Response options were subsequently classified into: no previous office experience (0); single-occupant enclosed office (1); and open-plan (2) which encompassed all remaining office configurations.

Identifying types of office work

The “type of work” measure, inspired by Parkin et al.’s (2011) breakdown of work in different work activities, was specifically developed to gain a deeper understanding of the types of office work respondents complete in their office, rather than just asking their occupation. Respondents were presented with a list of 15 non-routine tasks which they may complete in their office, such as: “quiet, concentrated work involving design” and “planning work and projects”. Respondents were asked “to what extent are these important features of the work you need to do as part of your profession?” Responses were collected on a five-point Likert type scale scored: 1 (not at all), 2 (not very important), 3 (moderately important), 4 (important), 5 (very important feature).

Outcome measures

A range of measures were used to measure the multiple aspects of perceived productivity and satisfaction outcomes.

Perceived productivity

Perceived productivity was measured by a single item from Parkin et al. (2011): “The office building provides an environment in which I can be productive”, scored: 1 (strongly disagree) to 5 (strongly agree).

Satisfaction measures

(a) Overall satisfaction with work environment

Respondents indicated on a five-point scale from 1 (very dissatisfied) to 5 (very satisfied), “overall, how satisfied are you with your work environment?”

(b) Office recommendation

Respondents were asked “would you recommend working in your physical office/workspace to others in your profession?”: 1 (strongly not recommend) to 5 (strongly recommend).

(c) General job satisfaction, general turnover and internal turnover

Three sections of the second module (general items) of the Michigan Organisational Assessment Questionnaire (Survey Research Center, 1975) were used to measure general job satisfaction, general turnover, and internal turnover. General job satisfaction was measured with three items: “All in all, I am satisfied with my job”, in general, I like working here” and

“in general, I don’t like my job”. General turnover was measured by two items: “I will probably look for a new job in the next year” and “I often think about quitting”. One item measured internal turnover: “If I had the chance, I would take a different job within this organisation”. Respondents indicated their level of agreement/disagreement for each item on a seven-point Likert type scale scored: 1 (strongly disagree) to 7 (strongly agree). “In general, I don’t like my job”, was reverse scored. The totalled score ranges were as followed: general job satisfaction (3-21); general turnover (2-14); and internal turnover (1-7). A higher score is indicative of higher general job satisfaction, and/or higher likelihood of turnover (general and/or internal).

(d) Disturbance

Disturbance when working in the office was measured with a five-item measure developed by Parkin et al. (2011). Example items include: “Noise from work-related/social conversations between colleagues” and “visual distraction from movement of people around the office” and were rated: 1 (low) to 3 (high).

(e) Organisational (affective) commitment

The affective commitment scale of Allen and Meyer’s (1990) Three-Component Organisational Commitment Questionnaire was used to assess respondent’s commitment to their organisation. Two items were removed from the eight-item scale to improve the scales appropriateness and to reduce its length. Item “I enjoy discussing my organisation with people outside it” was removed because respondents could score high on this measure when they actually enjoy complaining about their organisation. Item “I think that I could easily become as attached to another organisation as I am to this one” was also removed. The rating scale was reduced from the original seven-point Likert type scale to five-points scored: 1 (strongly disagree) to 5 (strongly agree) to remain consistent with the other measures used in this study. All six-items were averaged. Scores ranged from 1 to 5. A high score is indicative of a high affective commitment towards the organisation.

(f) Office space adequacy

Office space adequacy was measured with McElroy and Morrow’s (2010) five-item office space adequacy measure. This measure incorporated four items developed by Brennan et al. (2002) to capture workers’ perceptions of their office space. McElroy and Morrow (2010) modified Brennan et al.’s (2002) item: “I have enough storage space at my workspace” into two separate items. They were: “I have enough storage space for work materials at my workspace”, and “I have enough storage space for personal items in my

workspace”. Respondents indicated their perceived office space adequacy on a five-point Likert-type scale scored from 1 (strongly disagree) to 5 (strongly agree). All items were averaged and scores ranged from 1 to 5.

(g) Department layout

McElroy and Morrow’s (2010) six-item measure of department layout was used to assess respondent’s satisfaction with their office configuration. This measure comprised of six items from three different scales: two from Brennan et al. (2002), one from Zalesny and Farance (1987) and three developed by McElroy and Morrow (2010). Example items are: “The general office layout facilitates teamwork” and “I like the way my department’s workspaces are configured”. Respondents indicated their level of agreement with the six statements on a five-point scale scored: 1 (strongly disagree) to 5 (strongly agree). All items were averaged and scores ranged from 1 to 5.

(h) Meeting space adequacy

McElroy and Morrow (2010) created three items to specifically measure employees’ perceived adequacy of meeting spaces at work. The items were: “Meeting space in my department is conveniently located”, “there are adequate meeting spaces for collaborative work with others”, and “there are places for me to go if I need privacy”. Items were scored on a five-point Likert type scale, ranging from 1 (strongly disagree) to 5 (strongly agree). All items were averaged and scores ranged from 1 to 5.

(i) Enjoy working in office building and office building is a stimulating place to work

Parkin et al. (2011) created a measure to broadly cover various aspects of working in an office. Two items were used in this study: “I enjoy working in my office building”, and “the office building is a stimulating place to work”. Respondents indicated their level of agreement to each statement on a five-point Likert type scale scored: 1 (strongly disagree) to 5 (strongly agree). Scores ranged from 1 to 5.

(j) Noise and privacy conditions support work

Satisfaction that noise and privacy conditions support work was measured with four items from Parkin et al.’s (2011) measure: “equipment noise”, “people noise”, “external noise”, and “privacy”. Respondents indicated their level of satisfaction on a five-point Likert type scale scored: 1 (very dissatisfied) to 5 (very satisfied). Scores ranged from 1 to 5.

(k) Noise and privacy

Satisfaction with privacy and noise in the immediate work environment was measured with a three-item measure developed by Parkin et al. (2011). The three items were: “Privacy from being overheard by others”; “privacy from being overlooked by others”; and “typical noise levels”. Respondents indicated their level of satisfaction to each item on a five-point Likert type scale scored: 1 (very dissatisfied) to 5 (very satisfied). Scores ranged from 1 to 5.

(l) Lighting, temperature, airflow/circulation, and overall ambience satisfaction

A measure was designed to ascertain respondents’ level of satisfaction in their workplace with the following four items: lighting, temperature, airflow/circulation, and overall ambience. Respondents indicated their level of satisfaction with each item on a five-point Likert type scale scored: 1 (very dissatisfied) to 5 (very satisfied). Scores for each item ranged from 1 to 5.

Data Analysis

First, the descriptive statistics of each outcome measure was calculated to ascertain the overall means of productivity, and satisfaction outcomes for all office configurations combined. Then, in-order to replicate the existing research on the various positive and negative effects of open-plan office configurations, current office type was organised into two categories: single-occupant enclosed office and open-plan. All offices that were shared by at least two people were reclassified as open-plan. These included shared-enclosed offices; cubicles; open-plan offices; hot-desks; and activity-based workplace/combi-office/flexible/creative/innovative space. Independent sample t-tests were used to compare any significant differences in means for each of the productivity and satisfaction outcomes between single-occupant and open-plan office configurations. Although these comparisons were also captured as main effects in the factorial ANOVAs which followed, it was felt important to provide these simple effects to assist in future meta-analyses and to demonstrate that this study could replicate the principal main effects from other studies before introducing moderating factors.

Second, the effect of the type of work conducted in the office environment was investigated. From the list of 15 types of work, the following four activities were identified as indicating greater cognitive absorption or concentration: “Quiet, concentrated work involving reading and writing”; “quiet, concentrated work involving design”; “complex computational work (e.g., statistical analysis/mathematics, computer programming)”; and “engineering / technical design work”. Each of these four items were dichotomised into either not important

or important and dummy coded (coded 0 or 1). Original ratings of “not at all”, “not very important” and “moderately important” were coded 0 and classified as not important; “important” and “very important feature” were coded 1 and classified as important. The sum of these four dichotomised items was calculated with scores ranging from 0 to 4. People were then classified into two work-type groups. A natural (close to 50% split) was achieved by separating those who scored 2-4 of these elements as important (at least 50%) from those who scored on 0 or 1 of them. A 2 Office type x 2 Work type factorial ANOVA was conducted with office type (single-occupant / open-plan) and cognitively demanding work important (0-1 / 2-4 items classified as important) as independent variables, and all listed outcome measures as the dependent variables. Prior open-plan office experience (no, yes) was then entered as a covariate to test for interactions with the other two factors.

5.2.5 Results

Replication of productivity and satisfaction outcomes

The mean productivity and satisfaction outcome scores for all office types combined are presented in Table 5.7. The results indicate that on average, the overall sample: slightly agrees that their office building provides them with an environment in which they can be productive; have moderate levels of job satisfaction; are somewhat satisfied with their overall work environment; are undecided whether they would recommend working in their physical workspace to others in their profession; and, have undecided turnover intentions.

Table 5.7. *M (SD) scores and ranges for all productivity and satisfaction outcomes for the entire sample*

Outcome measure	<i>M</i>	<i>SD</i>
<u>Productivity</u>		
Perceived productivity	3.60	0.95
<u>Satisfaction</u>		
Overall workplace satisfaction	3.47	1.07
Recommend office	3.29	1.18
General job satisfaction	15.08	4.45
General turnover	7.34	3.66
Internal turnover	3.60	1.88
Disturbance	1.62	0.54
Organisational (affective) commitment	3.22	0.91
Office space adequacy satisfaction	3.51	0.91
Department layout satisfaction	3.38	0.82
Meeting space satisfaction	3.42	0.98
Enjoy working in office building	3.50	1.00
Office building is a stimulating place to work	3.08	1.08
Satisfaction equipment noise supports your work	3.71	0.93
Satisfaction people noise supports your work	3.10	1.11
Satisfaction external noise supports your work	3.53	1.07
Satisfaction privacy supports your work	3.09	1.23
Satisfaction with privacy from being overheard	2.77	1.27

Outcome measure	<i>M</i>	<i>SD</i>
Satisfaction with privacy from being overseen	2.89	1.25
Satisfaction with typical noise levels	3.15	1.19
Lighting satisfaction	3.59	1.06
Temperature satisfaction	3.23	1.18
Airflow/circulation satisfaction	3.23	1.16
Overall ambience satisfaction	3.35	1.05

Score range: Overall Job satisfaction (3 – 21); Internal turnover (1 – 7); General turnover (2 – 14); Disturbance (1 – 3); All other measures (1 – 5).

Table 5.8 presents the mean perceived productivity and satisfaction scores for single-occupant and open-plan offices. Compared to single-occupant offices, open-plan offices scored significantly worse on perceived productivity and on numerous satisfaction measures, most notably those relating to noise, environmental conditions and the level of privacy. Those who worked in open-plan environments also had significantly less workplace commitment and had significantly higher rates of turnover – both internal and general, compared to those in single-occupant offices.

Table 5.8. *T*-test comparison of the single-occupant enclosed offices vs open-plan offices on outcome variables

Outcome measure	Single-Occupant Enclosed Office <i>M (SD)</i>	Open-Plan Office <i>M (SD)</i>	<i>t</i>	Cohen's <i>d</i>
<u>Productivity</u>				
Productivity	3.94 (0.78)	3.52 (0.97)	5.41**	0.44
<u>Satisfaction</u>				
Overall Workplace Satisfaction	3.89 (0.97)	3.36 (1.07)	5.69**	0.50
Recommend Office	3.78 (1.08)	3.16 (1.18)	5.98**	0.53
Overall Job Satisfaction	16.23 (4.25)	14.79 (4.45)	3.48**	0.33
General turnover	6.39 (3.51)	7.58 (3.66)	3.51**	0.33
Internal turnover	3.19 (1.90)	3.70 (1.87)	2.91**	0.27
Disturbance	1.35 (0.47)	1.69 (0.54)	7.51**	0.65
Organisational (affective) commitment	3.49 (0.94)	3.15 (0.89)	4.15**	0.39
Office Space Adequacy Satisfaction	4.02 (0.76)	3.38 (0.91)	8.62**	0.72
Department Layout Satisfaction	3.33 (0.86)	3.40 (0.81)	0.85	0.08
Meeting Space Satisfaction	3.59 (0.94)	3.37 (0.98)	2.38*	0.22
Enjoy working in office building	3.72 (0.93)	3.45 (1.01)	3.10**	0.28

Outcome measure	Single-Occupant Enclosed Office <i>M (SD)</i>	Open-Plan Office <i>M (SD)</i>	<i>t</i>	Cohen's <i>d</i>
	<i>M (SD)</i>	<i>M (SD)</i>		
Office building is a stimulating place to work	3.30 (1.11)	3.03 (1.07)	2.65**	0.25
Satisfaction equipment noise supports your work	3.93 (0.96)	3.65 (0.92)	3.18**	0.30
Satisfaction people noise supports your work	3.68 (1.07)	2.96 (1.07)	7.20**	0.67
Satisfaction external noise supports your work	3.68 (1.14)	3.50 (1.05)	1.83	0.17
Satisfaction privacy supports your work	4.11 (1.02)	2.83 (1.15)	13.15**	1.14
Satisfaction with privacy from being overheard	3.97 (1.03)	2.46 (1.15)	15.34**	1.34
Satisfaction with privacy from being overseen	3.97 (1.08)	2.62 (1.14)	13.23**	1.20
Satisfaction with typical noise levels	3.92 (1.06)	2.95 (1.14)	9.58**	0.86
Lighting satisfaction	3.82 (0.99)	3.54 (1.07)	3.00**	0.27
Temperature satisfaction	3.61 (1.12)	3.13 (1.18)	4.56**	0.41
Airflow/circulation satisfaction	3.56 (1.13)	3.15 (1.15)	3.76**	0.35
Overall ambience satisfaction	3.63 (1.02)	3.29 (1.04)	3.50**	0.33

Score range: Overall Job satisfaction (3 – 21); Internal turnover (1 – 7); General turnover (2 – 14); Disturbance (1 – 3); All other measures (1 – 5).

**p*<.05

***p*<.01

Type of work

The results of a 2 Office type (single-occupant vs open-plan) x 2 Work type (low vs high cognitive absorption required) factorial ANOVA for productivity and all satisfaction outcomes are presented in Table 5.9. Significant interactions were found between current office type and cognitively demanding work important, and for perceived productivity and for the following satisfaction outcomes: disturbance; satisfaction with the level of noise from other people; satisfaction with privacy from being overseen; satisfaction with typical noise levels; and lighting satisfaction. These findings suggested that those who worked in more cognitively more demanding work and in open-plan have significantly worse productivity and satisfaction outcomes than open-plan office workers who complete fewer tasks that require greater cognitive absorption or concentration.

Table 5.9. *Factorial ANOVA: productivity and satisfaction outcomes in relation to office and work type*

Outcome measure	Office type		Type of work (Imp cog tasks)		Office type x Type of work	
	Main effect		Main effect		Interaction	
	<i>F</i>	<i>n₂</i>	<i>F</i>	<i>n₂</i>	<i>F</i>	<i>n₂</i>
<u>Productivity</u>						
Productivity	15.60**	0.022	4.62*	0.006	6.21*	0.009
<u>Satisfaction</u>						
Overall Workplace Satisfaction	21.74**	0.030	3.65	0.005	3.21	0.005
Recommend Office	28.70**	0.039	0.55	0.001	0.002	0.000
Overall Job Satisfaction	8.35**	0.012	3.91*	0.005	1.66	0.002
General turnover	9.79**	0.014	0.85	0.001	0.97	0.001
Internal turnover	9.73**	0.014	1.99	0.003	0.14	0.000
Disturbance	43.02**	0.057	0.23	0.000	5.55*	0.008
Organisational (affective) commitment	11.32**	.016	7.02**	.010	2.79	.004
Office Space Satisfaction	50.04**	0.066	2.71	0.004	1.36	0.002
Department Layout Satisfaction	1.59	0.002	1.93	0.003	2.32	0.003
Meeting Space Satisfaction	5.01*	0.007	0.18	0.000	0.002	0.000

Outcome measure	Office type		Type of work (Imp cog tasks)		Office type x Type of work	
	Main effect		Main effect		Interaction	
	<i>F</i>	<i>n</i> ₂	<i>F</i>	<i>n</i> ₂	<i>F</i>	<i>n</i> ₂
Enjoy working in office building	5.81*	.008	2.68	0.004	2.07	0.003
Office building is a stimulating place to work	4.67*	0.007	4.76*	0.007	0.28	0.000
Satisfaction equipment noise supports your work	8.03**	0.011	0.25	0.000	1.81	0.003
Satisfaction people noise supports your work	40.55**	0.054	3.38	0.005	6.11**	0.009
Satisfaction external noise supports your work	1.53	0.002	3.83	0.005	3.09	0.004
Satisfaction privacy supports your work	131.50**	0.156	1.26	0.002	1.75	0.002
Satisfaction with privacy from being overheard	178.78**	0.202	5.36*	0.008	2.25	0.003
Satisfaction with privacy from being overseen	137.31**	0.162	8.29**	0.012	4.17*	0.006
Satisfaction with typical noise levels	70.10**	0.090	2.32	0.003	4.15*	0.006
Lighting satisfaction	4.15*	0.006	8.04**	0.011	4.76*	0.007

Outcome measure	Office type		Type of work (Imp cog tasks)		Office type x Type of work	
	Main effect		Main effect		Interaction	
	<i>F</i>	<i>n</i> ₂	<i>F</i>	<i>n</i> ₂	<i>F</i>	<i>n</i> ₂
Temperature satisfaction	14.62**	0.020	4.83*	0.007	0.34	0.000
Airflow/circulation satisfaction	10.09**	0.014	4.65*	0.007	0.50	0.001
Overall ambience satisfaction	8.93**	0.012	2.51	0.003	1.68	0.002

* $p < .05$

** $p < .01$

Most recent previous office experience

The results of a 2 Office type (single-occupant vs open-plan) x 2 Work type (low vs high cognitive absorption required) factorial ANOVA for all productivity and satisfaction outcomes with most recent previous office experience as a covariate are presented in Table 5.10. The same interactions were significant when most recent previous office experience was added as a covariate. Therefore, when controlling for most recent previous office experience, significant interactions were found between current office type and cognitively demanding work important, and for perceived productivity, and for the following satisfaction outcomes: disturbance; satisfaction with the level of noise from other people; satisfaction with privacy from being overseen; satisfaction with typical noise levels; and lighting satisfaction. These findings suggest that most recent previous office experience does not influence the interaction between office type, more cognitively demanding work, and work outcomes.

Table 5.10. *Factorial ANOVA: productivity and satisfaction outcomes in relation to office and work type with most recent previous office type as a covariate*

Outcome measure	Office type		Type of work (Imp cog tasks)		Office type x Type of work	
	Main effect		Main effect		Interaction	
	<i>F</i>	<i>n</i> ₂	<i>F</i>	<i>n</i> ₂	<i>F</i>	<i>n</i> ₂
<u>Productivity</u>						
Productivity	10.90**	0.015	4.76*	0.007	6.26*	0.009
<u>Satisfaction</u>						
Overall Workplace Satisfaction	16.51**	0.023	4.47*	0.006	3.50	0.005
Recommend Office	18.16**	0.025	0.69	0.001	0.001	0.000
Overall Job Satisfaction	3.67	0.005	4.29*	0.006	1.75	0.002
General turnover	5.03*	0.007	0.93	0.001	0.99	0.001
Internal turnover	6.49*	0.009	2.00	0.003	0.15	0.000
Disturbance	35.17**	0.047	0.23	0.000	5.50*	0.008
Organisational (affective) commitment	6.47*	.009	6.78**	.009	2.73	.004
Office Space Satisfaction	41.89**	0.056	3.33	0.005	1.53	0.002
Department Layout Satisfaction	3.25	0.005	1.69	0.002	2.21	0.003
Meeting Space Satisfaction	2.25	0.003	0.12	0.000	0.01	0.000

Outcome measure	Office type		Type of work (Imp cog tasks)		Office type x Type of work	
	Main effect		Main effect		Interaction	
	<i>F</i>	<i>n₂</i>	<i>F</i>	<i>n₂</i>	<i>F</i>	<i>n₂</i>
Enjoy working in office building	2.61	0.004	2.90	0.004	2.12	0.003
Office building is a stimulating place to work	1.81	0.003	4.62*	0.007	0.26	0.000
Satisfaction equipment noise supports your work	4.70*	0.007	0.003	0.000	1.39	0.002
Satisfaction people noise supports your work	29.83**	0.041	3.30	0.005	6.07*	0.009
Satisfaction external noise supports your work	1.28	0.002	3.32	0.005	2.93	0.004
Satisfaction privacy supports your work	108.92**	0.133	0.97	0.001	1.61	0.002
Satisfaction with privacy from being overheard	156.24**	0.181	5.46*	0.008	2.29	0.003
Satisfaction with privacy from being overseen	116.12**	0.141	8.52**	0.012	4.25*	0.006
Satisfaction with typical noise levels	56.36**	0.074	2.43	0.003	4.19*	0.006
Lighting satisfaction	1.81	0.003	7.50**	0.011	4.62*	0.007

Outcome measure	Office type		Type of work (Imp cog tasks)		Office type x Type of work	
	Main effect		Main effect		Interaction	
	<i>F</i>	<i>n₂</i>	<i>F</i>	<i>n₂</i>	<i>F</i>	<i>n₂</i>
Temperature satisfaction	5.38*	0.008	4.99*	0.007	0.35	0.000
Airflow/circulation satisfaction	3.53	0.005	4.71*	0.007	0.51	0.001
Overall ambience satisfaction	3.78	0.005	2.29	0.003	1.74	0.002

* $p < .05$

** $p < .01$

5.2.6 Discussion

Summary of overall findings

The study aimed to explore the perceived effects of working in more open or shared work environments as compared with single-occupant enclosed offices, but taking into account the types of work involved. In particular, the authors sought to investigate whether the respondents' line of work (whether it mainly involved concentration and cognitive absorption) moderated the relationship between office design and work outcomes. The results showed that respondents who worked in single-occupant enclosed offices reported more positive experiences on all measures of productivity and satisfaction, with the expectation of "department layout satisfaction". Nonetheless, the difference in department layout satisfaction for open-plan office configurations to single-occupant enclosed offices was not significant. The results also provide some modest evidence to show that the type of work conducted in the office influences the office worker's experiences working in their office environment. In particular, it was found that respondents who completed more cognitively demanding work in an open-plan office experience significantly decreased levels of perceived productivity, and significantly worse outcomes on a range of measures of satisfaction with their work environment, than open-plan office workers who complete fewer tasks that require higher levels of cognitive absorption. Finally, the relationship between office type, more cognitively demanding work, and work outcome measures of productivity and satisfaction, did not appear to be significantly influenced by most recent previous office experience.

These findings are consistent with the existing literature. For example, previous studies have found perceived productivity (Haynes et al., 2017; Lee, 2010), job satisfaction (Bodin Danielsson & Bodin, 2008; Leder et al., 2016; Otterbring et al., 2018), satisfaction with overall work environment (Frontczak et al., 2012; Kim & de Dear, 2013; Leder et al., 2016), satisfaction with noise (Lee, 2010; Kim & de Dear, 2013), privacy (Bodin Danielsson & Bodin, 2009; Kim & de Dear, 2013; Leder et al., 2016), and staff turnover (Oommen et al., 2008) to be significantly worse in open-plan offices than single-occupant enclosed offices.

Those who work in open-plan offices and complete more cognitively demanding work, reported significantly worse work outcomes for perceived productivity and in response to a range of questions relating to workplace satisfaction. The majority of complaints related to noise, but many also reported problems with visual distraction. These findings support the idea that people who complete work that is more cognitively demanding perceive the acoustic conditions that commonly arise in open-plan work environments significantly more

negatively than their co-workers who complete less cognitively demanding work. This finding is consistent with the existing literature which has found noise, particularly irrelevant but audible speech, to disturb and negatively affect performance on tasks requiring cognitive processing (Banbury & Berry, 2005; Haka et al., 2009; Smith-Jackson & Klein, 2009; Virjonen et al., 2007).

Another important variable was lighting, with people who work in open-plan offices and complete more cognitively demanding work reporting being significantly less satisfied with the lighting conditions in their work environment. These findings were generally consistent with previous studies (e.g., Frontczak, et al., 2012; Kim & de Dear, 2013). This difference may be partly attributed to open-plan office workers having less control over their lighting conditions, as their office environmental controls are often centralised and workers may not be located near a window (Frontczak, et al., 2012). It is plausible that people who complete more cognitively demanding work will be even less satisfied with the lighting conditions in their open-plan work environment because research suggests that tasks which are more cognitively demanding may be more negatively sensitive to lighting conditions (Huiberts et al., 2015).

Contrary to expectations, we found that the relationship between cognitively demanding work, office type and work outcomes were not moderated by a respondent's most recent previous office experience. A possible reason for this is that many may have had time to adjust to their new office environment. In addition, there were relatively few cases where a person had moved from a closed office to an open workplace in recent times, so it may have been difficult to detect a significant interaction when the majority of cases were generally working in a type of office that was similar to their previous one.

Limitations / Strengths

A principal limitation of this study is that it did not differentiate between different types of shared office design. Although it is conceptually clearer to make binary comparisons between shared and single occupancy offices, there may be some subtle differences between different shared or open designs. For example, differences in worker responses may be detected between offices with two occupants to those with 50 occupants; based on partition heights; the m² per office worker; or, whether people have their own desk or have to work in a hot-desking style arrangement. Furthermore, extrapolation of the results is limited because causation cannot be inferred from cross-sectional studies (Sedgwick, 2014). A strength of this

study was that the results are based on a diverse sample and classified work-type base on specific tasks rather than trying to classify people based on their title or role description.

Summary

In summary, this builds upon the results of other general studies of office design by examining the moderating role of work type. The findings showed that, although the majority of office workers report negative effects from open or shared work environments, this effect is worse for those engaged in cognitively demanding work (e.g., detailed analysis, reading and writing); who report poorer productivity and workplace satisfaction. Much of this relates to problems with the acoustic environment as well as the lighting. Such findings suggest that modern office designs and, particularly those in higher education institutions, are likely to have negative effects on productivity and could contribute to significantly more staff dissatisfaction.

5.3 Publication: Let's talk: An examination of collaborative behaviours in open-plan and cellular office designs

5.3.1 Statement of authorship

Statement of Authorship

Title of Paper	Let's talk: An examination of collaborative behaviours in open-plan and cellular office designs	
Publication Status	☐ Published ☐ Accepted for Publication ☐ Submitted for Publication ☒ Unpublished and Unsubmitted work written in manuscript style	
Publication Details		

Principal Author

Name of Principal Author (Candidate)	Olivia Isabel Shirley James		
Contribution to the Paper	Conceptualised and designed the study, collected the data, completed the data analysis, interpreted the results and drafted the manuscript.		
Overall percentage (%)	80		
Certification:	This paper reports on original research I conducted during the period of my Higher Degree by Research candidature and is not subject to any obligations or contractual agreements with a third party that would constrain its inclusion in this thesis. I am the primary author of this paper.		
Signature		Date	19/01/21

Co-Author Contributions

By signing the Statement of Authorship, each author certifies that:

- the candidate's stated contribution to the publication is accurate (as detailed above);
- permission is granted for the candidate to include the publication in the thesis; and
- the sum of all co-author contributions is equal to 100% less the candidate's stated contribution.

Name of Co-Author	Paul Delfabbro		
Contribution to the Paper	Contributed to the conceptualisation of the study and analysis, assisted with the interpretation of the findings and provided critical feedback on the manuscript.		
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5.3.2 Abstract

Over the past few decades organisations have endeavoured to design workplaces that encourage communication and collaboration between employees. The study utilised an online cross-sectional survey to compare the experiences of 714 responses in single-occupant enclosed offices and various shared workplace designs, in relation to their perception of collaboration being important and social outcomes. Respondents were predominantly recruited from Australia, New Zealand, United States of America and United Kingdom. It was hypothesised that those workers who believed that collaboration was important for their work would report better outcomes in shared work designs. Independent sample t-tests, chi-squared tests for association, and 2 office type x 2 work type factorial ANOVA were used to analyse the data. The findings suggested that, while people who work in shared work environments appear to report greater social outcomes, this was most likely due to a selection effect towards people who perceive collaboration to be important to complete their work. Moreover, those who perceived collaboration to be important for their work reported greater collaboration and socially engaged with others, regardless of their office arrangement.

5.3.3 Introduction

Communication and collaboration between employees have become increasingly important over the last few decades as the nature of work shifts towards work that is more complex and often involves a team of specialists to complete (Greene & Myerson, 2011; Smith, 2005). As a result, CEOs and managers have endeavoured to find ways to facilitate collaboration between their staff. A popular way has been through the design of the office work environment. Since the 1960s, architects have endeavoured to design offices which encourage human interaction and collaboration between colleagues (Hassanian, 2006). Proposed in 1960s Germany, the Burolandschaft, was the first office designed specifically around flows of communication (Hassanian, 2006). The Burolandschaft comprised 'organically' grouped desks in a large open floor plan with no walls, and used plants for partitions (Hassanian, 2006; Walsh, 2015).

Two principal perspectives can be used to explain the potential influence of open-plan work environments on occupants' social interactions: a social relations approach and a sociotechnical approach (Oldham & Brass, 1979). The principal argument underlying the social relations approach is that the removal of all physical barriers including walls, doors and even partitions will facilitate social interactions between workers because people are more likely to communicate with others in close proximity (Oldham & Brass, 1979). Using this logic, it is hoped that that open-plan workspaces will increase the number of 'chance' encounters, and that the collaboration of employees with different skills, views and thoughts will lead to new innovative ideas, and assist groups of specialists to solve complex problems (Goldstein, 2006; Waber et al., 2014). As a result, besides their lower financial costs, a key driver for adopting an open-plan office design is that they supposedly encourage communication and collaboration between workers (Davis et al., 2011). Nonetheless, little empirical evidence exists to support claims that open-plan offices increase communication and collaboration between workers (Kaarlela-Tuomaala et al., 2009; Kim & de Dear, 2013). Accordingly, some researchers suggest a more sociotechnical approach, whereby open-plan work environments may actually decrease communication because they reduce workers' privacy, making it difficult to hold confidential conversations and limit opportunities for meaningful interactions (Brennan et al., 2002; Oldham & Brass, 1979).

Research has examined the way in which office workers socially interact in a range of closed and open work environments. Oommen et al.'s (2008) review of the literature concluded that open-plan work environments enhance communication and increase

collaboration between employees. Despite this overall positive finding, individual studies investigating more detailed aspects of social interaction in shared work environments (i.e., workplaces occupied by more than one worker) compared to single-occupant enclosed offices have found less favourable effects. These include: significantly more negative relationships (Morrison & Macky, 2017); fewer friendship opportunities (Oldham & Brass, 1979); lower interpersonal satisfaction (Oldham & Brass, 1979); higher levels of uncooperative behaviours (Morrison & Macky, 2017); higher levels of distrust (Morrison & Macky, 2017); decreased support of affinity (Bodin Danielsson & Bodin, 2009); increased feelings of crowding (Sundstrom et al., 1980); decreased ability to converse without raising voice (Kaarlela-Tuomaala et al., 2009); and an inability to conduct confidential (Sundstrom et al., 1982b) and private conversations (Oldham & Brass, 1979; Sundstrom, 1986). Nonetheless some research has found that compared to single-occupant enclosed offices, workers in open-plan work environments report: significantly higher levels of connectivity (Duncan et al., 2015); increased co-worker visibility and proximity (Duncan et al., 2015); and increased ease for visitors to locate workers (Sundstrom et al., 1982b). It is clear that despite efforts to examine this social phenomenon, there is currently little consensus with the research to date producing different conclusions for a range of social outcomes.

It is plausible that some of these differences in open-plan office workers' social outcomes can be attributed to the type of work being conducted in the office environment as some occupations are more socially interactive than others. For example, some jobs, such as software design, program development, and marketing, are highly collaborative in nature as they require constant teamwork and communication to complete their day to day tasks. By contrast, other jobs require large amounts of independent thought and occasional collaboration to complete e.g., academia, accountants, and lawyers. Preliminary research supports this proposition and suggests that open-plan work environments are not suitable for all types of work and that moving employees into an open-plan work environment is not necessarily going to result in a sudden increase in worker's collaborative practices (e.g., Lansdale et al., 2011). Lansdale et al. (2011) conducted a 12-month longitudinal study to examine how a group of PhD students who moved from high partitioned cubicles to a non-territorial open-plan office interacted – with a focus on their face-to-face interactions. The researchers found that over 12 months, face-to-face interactions decreased between the PhD students who moved to the open-plan workspace and were lower compared to the PhD students who remained in their cubicle offices (Lansdale et al., 2011). The researchers concluded that for higher education environments, open-plan environments alone are not

sufficient to increase collaboration. Rather the structure and nature of the work conducted would need to be changed to increase collaborative practices (Lansdale et al., 2011).

To the authors' best knowledge, no research has specifically investigated the impact that one's perception for communication to be important to complete their work has on the relationship between office type and social outcomes in the workplace. It is possible that, although on first glance people who work in shared work environments may appear to communicate and collaborate more, this relationship may actually be due to people in shared office environments placing a greater importance on communication to complete their work. Accordingly, it may be that, it is not the office environment that increases one's level of communication and collaboration, but rather one's perception of whether collaboration is important to complete their work.

The current study

A popular belief is that open-plan workplace designs increase collaboration and help facilitate social interactions between colleagues (Goldstein, 2006; Waber et al., 2014). However, the majority of these claims are based on anecdotal reports, with very little empirical evidence to provide support (Kaarlela-Tuomaala et al., 2009; Kim & de Dear, 2013). Furthermore, it is possible that these claims of increased levels of collaboration and social interactions in open-plan work environments are due to their occupants' perception of collaboration being important to complete their work, rather than the physical design features of the work environment. Accordingly, the aim of this study is to investigate how people collaborate and socially interact in different workplace designs. In this paper, we examine how open-plan work environments appear to affect workers' perceived social interactions, with a particular focus on whether workers' perception of the importance of collaboration is related to the association between office type and social outcomes. The specific hypotheses addressed in this paper were as follows: (a) It is hypothesised that the results will support the anecdotal evidence and popular belief that people in open-plan workplace designs collaborate more and have higher scores on measures of social interaction compared to people working in single-occupant enclosed offices using a comprehensive range of measures informed by a review of the existing literature; (b) It is hypothesised that those who perceive collaboration with others in their workplace to be important to complete their work will report higher scores on measures of social interaction in open-plan work environments.

5.3.4 Method

Sample Characteristics

The study involved 714 respondents drawn largely from an international online panel as well as from the broader South Australian community. A summary of the demographic characteristics of the sample is provided in Table 5.11. As indicated, the majority of the sample was aged between 25 and 44 years of age and there was a slightly greater proportion of women in the survey. The majority of the sample (N = 619; 86.7%) had completed some form of post-school qualification, with 302 (42.3%) having a bachelor degree as their highest level of completed education. 7.0% (N = 50) of the sample reported speaking a language other than English at home. Respondents reported working between 15 and 80 hours of paid work each week, with an average of 38.25 hours. The most commonly reported number of paid work hours worked per week was 40 hours. Six respondents did not report how many paid hours they worked each week.

The majority of respondents (N = 514; 72.0%) spend at least 70% of their work-time in their main office configuration/workstation, with almost half the respondents (N = 330; 46.2%) reported spending at least 85% of their work-time in their main office configuration/workstation. On the other hand, only 61 (8.5%) respondents reported spending less than 50% of their work-time in their main office configuration/workstation. The majority of respondents (N = 536; 75.5%) had worked in their current office configuration for at least one year, regardless of occupation or organisation.

Respondents selected the following office configurations as most representative of their current main workspace: single-occupant enclosed office (N = 143; 20.0%); shared enclosed office (N = 145; 20.3%); open-plan (N = 286; 40.1%); cubicle (N = 52; 7.3%); hot-desk (N = 48; 6.7%); activity-based workplace/combi-office/flexible/creative/innovative space (N = 40; 5.6%). Respondents were subsequently classified into single-occupant enclosed office (N = 143; 20.0%) and open-plan (N = 571; 80.0%) – any shared workspace with at least two occupants.

Study Procedure

An online cross-sectional survey was utilised because it enabled the researchers to: 1) collect data from anyone who worked in an office; 2) collect data on office workers who complete different types of knowledge work; 3) the researchers did not have to find an organisation to participate in and approve the study; and 4) the researchers were not limited

to collecting data in one or a few organisations. Therefore, a larger more varied sample could be recruited. The survey was designed to obtain extensive detail concerning how people socially interact and collaborate in the workplace. In this study, a more refined methodology was implemented that tried to capture multiple aspects of social interaction and collaboration in the workplace. The study also aimed to ascertain whether people perceived collaboration to be important for the work they complete, to determine whether it is actually the perception of collaboration being important that influences whether people collaborate, rather than the physical aspects of an office's design. The survey was designed to collect information on respondents' social interactions and collaboration in four ways: (1) standardised measures of social support, interactions and community; (2) frequency of collaboration; (3) perception of whether collaboration is important to complete work; and (4) staff morale. It was anticipated that perception of whether collaboration is important to complete work would influence social interactions more than office workplace design.

Respondents were invited to complete a 45-minute online survey on their experiences working in their office environment. Participation was requested from respondents aged 18 years and over who undertook at least 15 hours of paid work a week in an office. Moreover, respondents were required to have a sufficient level of English to comprehend the study. The study aimed to survey people working in information intensive work. Common examples of professions include: researchers, public servants, architects, and computer programmers. People were excluded from participating if they engaged in work which is more physical and technical; involves mainly private communication by its very nature; and/or is clerical in nature. Examples of people who would fall inside the exclusion criteria are people working as clinicians (medical and healthcare treatment/clinicians); those who work in reception/administration offices, teachers working in classrooms, or those who are call centre and factory workers.

Respondents were recruited through word of mouth, flyers, and a paid panel recruitment service (Prolific). Respondents recruited through Prolific received a small honorarium of four pounds for completing the survey. The study was also advertised on social media.

Table 5.11. *Sample demographics*

	Total (N = 714) <i>n</i> (%)	Single-Occupant Enclosed Office (N = 143) <i>n</i> (%)	Open-Plan Office (N = 571) <i>n</i> (%)
<u>Sex</u>			
Male	340 (47.6)	79 (55.2)	261 (45.7)
Female	372 (52.1)	64 (44.8)	308 (53.9)
<u>Age</u>			
18-24	56 (7.8)	10 (7.0)	46 (8.1)
25-34	316 (44.3)	58 (40.6)	258 (45.2)
35-44	205 (28.7)	46 (32.2)	159 (27.8)
45-54	100 (14.0)	18 (12.6)	82 (14.4)
55-64	30 (4.2)	9 (6.3)	21 (3.7)
65+	4 (0.6)	2 (1.4)	2 (0.4)
<u>Languages other than English at home</u>			
Yes	50 (7.0)	22 (15.4)	28 (4.9)
No – Only English	663 (92.9)	121 (84.6)	542 (94.9)
<u>Highest Education Level</u>			
Less than Year 12	14 (2.0)	0 (0.0)	14 (2.5)
Year 12	76 (10.6)	10 (7.0)	66 (11.6)
Other post-school qualification (e.g. VET/TAFE certificate, apprenticeship, diploma)	133 (18.6)	19 (13.3)	114 (20.0)

	Total (N = 714) <i>n</i> (%)	Single-Occupant Enclosed Office (N = 143) <i>n</i> (%)	Open-Plan Office (N = 571) <i>n</i> (%)
Bachelor Degree	302 (42.3)	65 (45.5)	237 (41.5)
Higher than Bachelor Degree	184 (25.8)	48 (33.6)	136 (23.8)
<u>Country</u>			
Australia/New Zealand	77 (10.7)	12 (8.4)	65 (11.4)
United Kingdom	461 (64.6)	65 (45.5)	396 (69.4)
United States of America	160 (22.4)	59 (41.3)	101 (17.7)
Canada	8 (1.1)	6 (4.2)	2 (0.4)
Europe (exc. UK)	5 (0.7)	0 (0.0)	5 (0.9)
Japan	3 (0.4)	1 (0.7)	2 (0.4)

Measures

Office configurations

Respondents were asked to select the office configuration that best represents their “current” or “main” workspace. Response options were: 1) enclosed office; 2) open-plan; 3) cubicle; 4) hot-desk; and 5) activity-based workplace/combi-office/flexible/creative/innovative space. Enclosed office responses were subsequently classified as either single-occupant enclosed office or shared enclosed office based on whether the respondent selected that their office was “not shared with anyone”.

Collaboration important

An item was designed for this study to ascertain the importance of collaboration for respondents to complete their work. Respondents were asked to “indicate the extent to which collaboration with others in your workplace is important to complete your work”. Responses were collected on a five-point Likert type scale scored: 1 (not at all important) to 5 (very important). Scores ranged from 1 to 5. A high score is indicative that collaboration in the workplace is important to complete work.

Outcome measures

Social measures

(a) Social support

Social support was measured with the Copenhagen Psychosocial Questionnaire (COPSOQ) four-item social support subscale consisting of questions such as “Have you had help and support from your colleagues” and “Has your immediate superior been willing to listen to your work related problems” (Kristensen et al., 2005). Respondents indicated their frequency of perceived social support on a five-point Likert-type scale scored: 0 (Never/Hardly ever), 25 (seldom), 50 (sometimes), 75 (often), 100 (always). The subscale was averaged with all four items weighted equally. Scores ranged from 0 to 100 with higher scores indicating a high level of perceived social support at work.

(b) Social relations

The three-item COPSOQ social relations subscale consisted of questions such as “Have you worked isolated from your colleagues” and “Have you been part of a group in your work” (Kristensen et al., 2005). Respondents indicated their frequency of perceived social support on a five-point Likert-type scale scored: 0 (Never/Hardly ever), 25 (seldom),

50 (sometimes), 75 (often), 100 (always). The first item, “Have you worked isolated from your colleagues” was reverse scored. The subscale was averaged with all three items weighted equally. Scores ranged from 0 to 100. A high score is indicative of a perceived high level of social relations at work.

(c) Sense of community

Sense of community was measured with the COPSQ three-item subscale consisting of questions such as “Had a good atmosphere between you and your colleagues” (Kristensen et al., 2005). Respondents indicated their frequency of perceived sense of community in the workplace on a five-point Likert type scale scored: 0 (Never/Hardly ever), 25 (seldom), 50 (sometimes), 75 (often), 100 (always). The subscale was averaged with all three items weighted equally. Scores ranged from 0 to 100. A high score is indicative of a perceived high sense of community at work.

(d) Team member relations

A modified version of Brennan et al. (2002) five-item measure of team member relations was used to measure team member relations in the workplace. The fourth item from Brennan et al. (2002): “I like having the team leaders located with the rest of the team” was removed from the measure because not all respondents will have team leaders located with their team. An additional item was created and added to the remaining four items: “I feel comfortable sharing ideas with team members”. Respondents indicated their level of agreement on a five-point Likert type scale scored: 1 (strongly disagree) to 5 (strongly agree). The five-items were averaged, and scores ranged from 1 to 5. A high score is indicative of a high perception of team member relations.

(e) Collaborative culture

McElroy and Morrow’s (2010) five-item measure of collaboration was used to capture the perceived collaborative culture in their organisation. Example questions are “I confer with my co-workers to discuss work-related issues” and “co-workers in my office location seldom visit with one another about work-related issues” (reverse scored). Respondents indicated their level of perceived collaborative culture on a five-point Likert type scale scored: 1 (strongly disagree) to 5 (strongly agree). Scores ranged from 1 to 5. A high score is indicative of employees perceiving their organisation to have a high level of collaborative culture.

(f) Collaboration frequency

A seven-item measure was created specifically for this study to assess collaboration frequency in the workplace. Example items were: “bounced ideas of co-workers” and “solved a problem working with a co-worker”. Respondents were asked to indicate their level of frequency for each item on a five-point Likert type scale scored: 1 (never), 2 (less than weekly), 3 (1-3 times per week), 4 (4-5 times per week), 5 (multiple times each day). Scores ranged from 1 to 5. A high score is indicative of a high frequency of collaboration in the workplace.

(g) Difficult to hold a conversation in office area

Parkin et al. (2011) created a measure to broadly cover various aspects of working in an office. One item was used in this study: “It is difficult to hold a conversation in my office area”. Respondents indicated their level of agreement on a five-point Likert type scale scored: 1 (strongly disagree) to 5 (strongly agree). Scores ranged from 1 to 5.

(h) Staff morale

A single item to assess staff morale was created for the survey. Respondents were asked “how do you describe the morale of the staff in your workplace?”. Responses were collected on a five-point Likert type scale scored: 1 (very poor), 2 (poor), 3 (neutral), 4 (good), 5 (very good). Scores ranged from 1 to 5. A high score is indicative of a perceived high level of staff morale in the workplace.

Data Analysis

First, the descriptive statistics of each outcome measure was calculated to ascertain the overall means of health and social outcomes for all office configurations combined. Current office type was organised into two categories: single-occupant enclosed office and open-plan. All offices that were shared by at least two people were reclassified as open-plan, i.e., shared-enclosed office; open-plan; cubicle; hot-desk; and activity-based workplace/combi-office/flexible/creative/innovative space. Independent sample t-tests were used to compare any significant differences in means for each of the social interaction outcomes between single-occupant and open-plan office configurations.

The perceived importance of collaboration in office work was investigated. Respondents were asked to “indicate the extent to which collaboration with others in your workplace is important to complete your work” with one of the following five response

options: “not important at all”; “not important”; neither not important nor important”; “important”; and “very important”. Each of these five response options were dichotomised into either not important or important and dummy coded (coded 0 or 1). Important and very important = 1 and the other ratings = 0. Thus, respondents were classified into two groups: collaboration important to complete work, and collaboration not important to complete work. As shown in Table 5.12, approximately three-quarters of respondents were classified as perceiving collaboration as important to complete their work (N = 538; 75.7%), whilst the remaining 173 respondents (24.3%) perceived collaboration to not be important to complete their work. A chi-squared test indicated that those in open-plan offices were more likely to rate collaboration is important for their work than those in single-occupant enclosed offices, $\chi^2(1) = 12.15, p < .01$.

In addition, to replicate previous findings relating to different social outcomes arising from different office types, independent samples t-tests were conducted. Finally, a 2 Office type x 2 Work type factorial ANOVA was conducted with office type (single-occupant / open-plan) and collaboration important to complete work (not important / important) as independent variables, social interaction outcome measures as the dependent variables.

Table 5.12. *Perceived importance of collaboration by office type*

Office type	Collaboration important to complete work		Total
	n (%)		
	Not Important	Important	
Single-occupant enclosed office	51 (35.9)	91 (64.1)	142 (20.0)
Open-plan office	122 (21.4)	447 (78.6)	569 (80.0)
Total	173 (24.3)	538 (75.7)	711

5.3.5 Results

Exploration of social outcomes

Table 5.13 presents the mean social interactions scores for all office types combined. The results indicate that on average, the overall sample: sometimes experience social support (M = 58.29, SD = 22.46) and sometimes engage socially at work (M = 58.25, SD = 20.65). Inspection of the scores in Table 5.13 indicate that on average respondents collaborate a

moderate amount; are mostly satisfied with their team member relations; and have neutral to good morale.

Table 5.13. *M (SD) scores and ranges for all social interaction outcomes for the entire sample*

Outcome measure	<i>M</i>	<i>SD</i>
<u>Social</u>		
Social support	58.29	22.46
Social relations	58.25	20.65
Community	69.02	21.49
Team member relations	3.77	0.73
Collaborative culture	3.74	0.72
Collaboration frequency	2.98	0.83
Difficult to hold a conversation in office area	2.58	1.11
Staff morale	3.56	0.97
<i>Score range: Social support (0 – 100); Social relations (0 – 100); Community (0 – 100); All other measures (1 – 5).</i>		

Table 5.14 depicts the mean social interactions scores for single-occupant and open-plan offices. Compared to single-occupant offices, open-plan office workers scored significantly higher on the following social outcomes: social support, social relations, collaborative culture and collaboration frequency. By contrast, open-plan office workers found it significantly more difficult to hold a conversation in their office area and reported lower staff morale compared to single-occupant enclosed offices.

Table 5.14. *T-test comparison of the single-occupant enclosed offices vs open-plan offices on outcome variables*

Outcome measure	Single-Occupant Enclosed Office	Open-Plan Office	t	Cohen's <i>d</i>
	<i>M (SD)</i>	<i>M (SD)</i>		
Social support	53.96 (24.69)	59.37 (21.76)	2.39*	0.24
Social relations	45.98 (21.23)	61.33 (19.34)	8.32**	0.78
Community	66.55 (24.88)	69.64 (20.53)	1.37	0.14
Team member relations	3.75 (0.78)	3.77 (0.72)	0.28	0.03
Collaborative culture	3.57 (0.85)	3.78 (0.68)	2.70**	0.29
Collaboration frequency	2.79 (0.91)	3.03 (0.81)	3.14**	0.29
Difficult to hold a conversation in office area	2.05 (0.96)	2.71 (1.10)	7.18**	0.62
Staff morale	3.73 (0.84)	3.51 (0.99)	2.62**	0.23

Score range: Social support (0 – 100); Social relations (0 – 100); Community (0 – 100); All other measures (1 – 5).

* $p < .05$

** $p < .01$

Importance of collaboration

The results of a 2 Office type (single-occupant vs open-plan) x 2 Collaboration importance (not important vs important) factorial ANOVA for all social interaction outcomes are presented in Table 5.15. As indicated in Table 5.15, those who reported that collaboration was more important to complete their work reported better social and collaboration outcomes than those who did not think it was important. However, with the exception of one variable (sense of community), there was little evidence of an interaction; namely, that being in an open-plan office and believing that collaboration was important led to stronger outcomes. The main effect for Importance of collaboration did not appear to differ depending upon the type of office. In effect, better social relations appear to result when people believed this was important and this effect did not increase or decrease based on the office they were in.

Table 5.15. *Factorial ANOVA: social outcomes in relation to office and whether collaboration was considered important*

Outcome measure	Office type		Collaboration		Office type x Collaboration	
	Main effect		Important		Important	
			Main effect		Interaction	
	<i>F</i>	<i>n</i> ₂	<i>F</i>	<i>n</i> ₂	<i>F</i>	<i>n</i> ₂
<u>Social</u>						
Social support	3.48	.005	85.88**	.108	2.68	.004
Social relations	58.15**	.076	73.66**	.094	3.39	.005
Community	1.10	.002	84.51**	.107	5.07*	.007
Team member relations	0.71	.001	88.73**	.112	0.23	.000
Collaborative culture	6.00*	.008	84.90**	.107	2.32	.003
Collaboration frequency	3.85	.005	110.47**	.135	0.68	.001
Difficult to hold a conversation in office area	31.65**	.043	0.58	.001	1.56	.002
Staff morale	12.16**	.017	28.63**	.039	0.54	.001
	(Higher for Single-occ)					
Score range: Social support (0 – 100); Social relations (0 – 100); Community (0 – 100); All other measures (1 – 5).						
*p<.05 **p<.01						

5.3.6 Discussion

The aim of this study was to investigate how people collaborate and socially interact in different workplace designs. A particular focus was upon a comparison between those who work in a single person enclosed office as compared with those in shared office designs with at least two occupants. We examined whether respondents' perception of collaboration to be important to complete their work moderated the relationship between office design and other work outcomes. The results suggested that respondents who worked in shared offices reported having better quality social interactions than respondents in single-occupant enclosed offices. However, respondents working in shared work environments scored lower on staff morale and reported greater difficulty to hold a conversation in their office area. There was little evidence to suggest that perceiving collaboration to be important to complete one's work and working in a shared office environment led to stronger social outcomes. The only significant interaction between collaboration importance and office design was for sense of community and this effect needs to be treated with caution because of the large number of statistical tests conducted. In other words, those who believed in the importance of collaboration and who reported positive social outcomes did so, irrespective of whether they were located in single or shared offices.

The findings of the overall comparison of social outcomes between single-occupant enclosed offices and shared work environments with at least two occupants are consistent with Oommen et al.'s (2008) review which found that open-plan work environments enhanced communication and increased collaboration. These results also support the anecdotal and popular belief that people in open-plan workplace designs collaborate more and have higher scores on measures of social interaction compared to people working in single-occupant enclosed offices. Moreover, these findings provide support for the social relations approach which argues that the removal of physical barriers will bring workers together and encourage communication and collaboration between employees (Oldham & Brass, 1979).

However, despite the majority of findings suggesting some positive social experiences in shared work environments, staff morale was significantly poorer in these shared work environments. These findings support Kim and de Dear's (2013) proposition that there is no basis in the research literature to support the claim that open-plan offices increase staff morale, despite advocates for shared work environments stating they do. Kim and de Dear

(2013) based their conclusion to the lower work environment satisfaction, perceived productivity, job satisfaction, and organisational outcomes associated with open-plan offices.

The results also support existing research which found that people find it more difficult to hold a conversation in shared work environments (e.g., Oldham & Brass, 1979; Sundstrom, 1986; Sundstrom et al., 1982b). Therefore, in contrast to the other social variables, this finding supports the view that physical barriers create fixed spaces for activities and provide people with privacy (Oldham & Brass, 1979). This effect could possibly be due to the fact that, all workers, regardless of their perception of collaboration being important, need to hold conversations in their work area. Consequently, when workers hold conversations in their shared work environment, they experience difficulties due to the lack of acoustic privacy (Bodin Danielsson & Bodin, 2009) and the presence and intelligibility of surrounding speech in their shared work environment (Kaarlela-Tuomaala et al., 2009).

The lack of evidence in support of an interaction between office design and beliefs about collaboration suggests that some people experience good social interactions irrespective of their work environment. These findings would, therefore, appear to imply a selection effect. Some people may have qualities (e.g., good social skills, extraversion) which motivate and enable them to interact with others irrespective of the environment. There may also be a tendency towards more socially engaged people to gravitate towards more open environments or be selected into them (i.e., be considered at an interview as being suitable to work in these environments).

Finally, despite the significant main effect for office type, the results of independent samples t-tests for just respondents who perceived collaboration to be important to complete their work, revealed no significant differences between collaborative culture for single-occupant and open-plan office designs, $t(536) = 0.83$, $p = .41$. Therefore, for the respondents who perceived collaboration to be important to complete their work, significant differences between office type occurred in only three social outcomes: social relations, staff morale, and difficult to hold a conversation in office area; of-which all, except social relations, were in-favour of the single-occupant enclosed offices. These findings support other studies that show that many social outcomes (i.e., staff morale, and ability to hold a conversation in office area) favour single-occupant enclosed offices (Morrison & Macky, 2017; Oldham & Brass, 1979; Sundstrom, 1986; Sundstrom et al., 1982b), and that this relationship occurs regardless of whether respondents perceive collaboration to be important to complete their work.

Limitations / Strengths

A limitation of this research is the combination of all office types with more than two workers into one category: shared work environments. Whilst there is validity in differentiating between single-occupant enclosed offices and arrangements with multiple workers, many subtle and distinguishing features exist between shared work environments and these features may also influence workers social outcomes. For example, while some research suggests that compared to single-occupant enclosed offices, workers cooperation is significantly worse in all shared workplace designs except shared enclosed offices (e.g., Morrison & Macky, 2017), others found cooperation to only be significantly worse in open-plan offices with 10 to 24 occupants (Bodin Danielsson & Bodin, 2008). Additionally, the limitations of cross-sectional designs must be acknowledged. Whilst the cross-sectional design enabled the comparison of multiple independent variables and the recruitment of a large and diverse sample, the sample is susceptible to non-response bias because the respondents self-selected to participate, and it is not possible to infer causation from the results (Sedgwick, 2014). Nonetheless, given the lack of research on possible factors influencing office workers' levels of collaboration and social interactions in shared work environments, the authors wanted to investigate the phenomena globally for all offices that contain more than one occupant. Nevertheless, replication studies should endeavour to investigate the influence of the perceived importance of collaboration on social outcomes in different office configurations and specific design features.

A significant contribution of this research is that it endeavoured to explore other possible explanations for why workers in shared work environments appear to communicate and collaborate more than workers in single-occupant enclosed offices. In doing so, the study also explored a broad range of social outcomes, rather than just communication and collaboration, through the selection and creation of measures guided by the literature. This enabled the influence of the perceived importance of collaboration to be examined in relation to multiple aspects of workers social experiences and to reduce concern that any particular findings were a function of the measure selected. Moreover, the study utilised a cross-sectional design with a diverse sample from a range of occupations and shared workplace designs to examine whether this phenomenon occurred across occupational groups and various shared work environments.

Future Directions

This study provides support for the popular belief and anecdotal claims that shared work environments are associated with increased levels of collaboration and social outcomes, compared to single-occupant enclosed offices. However, this may in fact be attributed to a selection effect – with respondents who perceive collaboration to be important for their work disproportionately working in shared work environments. Overall the findings suggest that respondents experience better social outcomes if they perceived collaboration to be important to complete their work, with their office design having little influence on this effect. Future research could refine this research using larger samples that enable the importance of collaboration to be examined in work environments based on a variety of shared workplace designs. A better understanding of the interactions between office design features, social outcomes, and workers' perception of collaboration being important to complete their work, will enable organisations to increase their understanding of how to effectively and efficiently increase their employees' collaboration and social interactions with each other. In the current era, too much emphasis is placed on the physical office environment; with the belief that moving office workers into shared work environments will make them collaborate more. The findings underscore the important point that outcomes are likely to be due to the interaction between individual level and environmental factors. Much of the success of modern office designs may as much be a feature of appropriate recruitment (e.g., identifying office workers who believe that collaboration is important for them to complete their work) and the training of existing staff, rather than merely focusing only on the office design. It is the selection of the right people for particular environments and their capacity for adaptation and change which is essential.

5.4 Publication: Adaptation to shared work environments: A comparison of the psychological, social and work outcomes for introverted and extraverted office workers

5.4.1 Statement of authorship

Statement of Authorship

Title of Paper	Adaptation to shared work environments: A comparison of the psychological, social and work outcomes for introverted and extraverted office workers
Publication Status	☐ Published ☐ Accepted for Publication ☒ Submitted for Publication ☐ Unpublished and Unsubmitted work written in manuscript style
Publication Details	James, O., Delfabbro, P., & King, D.L. (under review). Adaptation to shared work environments: A comparison of the psychological, social and work outcomes for introverted and extraverted office workers.

Principal Author

Name of Principal Author (Candidate)	Olivia Isabel Shirley James
Contribution to the Paper	Conceptualised and designed the study, collected the data, completed the data analysis, interpreted the results and drafted the manuscript.
Overall percentage (%)	80
Certification:	This paper reports on original research I conducted during the period of my Higher Degree by Research candidature and is not subject to any obligations or contractual agreements with a third party that would constrain its inclusion in this thesis. I am the primary author of this paper.
Signature	Date 19/01/21

Co-Author Contributions

By signing the Statement of Authorship, each author certifies that:

- i. the candidate's stated contribution to the publication is accurate (as detailed above);
- ii. permission is granted for the candidate to include the publication in the thesis; and
- iii. the sum of all co-author contributions is equal to 100% less the candidate's stated contribution.

Name of Co-Author	Paul Delfabbro
Contribution to the Paper	Contributed to the conceptualisation of the study and analysis, assisted with the interpretation of the findings and provided critical feedback on the manuscript.
Signature	Date 19/1/21

Name of Co-Author	Daniel King
Contribution to the Paper	Assisted with the interpretation of the findings and provided critical feedback on the manuscript.
Signature	Date 19/1/21

Please cut and paste additional co-author panels here as required.

5.4.2 Abstract

The widespread adoption of shared and open-plan office designs has been met with a mixed reception. This paper examined the role of individual differences in introversion – extraversion in a study of 571 respondents predominantly from Australia, New Zealand, United States of America and United Kingdom in various shared workplace designs. It was hypothesised that introverts would report poorer health, work and social outcomes. The study also examined how well different office workers adapt to their shared work environments. Independent sample t-tests and chi-squared tests for association were conducted to analyse the data. As hypothesised, introverts reported significantly lower scores on a range of work and social outcomes. Extraverts, by contrast, reported better outcomes and were generally more aware of the protocols and adaptive strategies available to help adapt to shared environments. The findings suggest that early identification of personality differences could help optimise office environments for different employees in a way that facilitates their strengths and preferences.

5.4.3 Introduction

The last few decades have seen a major shift from cellular office design, to offices that are open and shared. Compared to single-occupant enclosed offices, open-plan offices have been associated with significantly lower levels of satisfaction with the work environment (e.g., Bergström et al., 2015; Kim and de Dear, 2013), decreased job satisfaction (e.g., de Croon et al., 2005; Oommen et al., 2008), lowered work productivity (e.g., Oommen et al., 2008), increased levels of disturbance (e.g., Kaarlela-Tuomaala et al., 2009), decreased concentration (e.g., Pejtersen et al., 2006; Seddigh et al., 2014), and a range of increased health complaints including increased stress levels (Seddigh et al., 2014), greater physical exhaustion (Oommen et al., 2008), higher levels of sickness absence (Danielsson et al., 2014), increased reports of contagious illness such as the common cold and the flu (Oommen et al., 2008), and increased sick-building syndrome symptoms (Kim and de Dear, 2013). Moreover, the debate around whether open-plan work environments facilitate or prohibit social interactions and collaborations between colleagues has been highly contended with many architects and proponents of shared work environments arguing that the removal of physical walls and barriers increases collaboration between colleagues (Goldstein, 2006; Waber et al., 2014). On the other hand, research has found evidence to support that shared work environments do not increase collaboration between workers (Morrison and Macky, 2017); rather they appear to limit the ability for workers to hold private and confidential conversations (Brennan et al., 2002; Oldham and Brass, 1979). However, as these negative experiences are not reported by all people, it is not clear whether there may be individual differences that might explain why some individuals adapt to shared work environments better than others.

Personality has been extensively studied and is widely viewed as one of the founding blocks of human psychology that helps distinguish people from each other. A key personality theory is Eysenck's (1967) theory that argues that people can be differentiated on a dimension of introversion to extraversion (Oseland, 2009). Introverts are often characterised by their preference to complete solitary activities (Oseland, 2009), whereas extraverts are generally described as being more gregarious, excitement-seeking and enjoy social settings (Oseland, 2009; Seddigh et al., 2016). Research suggests negative associations between extraversion and both emotional exhaustion and depersonalisation (Swider and Zimmerman, 2010); and positive associations between extraversion and job satisfaction (Judge et al., 2002), personal accomplishment (Swider and Zimmerman, 2010), and performance in jobs that demand interactions with others (Barrick and Mount, 1991). Furthermore, Eysenck's

theory suggests that introverts will prefer to work alone, while extraverts will prefer to work surrounded by others (Oseland, 2009). Such differences could also, in turn, influence people's experiences when working in a shared work environment and, in-particular, their social interactions with co-workers.

To date, few studies have investigated the relationship between personality, different office configurations, and various health, work and social outcomes. For example, Gehlmann (1992) examined whether the relationship between office type (open, semi-private, and private), and both stress and job satisfaction were influenced by the personality trait extraversion but found no significant interaction. However, Seddigh et al. (2016) argued that this non-significant finding could be attributed to the study's small sample size. Using a larger sample, Seddigh et al. (2016) administered the Big Five personality traits to investigate the role of office type (cell, shared room, open-plan, and flex) and personality, on office workers' self-rated measures of distraction, job satisfaction, and professional efficacy. Notably, no significant interactions were found between office type, extraversion and any of the measured outcomes (Seddigh et al., 2016). Seddigh et al. (2016) concluded that interactions between office type and personality are modest at best. By contrast, McCusker (2002) found that open-plan office workers who score higher on extraversion, agreeableness, or conscientiousness were more satisfied with the communication climate in open-plan work environments. They also expressed more positive views about the feedback they receive in their open office spaces, and with the overall open space, than colleagues who scored lower on these personality traits (McCusker, 2002).

In addition to the relatively small number of studies on the relationship between personality and outcomes in shared office environments, there has also been very little research that has explored how different office workers adapt to their shared work environments. Kaarlela-Tuomaala et al. (2009) found that employees who moved into open-plan offices adapted new behaviours to cope with their work due to the poorer auditory conditions in the open work environment. Examples included postponing work to another time, working more from home or modifying work-stations. However, research has also not examined whether personality differences might relate to how people adapt, for example, by using the various office protocols or strategies (e.g., as listed by Brennan et al., 2002).

The current study

Although the positive and negative impacts of office designs have been studied, less is known about factors that moderate outcomes. Accordingly, the aim of this study is to

investigate why some people appear to cope well in shared work environments while others find it more difficult. In this paper, we further examine how personality (introversion / extraversion) appears to affect shared office worker's health, productivity, satisfaction with job and work environment, and social interactions. The study also examines whether personality influences how people adapt to their shared work environments. The specific research questions addressed in this paper were as follows: (a) To examine whether introverts are more negatively affected by open-plan designs than extraverts; (b) Explore how introverts and extraverts adapt to their shared work environment.

5.4.4 Method

Sample Characteristics

The study involved 571 respondents (shared office workers) drawn largely from an international online panel as well as from the broader South Australian community. Demographic characteristics are summarised in Table 5.16. The majority of the sample was aged between 25 and 44 years of age and contained slightly higher proportion of men than women. Most (N = 487; 85.3%) had completed a post-school qualification, with 237 (41.5%) having obtained a bachelors degree. A total of 4.9% (N = 28) of the sample reported speaking a language other than English at home. Respondents reported working between 15 and 80 hours of paid work each week (Mean = 37.92 hours), with 40 hours per week being the modal response. The majority of respondents (N = 536; 75.5%) had worked in their current office configuration for at least one year, regardless of occupation or organisation.

Table 5.16. *Descriptive data for demographic variables*

	Open-Plan Office (N = 571) <i>n</i> (%)
<u>Sex</u>	
Male	261 (45.7)
Female	308 (53.9)
<u>Age</u>	
18-24	46 (8.1)
25-34	258 (45.2)
35-44	159 (27.8)
45-54	82 (14.4)
55-64	21 (3.7)
65+	2 (0.4)
<u>Languages other than English at home</u>	
Yes	28 (4.9)
No – Only English	542 (94.9)
<u>Highest Education Level</u>	
Less than Year 12	14 (2.5)
Year 12	66 (11.6)
Other post-school qualification (e.g. VET/TAFE certificate, apprenticeship, diploma)	114 (20.0)
Bachelor Degree	237 (41.5)
Higher than Bachelor Degree	136 (23.8)
<u>Country</u>	
Australia/New Zealand	65 (11.4)
United Kingdom	396 (69.4)

	Open-Plan Office
	(N = 571)
	<i>n</i> (%)
United States of America	101 (17.7)
Canada	2 (0.4)
Europe (exc. UK)	5 (1.0)
Japan	2 (0.4)

Study Procedure

An online cross-sectional survey was utilised because it enabled the researchers to: 1) collect data from anyone who worked in an office; 2) collect data on office workers who complete different types of knowledge work; 3) the researchers did not have to find an organisation to participate in and approve the study; and 4) the researchers were not limited to collecting data in one or a few organisations.

Respondents had to be aged 18 years or older, speak English, and undertake at least 15 hours of paid work per week to complete the 45-minute online survey. The study aimed to survey people working in information intensive work, e.g., researchers, public servants, architects, and computer programmers. People were excluded from participating if they engaged in work which is more physical and technical; involved mainly private communication by its very nature; and/or was largely clerical in nature. Respondents were recruited through word of mouth, flyers, and a paid panel recruitment service (Prolific).

Measures

Office configurations

Respondents were asked to select the office configuration that best represents their “current workspace”. Respondents who worked in multiple workspaces were asked to select the one that best represents their “current” or “main” workspace. Response options were: 1) enclosed office; 2) open-plan; 3) cubicle; 4) hot-desk; and 5) activity-based workplace/combi-office/flexible/creative/innovative space. Enclosed office responses were classified as either single-occupant enclosed office or shared enclosed office based on whether the respondent selected that their office was “not shared with anyone”. Single-occupant enclosed office configurations respondents have been removed from this study.

Personality

Personality was measured using an abbreviated form of the revised Eysenck Personality Questionnaire (EPQR-A) (Francis et al., 1992). Only the six-item extraversion scale was used for this study. Respondents were asked to respond either yes (1) or no (0) to six statements. Items “do you tend to keep in the background on social occasions?” and “are you mostly quiet when you are with other?” were reverse scored. Scores ranged from 0 to 6. A high score on this scale is indicative of a high level of extraversion.

Adaptations

Work environment's adaptability was assessed through a specifically developed list of 26 features that may be available in an office/workspace. The 26 features were divided into four sections: facilities features; personalisation features; flexible work schedule features; social features. Example items from each section are: facilities features – “main computer is portable”; personalisation features – “ability to decorate and personalise desk/workspace”; flexible work schedule features – “can work from home”; social features – “non-work social activities planned for co-workers”. Respondents were asked to “tick the following which you use in your office/workspace”. Each tick was scored 1 and the total number of adaptations ticked was calculated. Scores ranged from 0 to 26.

Office protocols

A 15-item measure was developed to assess how many expectations about appropriate conduct in the workplace had been established. The measure was based on the first component of Brennan et al. (2002) protocol measure, of-which one item was modified and two were added. Items include: “telephone conversational noise”, “use of private study rooms and spaces”, and “clean desk policy”. Respondents were asked to “check each of the following which have established expectations in your work area” from a list of 15 possible office protocols and expectations. Each check was scored 1 and the total number of office protocols/expectations checked was calculated (range 0 to 15).

Health outcomes

(a) Kessler-10

The Kessler Psychological Distress Scale (K10) was used to yield a global measure of psychological distress. It assesses 10 anxiety and depressive symptoms experienced in the last four weeks (Kessler et al., 2002). Scores range from 10 (low distress) to 50 (high distress).

(b) Total health problems

Respondents were asked how often “during the past 4 weeks” they had experienced a range of health conditions: 1 (never), 2 (seldom), 3 (sometimes), 4 (often), 5 (always). A list of 12 was used and examples included: headaches, stomach problems, colds/flu. Total scores could range from 12 to 60.

Productivity

Perceived productivity was measured by a single item from Parkin et al. (2011). Respondents rated the following statement, “The office building provides an environment in which I can be productive”, on a five-point Likert type scale scored: 1 (strongly disagree) to 5 (strongly agree).

Satisfaction

(a) Overall satisfaction with work environment

Respondents were asked to indicate on a five-point scale from 1 (very dissatisfied) to 5 (very satisfied), “overall, how satisfied are you with your work environment?”

(b) Recommend office

Respondents were asked “would you recommend working in your physical office/workspace to others in your profession?”: 1 (strongly not recommend) to 5 (strongly recommend).

(c) General job satisfaction, general turnover and internal turnover

Three sections of the second module (general items) of the Michigan Organisational Assessment Questionnaire (Survey Research Center, 1975) measured general job satisfaction, general turnover, and internal turnover. General job satisfaction was measured with three items: “All in all, I am satisfied with my job”, “In general, I like working here” and “In general, I don’t like my job”. General turnover was measured by two items: “I will probably look for a new job in the next year” and “I often think about quitting”. One item measured internal turnover: “If I had the chance, I would take a different job within this organisation”. Respondents indicated their level of dis/agreement on a seven-point Likert type scale scored from 1 (strongly disagree) to 7 (strongly agree). The score ranges were as follows: general job satisfaction (3-21); general turnover (2-14); and internal turnover (1-7).

(d) Disturbance

Disturbance when working in the office was measured with a five-item measure developed by Parkin et al. (2011). Example items include: “Noise from work-related/social conversations between colleagues” and “visual distraction from movement of people around the office” and were rated: 1 (low) to 3 (high).

(e) Organisational (affective) commitment

The affective commitment scale of Allen and Meyer's (1990) Three-Component Organisational Commitment Questionnaire was used to assess respondent's commitment to their organisation. The scale was modified to improve its suitability and to retain consistency with other measures. Two items were removed from the eight-item scale to improve the scales appropriateness for this study and to reduce its length. Item "I enjoy discussing my organisation with people outside it" was removed because respondents could score high on this measure when they actually enjoy complaining about their organisation to people outside their organisation. Item "I think that I could easily become as attached to another organisation as I am to this one" was also removed. The rating scale was reduced from the original seven-point Likert type scale to five-points scored: 1 (strongly disagree) to 5 (strongly agree) to remain consistent with the other measures used in this study. Responses for all six-items were averaged. Scores ranged from 1 to 5. A high score is indicative of a high affective commitment towards the organisation.

(f) Noise and privacy conditions support work

Satisfaction that noise and privacy conditions support work was measured with four items from Parkin et al.'s (2011) measure: "equipment noise", "people noise", "external noise", and "privacy". Respondents indicated their level of satisfaction on a five-point Likert type scale scored: 1 (very dissatisfied) to 5 (very satisfied). Scores ranged from 1 to 5.

Social measures

(a) Social support

Social support was measured with the Copenhagen Psychosocial Questionnaire (COPSOQ) four-item social support subscale consisting of questions such as "Have you had help and support from your colleagues" and "Has your immediate superior been willing to listen to your work related problems" (Kristensen et al., 2005). Respondents indicated the frequency of perceived social support on a five-point scale scored: 0 (Never/Hardly ever), 25 (seldom), 50 (sometimes), 75 (often), 100 (always). The subscale was averaged with all four items weighted equally. Scores ranged from 0 to 100 with higher scores indicating a high level of perceived social support at work.

(b) Social relations

The three-item COPSOQ social relations subscale consisted of questions such as "Have you worked isolated from your colleagues" and "Have you been part of a group in your work" (Kristensen et al., 2005). Respondents indicated their frequency of perceived

social support on a five-point scale scored: 0 (Never/Hardly ever), 25 (seldom), 50 (sometimes), 75 (often), 100 (always). The first item, “Have you worked isolated from your colleagues” was reverse scored. The subscale was averaged with all three items weighted equally. Scores ranged from 0 to 100. A high score is indicative of a perceived high level of social relations at work.

(c) Sense of community

Sense of community was measured with the COPSOQ three-item subscale consisting of questions such as “Had a good atmosphere between you and your colleagues” (Kristensen et al., 2005). Respondents indicated the frequency of perceived sense of community in the workplace on a five-point scale scored: 0 (Never/Hardly ever), 25 (seldom), 50 (sometimes), 75 (often), 100 (always). The subscale was averaged with all three items weighted equally. Scores ranged from 0 to 100. A high score is indicative of a perceived high sense of community at work.

(d) Team member relations

A modified version Brennan et al. (2002) five-item measure of team member relations was used to measure team member relations in the workplace. The fourth item from Brennan et al. (2002): “I like having the team leaders located with the rest of the team” was removed from the measure because not all respondents will have team leaders located with their team. An additional item was created and added to the remaining four items: “I feel comfortable sharing ideas with team members”. Respondents indicated their level of agreement on a five-point Likert type scale scored: 1 (strongly disagree) to 5 (strongly agree). The score of all five-items was averaged. Scores ranged from 1 to 5. A high score is indicative of a high perception of team member relations.

(e) Collaborative culture

McElroy and Morrow’s (2010) five-item measure of collaboration was used to capture the perceived collaborative culture in their organisation. Example questions are “I confer with my co-workers to discuss work-related issues” and “co-workers in my office location seldom visit with one another about work-related issues” (reverse scored). Respondents gave ratings on a five-point Likert scale from 1 (strongly disagree) to 5 (strongly agree) their level of perceived collaborative culture. A NA (0) option was added for respondents whose work does not involve any collaboration. The score of all five-items were averaged. Scores ranged from 0 to 5. A high score is indicative of employees perceiving their organisation to have a high level of collaborative culture.

(f) Collaboration frequency

A seven-item measure was created specifically for this study to assess collaboration frequency in the workplace. Example items were: “bounced ideas of co-workers” and “solved a problem working with a co-worker”. Respondents were asked to indicate their level of frequency for each item on a five-point Likert type scale scored: 1 (never), 2 (less than weekly), 3 (1-3 times per week), 4 (4-5 times per week), 5 (multiple times each day). The scores from all seven items were averaged. Scores ranged from 1 to 5. A high score is indicative of a high frequency of collaboration in the workplace.

(g) Collaboration important

An item was designed for this study to ascertain the importance of collaboration for respondents to complete their work. Respondents were asked to “indicate the extent to which collaboration with others in your workplace is important to complete your work”. Responses were collected on a five-point Likert type scale scored: 1 (not at all important) to 5 (very important). Scores ranged from 1 to 5. A high score is indicative that collaboration in the workplace is important to complete work.

(h) Staff morale

A single item to assess staff morale was created for the survey. Respondents were asked “how do you describe the morale of the staff in your workplace?”. Responses were collected on a five-point Likert type scale scored: 1 (very poor), 2 (poor), 3 (neutral), 4 (good), 5 (very good). Scores ranged from 1 to 5. A high score is indicative of a perceived high level of staff morale in the workplace.

Data Analysis

First, in-order to explore the relationship between personality and open-plan workplace designs, all offices that were shared by at-least two people were reclassified as open-plan. These included shared-enclosed offices; open-plan cubicles; hot-desks; and activity-based workplace/combi-office/flexible/creative/innovative space.

Second, the effect of personality (introversion / extraversion) on open-plan office workers’ health, productivity, satisfaction, and social interaction outcomes was investigated. Respondents were classified as introverts or extraverts based on their total score on the six-item EPQR-A extraversion scale. A histogram inspection of scores indicated a strong bimodal distribution and so scores were dichotomised into either introvert or extravert and

dummy coded (coded 0 or 1). EPQR-A extraversion total scores of 0, 1, or 2 were coded 0 and classified as introvert; total scores of 4, 5, or 6 were coded 1 and classified as extravert. Respondents who scored 3 (N = 45; 7.9%) were classified as neither introvert or extravert and were removed from analysis. A natural (close to 50% split) was achieved by separating those who scored 0-2 (introvert) on the six-item EPQR-A extraversion scale from those who scored 4-6 (extravert). In total, 295 (56.1%) respondents were classified as introvert, and 231 (43.9%) as extraverts. A final sample of 526 respondents working in shared offices were classified as introverts or extraverts. Differences in outcomes, such as health, productivity, satisfaction and social interaction, were compared between the groups using Independent sample t-tests.

Third, possible ways in which introverts and extraverts adapt to their open-plan work environments were explored. Respondents were asked to select the adaptations and rules/expectations which they use and follow, and any office protocols that have established expectations in their office/workspace. Each selected item was scored 1, and non-selected items were scored 0. Chi-square tests were used to examine the association between the adaptive features and office protocols utilised by introverts and extraverts.

5.4.5 Results

The mean health, perceived productivity, satisfaction, and social interaction scores for introverts and extraverts in open-plan offices are presented in Table 5.17. Compared to extraverts, introverts reported poorer perceived productivity and scored lower on numerous satisfaction measures, most notably those relating to satisfaction with overall work environment, overall job satisfaction, and noise conditions, and on all measures of social interaction. Introverts who worked in open-plan environments also had less organisational (affective) commitment and had significantly higher rates of general turnover, compared to extraverts.

Table 5.17. *Comparison of introverts and extraverts in open-plan offices on outcome variables*

	Introvert	Extravert		
Outcome measure	<i>M (SD)</i>	<i>M (SD)</i>	t	Cohen's d
<u>Health measures</u>				
K10	20.14 (7.16)	18.89 (7.68)	1.93	0.17
Total Health Problems	23.19 (8.83)	24.20 (9.23)	1.29	0.11
<u>Productivity</u>				
Productivity	3.41 (1.00)	3.63 (0.92)	2.64**	0.23
<u>Satisfaction</u>				
Overall workplace satisfaction	3.24 (1.08)	3.49 (1.02)	2.71**	0.24
Recommend office	3.02 (1.16)	3.30 (1.18)	2.69**	0.24
General job satisfaction	14.17 (4.72)	15.51 (4.08)	3.49**	0.30
General turnover	7.96 (3.57)	7.20 (3.70)	2.38*	0.21
Internal turnover	3.74 (1.82)	3.64 (1.90)	0.63	0.05
Disturbance	1.68 (0.54)	1.67 (0.53)	0.25	0.02
Organisational (affective) commitment	2.99 (0.89)	3.30 (0.88)	4.01**	0.35
Satisfaction equipment noise supports your work	3.59 (0.93)	3.77 (0.85)	2.29*	0.20
Satisfaction people noise supports your work	2.78 (1.06)	3.17 (1.02)	4.21**	0.37

	Introvert	Extravert		
Outcome measure	<i>M (SD)</i>	<i>M (SD)</i>	t	Cohen's d
Satisfaction external noise supports your work	3.47 (1.05)	3.51 (1.02)	0.040	0.04
Satisfaction privacy supports your work	2.69 (1.10)	2.99 (1.16)	2.96**	0.27
<u>Social</u>				
Social support	56.55 (22.38)	61.77 (20.92)	2.73**	0.24
Social relations	58.19 (19.94)	64.94 (18.11)	4.01**	0.35
Community	65.51 (20.84)	74.17 (18.62)	5.02**	0.44
Team member relations	3.63 (0.71)	3.93 (0.69)	4.93**	0.43
Collaborative culture	3.72 (0.69)	3.88 (0.68)	2.65**	0.23
Collaboration frequency	2.88 (0.74)	3.17 (0.82)	4.12**	0.37
Collaboration is important to complete your work	3.84 (0.94)	4.03 (0.87)	2.29*	0.21
Staff morale	3.34 (1.03)	3.70 (0.92)	4.25**	0.37

Score range: K10 (10 – 50); Total health problems (12 – 60); General Job satisfaction (3 – 21); General turnover (2 – 14); Internal turnover (1 – 7); Disturbance (1 – 3); Social support (0 – 100); Social relations (0 – 100); Community (0 – 100); All other measures (1 – 5).

* $p < .05$

** $p < .01$

Adaptations

The proportion of introverts and extraverts in open-plan offices who utilise different facilities features, personalisation features, flexible work schedule features, and social features are presented in Table 5.18. Overall, only three respondents (one introvert) did not select any adaptive features. On average extraverts ($M = 10.13$; $SD = 4.30$) used significantly more adaptive features than introverts ($M = 8.87$; $SD = 4.19$), $t(524)=3.37$, $p < .001$. Compared to introverts, extraverts were significantly more likely to use their facility's features of private phone booths/areas to speak on the phone and their office's relaxation facilities and zones. Extraverts were also more likely to personalise their workspace, with significantly more extraverts constructing physical barriers between co-workers (e.g., using plants or books); using sit/stand workstations; movable furniture; and, that they regularly moved the furniture to suit their needs. Extraverts were also more likely to utilise the social features of their work environment such participating in group and team building activities, and attending non-work social activities planned for co-workers. There were no significant differences in the number of flexible work schedule features used by the introverts and extraverts.

Table 5.18. *N (%) introverts and extraverts in open-plan offices awareness or utilisation of office adaptation features*

Feature in office/workspace	Total N = 526 <i>n (%)</i>	Introvert N = 295 <i>n (%)</i>	Extravert N = 231 <i>n (%)</i>	χ^2	Phi
<u>Facilities Features</u>					
Main computer is portable	214 (40.7)	112 (40.0)	102 (44.2)	2.06	0.063
Main phone is portable (not a fixed landline)	137 (26.0)	68 (23.1)	69 (29.9)	3.13	0.077
Private phone booths/areas to speak on your phone	77 (14.6)	35 (11.9)	42 (18.2)	4.14*	0.089
A meeting or private work area can be booked last-minute	237 (45.1)	129 (43.7)	108 (46.8)	0.48	0.030
A meeting or private work area can be booked at a regular time for group use	329 (62.5)	182 (61.7)	147 (63.6)	0.21	0.020
A meeting or private work area can be booked at a regular time for personal use (just you)	160 (30.4)	88 (29.8)	72 (31.2)	0.11	0.014
Quiet/silent work areas	134 (25.5)	68 (23.1)	66 (28.6)	2.08	0.063
Relaxation facilities and zones	105 (20.0)	48 (16.3)	57 (24.7)	5.73*	0.104

Feature in office/workspace	Total N = 526 <i>n</i> (%)	Introvert N = 295 <i>n</i> (%)	Extravert N = 231 <i>n</i> (%)	χ^2	Phi
Provision of other facilities - I.e. coffee shop/café, gym, landscaped outdoor gardens	206 (39.2)	115 (39.0)	91 (39.4)	0.01	0.004
Loud and quiet areas are far apart– I.e. Lunch room is not right next to a quiet work zone	129 (24.5)	73 (24.7)	56 (24.2)	0.02	0.006
<u>Personalisation Features</u>					
Ability to decorate and personalise desk/workspace	308 (58.6)	169 (57.3)	139 (60.2)	0.44	0.029
Can load photos onto computer desktop	246 (46.8)	132 (44.7)	114 (49.4)	1.10	0.046
Constructing physical barriers between co-workers – I.e. books, plants, photos, hang coats etc.	96 (18.3)	43 (14.6)	53 (22.9)	6.08*	0.108
Sit/stand workstations	142 (27.0)	67 (22.7)	75 (32.5)	6.26*	0.109
Movable furniture	128 (24.3)	62 (21.0)	66 (28.6)	4.02*	0.087
People regularly move the furniture to suit their needs	84 (16.0)	37 (12.5)	47 (20.3)	5.88*	0.106

	Total	Introvert	Extravert		
Feature in office/workspace	N = 526	N = 295	N = 231	χ^2	Phi
	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)		
<u>Flexible Work Schedule Features</u>					
Flexible hours – I.e. Can use the office in less busy times	229 (43.5)	118 (40.0)	111 (48.1)	3.42	0.081
Ability to schedule your work tasks around how busy the office is – I.e. Complete complex tasks during quiet periods, and mundane/routine work during busy/peak periods.	238 (45.2)	126 (42.7)	112 (48.5)	1.74	0.058
Ability to avoid most annoying regular distractions - I.e. If you know that a colleague makes a loud phone call every morning, then you can use that time to do your photocopying and grab a coffee.	170 (32.3)	87 (29.5)	83 (35.9)	2.46	0.068
Can take your lunch break when you want	387 (73.6)	212 (71.9)	175 (75.8)	1.01	0.044
Can work from home	196 (37.3)	114 (38.6)	82 (35.5)	0.55	0.032
People generally work from home when sick	194 (36.9)	100 (33.9)	94 (40.7)	2.57	0.070

	Total	Introvert	Extravert		
Feature in office/workspace	N = 526	N = 295	N = 231	χ^2	Phi
	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)		
<u>Social Features</u>					
Group and team building activities	190 (36.1)	85 (28.8)	105 (45.5)	15.55**	0.172
Non-work social activities planned for co-workers	254 (48.3)	128 (43.4)	126 (54.5)	6.46*	0.111
There is a designated place for co-workers to eat lunch together	303 (57.6)	177 (60.0)	126 (54.5)	1.58	0.055
There is a designated time when co-workers eat lunch together	63 (12.0)	42 (14.2)	21 (9.1)	3.26	0.079
*$p < .05$ **$p < .01$					

Protocols

Table 5.19 indicates the number of introverts and extraverts with established expectations about appropriate conduct in shared work environments. Overall, 39 respondents (27 introverts) did not select any office protocols. On average extraverts ($M = 4.69$; $SD = 2.88$) selected more office protocols than introverts ($M = 3.61$; $SD = 2.66$), $t(524) = 4.48$, $p < .001$. Compared to introverts, extraverts reported significantly more protocols for 10 of the 15 measured behaviours in their open-plan work environment: Face to face conversational noise; telephone conversational noise; meeting noise; use of social spaces and/or common areas; odours (e.g., food, cologne, perfume); appropriate traffic flow for workers and/or visitors; respecting the privacy of others; use of headphones (e.g. don't interrupt someone wearing headphones); personal space "markers" (e.g., plants, photos, posters); and borrowing materials (e.g., manuals). No significant differences were recorded for the remaining five office protocols.

Table 5.19. *N (%) introverts and extraverts in open-plan offices with established expectations about appropriate conduct in the workplace*

<u>Expectation</u>	Total N = 526 <i>n (%)</i>	Introvert N = 295 <i>n (%)</i>	Extravert N = 231 <i>n (%)</i>	χ^2	Phi
Face to face conversational noise	252 (47.9)	125 (42.4)	127 (55.0)	8.25**	0.13
Telephone conversational noise	235 (44.7)	116 (39.3)	119 (51.5)	7.79**	0.12
Meeting noise	115 (21.9)	51 (17.3)	64 (27.7)	8.23**	0.13
Use of “breakout rooms”	127 (24.1)	72 (24.4)	55 (23.8)	0.03	0.01
Use of private study rooms and spaces	91 (17.3)	48 (16.3)	43 (18.6)	0.50	0.03
Use of social spaces and/or common areas	107 (20.3)	48 (16.3)	59 (25.5)	6.87**	0.11
Odours (e.g., food, cologne, perfume)	147 (27.9)	70 (23.7)	77 (33.3)	5.94*	0.11
Appropriate traffic flow for workers and/or visitors	87 (16.5)	40 (13.6)	47 (20.3)	4.32*	0.09
Respecting the privacy of others	229 (43.5)	106 (35.9)	123 (53.2)	15.80**	0.17
Use of speakers	103 (19.6)	61 (20.7)	42 (18.2)	0.51	0.03

<u>Expectation</u>	Total N = 526 <i>n</i> (%)	Introvert N = 295 <i>n</i> (%)	Extravert N = 231 <i>n</i> (%)	χ^2	Phi
Use of headphones (e.g. don't interrupt someone wearing headphones)	124 (23.6)	55 (18.6)	69 (29.9)	9.06**	0.13
Personal space "markers" (e.g., plants, photos, posters)	73 (13.9)	33 (11.2)	40 (17.3)	4.07*	0.09
Borrowing materials (e.g., manuals)	125 (23.8)	60 (20.3)	65 (28.1)	4.35*	0.09
Clean desk policy	207 (39.4)	113 (38.3)	94 (40.7)	0.31	0.02
People work from home when sick	126 (24.0)	66 (22.4)	60 (26.0)	0.92	0.04

* $p < .05$

** $p < .01$

5.4.6 Discussion

This study investigated whether adaptation to shared or open work environments was associated with personality differences. As hypothesised, introverts reported poorer outcomes on a range of measures relating to their productivity, satisfaction, and social interactions. Notably, compared to extraverts, introverts reported lower scores for perceived productivity, satisfaction with overall work environment, overall job satisfaction, organisational (affective) commitment, satisfaction that noise (except external) and privacy conditions support their work, and all measures of social interaction. Introverts also had significantly higher rates of general turnover, compared to extraverts. However, health outcomes were not found to be related to personality differences. A second part of the study investigated whether personality influenced people's adaption to shared work environments. These results showed that, although the majority of respondents utilised strategies to adapt to their offices, extraverts reported this activity more than introverts. In particular, extraverts were significantly more likely to personalise their environment, take advantage of social features, and work in offices with established expectations than introverts.

The finding that introverts reported poorer outcomes in shared office environments has not been consistently found in all studies (e.g., Gehlmann, 1992; Seddigh et al., 2016). For example, Seddigh et al. (2016) showed that, although there was a significant relationship between efficacy and extraversion, no significant interaction was observed between office type and personality. However, our findings are generally consistent with the broader literature relating to office design and the characteristics of introverts. Noise is a common complaint in shared work environments, with many workers reporting higher levels of dissatisfaction with the acoustic conditions as compared with those in single-occupant offices (e.g., Kaarlela-Tuomaala et al., 2009; Kim and de Dear, 2013). Moreover, studies on a range of tasks have shown consistent relationships between introversion, noise and performance with introverts found to be more negatively affected by background noise than extraverts, particularly on complex cognitive tasks (e.g., Furnham and Allass, 1999; Furnham and Strbac, 2002; Belojevic et al., 2001). These findings are consistent with Eysenck's (1981) model that proposed that extraverts have a higher level of optimum cortical arousal than introverts that enables them to tolerate higher levels of external (often social) stimulation before experiencing fatigue (Furnham and Strbac, 2002). Thus, introverts become more rapidly fatigued when exposed to continual external stimulation. Consequently, introverts have been found to prefer to work or study in quieter locations away from noise, whereas extraverts are more likely to choose noisier areas (Campbell and Hawley, 1982).

Introverts scored significantly lower than extraverts on all social measures. This finding is consistent with McCusker's (2002) dissertation which similarly found a positive association between higher scores of extraversion and both greater levels of satisfaction with the open-plan work environment's communication climate, and the feedback office workers receive in their open office spaces. This lower sociability is likely attributable to introvert's preference to keep to themselves and to partake in solitary activities (Oseland, 2009). However, it is important to acknowledge the possibility of selection effects in that introverts may be more likely to be drawn to occupations which do not require high levels of social interaction and collaboration. In support of this view, introverts were found to be significantly less likely than extraverts to perceive collaboration to be important to complete their work.

The second principal finding in this study which extends previous work is that extraverts appeared more willing to adapt to shared work environments. For example, extraverts were significantly more likely to engage in the social opportunities offered by their shared work environment and reported greater use of opportunities to personalise their workplace. These findings suggest that introverts will continue to keep to themselves in shared work environments and, despite their lower levels of workplace satisfaction, appear to make fewer attempts to customise their work environment. It is possible that introverts do not feel comfortable utilising some of their workplace's adaptive features such as moving office furniture or utilising relaxation facilities/zones, because this may increase interactions with others or having to be assertive and make their needs known to others. It is also possible that compared to extraverts, introverts simply had less adaptive features available for their use in their workspaces. Finally, extraverts may be more aware of office protocols as they are more likely to need to modify their social behaviours in the office (e.g., when they speak too loudly or form conversational groups). Nonetheless, further qualitative work that asks more detailed questions about the experiences of introverts and extraverts may be needed to investigate how workers adapt to shared workplace designs.

Limitations / Strengths

Several important limitations need to be taken into account when interpreting these findings. The study was based on a convenience sample and used a self-report methodology, so it is unclear whether the findings can be generalised to all office workers and whether the responses reflect actual differences in behaviour. Furthermore, the use of a cross-sectional

design means that causation cannot be inferred from the results (Sedgwick, 2014). The measure of adaptive features did not include a “feature not available” option. Therefore, it is possible that the differences in the number of adaptive features utilised between introverts and extraverts is due to availability rather than personality differences. The study also examined differences in office design only at a macro-level (shared vs. single), so it would be possible to conduct more nuanced studies of differences between different types of shared design. Nevertheless, given that introverts generally like fewer distractions and may prefer greater time alone, we believed that this higher level of division of office design was conceptually useful and avoided some of the ambiguities that can arise when trying to differentiate between slightly different open-plan designs. The study also was able to demonstrate differences using a diverse sample and across a range of measures.

5.4.7 Summary

Overall the findings suggest that introverts have worse experiences in shared work environments than extraverts, with significantly lower scores across measures of productivity, satisfaction and social interaction. It also showed that introverts may be less willing or able to adapt to these shared environments, even when attempts are made to facilitate this process. Future research could build upon these findings by examining whether hybrid office designs can be developed that meet the needs of people who differ along the introversion-extraversion dimension or if introverts can be encouraged to take greater advantage of protocols and strategies that might help them fare better in more shared office environments.

6 Future Office Designs

This chapter will explore the future of office designs. In particular, the influence of the current global pandemic, COVID-19, and the transformative impact this is having on office designs and where people work around the world is examined. The chapter contains a narrative review to explore how issues raised in this thesis may be addressed by innovative office designs and to provide commentary on how COVID-19 is changing how and where people work. This paper is not intended to be an empirical study, rather, the paper intends to provide a connection between the empirical research collected in this thesis pre COVID-19 to the current context and discuss the potential implications for future office designs. The paper observes how pre COVID-19 three International companies used innovation to overcome some common open-plan office complaints. The paper then explores how COVID-19 has impacted the way people work globally and concludes with a discussion on the possible implications of this transformation for the future of office design.

6.1 Publication: The future of office design: A narrative review of innovative workplaces and COVID-19 influences

6.1.1 Statement of Authorship

Statement of Authorship

Title of Paper	The future of office design: A narrative review of innovative workplaces and COVID-19 influences
Publication Status	☐ Published ☐ Accepted for Publication ☐ Submitted for Publication ☒ Unpublished and Unsubmitted work written in manuscript style
Publication Details	

Principal Author

Name of Principal Author (Candidate)	Olivia Isabel Shirley James		
Contribution to the Paper	Conceptualised and designed the study, collected the data, completed the data analysis, interpreted the results and drafted the manuscript.		
Overall percentage (%)	80		
Certification:	This paper reports on original research I conducted during the period of my Higher Degree by Research candidature and is not subject to any obligations or contractual agreements with a third party that would constrain its inclusion in this thesis. I am the primary author of this paper.		
Signature		Date	19/01/21

Co-Author Contributions

By signing the Statement of Authorship, each author certifies that:

- the candidate's stated contribution to the publication is accurate (as detailed above);
- permission is granted for the candidate to include the publication in the thesis; and
- the sum of all co-author contributions is equal to 100% less the candidate's stated contribution.

Name of Co-Author	Paul Delfabbro		
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Signature		Date	19/1/21

Please cut and paste additional co-author panels here as required.

6.1.2 Abstract

The current global pandemic, COVID-19, has resulted in a significant transformation in how and where people work. The current paper aimed to provide commentary around the future of workplace environments through using examples presented in five case studies. The paper examined how three organisations had implemented innovative design concepts over the last decade to overcome some common complaints of open-plan work environments. The paper then discussed how the current global pandemic was influencing office design and examined two keyways businesses have adapted: (1) physical office space adaptation and (2) remote working. The paper then explored the future of workplace environments in a post COVID-19 world. There is no doubt that workplace environments are about to enter a new era as a result of COVID-19. This may be an opportunity for businesses to re-evaluate the role and purpose of their current work arrangements to ensure they are tailored to their needs and to maximise the potential of alternative office designs.

6.1.3 Introduction

Throughout time offices have changed and evolved in response to a range of external factors. The last few decades have been characterised by an increase in technological capability, rise in knowledge-based work, and an increased complexity of problems which often require the collaboration of specialised individuals to solve (Kaarlela-Tuomaala et al., 2009). The combination of these three factors lead to the most recent office trend: open-plan offices – characterised by their open-spaces, shared areas and lack of physical barriers (Davis et al., 2011). It was believed that the lack of physical barriers would encourage and facilitate collaboration and communication between colleagues (Maher & von Hippel, 2005; Oldham & Brass, 1979). Open-plan office design was also adopted because of its lower cost to management as compared to more traditional cellular office designs (Brennan et al., 2002). Office real estate is often a business's second largest expense after their human resources (Pole & Mackay, 2009), so that considerable savings can be made by reducing floor area occupied by workers. As a result, of these two key factors, office environments underwent a large transformation and in 2010, the International Facility Management Association and Corenet Global estimated that more than 70% of office workers in the United States of America worked in an open-plan office (Congdon et al., 2014).

Nonetheless, the last decade has seen open-plan offices widely scrutinised, with research finding open-plan offices to be negatively associated with a range of negative outcomes including decreased productivity (e.g., Oommen et al., 2008), reduced job satisfaction (e.g., de Croon et al., 2005; Oommen et al., 2008); decreased satisfaction with work environment (e.g., Bergström et al., 2015; Kim & de Dear, 2013); reduced privacy (e.g., de Croon et al., 2005; Oommen et al., 2008); increased stress (e.g., Seddigh et al., 2014), and greater spread of contagious conditions such as the common cold and the flu (Oommen et al., 2008). As a result, researchers, architects, designers, and business decision makers have endeavoured to create innovative solutions in an attempt to overcome the many negative issues often reported in shared work environments.

Businesses are also beginning to view their work environment as an asset which can be leveraged to differentiate themselves and attract talent to their organisation (Coster & Govan, 2015). In-particular, more innovative and flexible office designs could be used to allure younger workers. Research has found that Millennials report being more satisfied working in a culture that is creative and inclusive (Deloitte, 2016), seek work-life balance (Deloitte, 2016), desire the opportunity to work flexibly and sometimes remotely (Deloitte,

2016), and are attracted by “cool” spaces to work (Sujansky & Ferri-Reed, 2009). As a result, businesses are attempting to create workplaces that are more than just a space to work. Offices are increasingly trialling social hubs with shared working areas, cafeteria style kitchens, coffee shops, gyms, and areas for relaxation (e.g., Lomholt, 2019). New designs also aim to spark creativity with colour, varied textures, “fun” furniture, and are sometimes designed to reflect the organisation’s values and their products (Merit, 2017; Ryan, & Winfrey, 2019). Such innovative office designs are often inspired by Silicon Valley companies and big multinational corporates such as Google with their playful designs and office benefits (Merit, 2017).

Just as the rise of technology and information-based work greatly transformed the way in which we work, how and where we work is currently undergoing another significant transformation as a result of the current severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) global pandemic – more commonly referred to as COVID-19. COVID-19 is a type of coronavirus transmitted from human to human through both contact and airborne droplets (World Health Organisation, 2020b). The outbreak originated in Wuhan, China in December 2019, and on March 11th, 2020, the World Health Organisation (WHO) declared COVID-19 a global pandemic (World Health Organisation, 2020c). With no cure, and (until recently) no effective vaccine, the most effective method to minimise the spread of COVID-19 is through comprehensive hygiene practices and social distancing (World Health Organisation, 2021). Social distancing rules have spread around the world (Le et al., 2020), with the Australian Government requiring everyone to remain at-least 1.5m away from each other (Safe Work Australia, 2020b). As a result, office environments which had been specifically designed to create human collisions and chance interactions – believed to spark the next big idea (Goldstein, 2006), have been redesigned to physically distance colleagues and to minimise face-to-face interactions. Furthermore, tough lockdown restrictions around the globe have forced many businesses to close their physical offices and ask employees to work remotely from their homes (Bick et al., 2020; Dubey & Tripathi, 2020). Whilst organisations may have previously considered work from home arrangements, with some already offering this remote option; COVID-19 has resulted in many businesses quickly adapting, and many employees working from home for the first time (Bick et al., 2020). As a result, it was estimated that the percentage of the US workforce who worked entirely from home increased from 8.2 percent in February 2020, to 35.2 percent in May 2020 (Bick et al., 2020). The longer-term effects of the global pandemic on office design have been widely speculated and it does not seem unreasonable to hypothesise that our work environments are entering a new era.

The current paper

The office work environment continues to change and is presently undergoing a period of significant transformation. Office designers have endeavoured to create new innovative office designs which are cost-effective, enticing to potential employees, and overcome common open-plan office complaints. Furthermore, the global COVID-19 pandemic has drastically influenced how and where people work around the world and has had great impacts on offices. Accordingly, the aim of this paper is to examine innovative office designs implemented by organisations globally and the possible future of office designs. In this paper, we examine various innovative and new models of office design and discuss them in relation to the empirical psychological research. The paper then investigates how the work environment has adapted to the global pandemic COVID-19. The paper also explores the future of offices in the post COVID-19 world. The specific research questions addressed in this paper were as follows: (1) To link case studies to the empirical psychological research; (2) Examine three case studies of innovative shared office designs (created pre COVID-19); (3) Examine two ways in which workplaces have been adapted during the COVID-19 global pandemic; (4) Discuss the future of office design in a post COVID-19 world.

6.1.4 Method

A systematic Google search was conducted to find three innovative and new models of workplace design which were utilised before COVID-19. A Google search of the term “innovative office” was conducted on 29th July 2020. The search produced around 759,000,000 results, of which the first 20 pages of search results were screened. After 10 pages the search ‘hits’ began to lose relevance and repeat ‘hits’ appeared. In particular, many hits were on innovative office furniture and for organisation’s “office of innovation”. The search resulted in 34 relevant hits which were investigated further. Three case studies were selected for this paper based on their innovative design features and the amount of available information on their designs. The rules and regulations for offices to operate in Australia during COVID-19 were then researched and an office which had been adapted for COVID-19 was found. Finally, remote working from home was explored.

6.1.5 Pre COVID-19 Innovative Workplaces Case Studies

The following three case studies were selected for their innovative and forward-thinking office designs which aimed to overcome some of the more common complaints of shared-workplace designs and equip their workers for the future. All three offices were designed before the COVID-19 global pandemic.

6.1.5.1 *Microsoft Headquarters, Munich, Germany*

Completed in 2016, Microsoft Germany's headquarters in Schwabing district of Munich was designed by HPP Architects as the "Workplace of the future" (Lomholt, 2019). Microsoft developed the new slogan "#Worklifeflow" as an alternative to the more common phrase of work-life balance to describe their new way of working at the German headquarters (Lomholt, 2019). This worklifeflow motto became the guiding principle for HPP when developing their workplace of the future. The design aims to provide employees the freedom to choose how they work; and to promote individual talent, team spirit, and collaboration (Lomholt, 2019).

The 29,765m² office utilises an activity-based workplace design whereby employees are able to individually organise their workday by selecting the office workspaces most suitable to their tasks and individual needs (Lomholt, 2019). This approach aims to address the problem that office workers typically complete numerous tasks that are suited to different office conditions (Appel-Meulenbroek et al., 2011). Microsoft Germany's headquarters utilises a desk sharing concept which enables an occupancy of 1,900 employees to share the 1,200 workstations across six floors (Lomholt, 2019). In that way, the headquarters comprises "anchor" areas for respective departments, rather than designated workspaces.

Microsoft Germany's headquarters is organised into four working areas: (1) accomplish; (2) share and discuss; (3) converse; (4) think (see Figure 6.1) (Lomholt, 2019). Employees are encouraged to select the space based on their tasks needs and personal preference. The accomplish area comprises desks for people to complete independent but not necessarily highly cognitively demanding work (Lomholt, 2019). The share and discuss area is designed for creative exchanges between colleagues (Lomholt, 2019). The converse space is designed for projects that are collaborative but also require intense concentration within teams (Lomholt, 2019). The think area has been specifically designed to facilitate highly concentrated independent work with cubicles and lounges to provide privacy, noise reduction and comfort (Lomholt, 2019). The idea is that workers will be able to complete focused work in silent working conditions and have spaces to collaborate without disturbing others.



Figure 6.1. Image of different working areas in Microsoft Germany's headquarters (Lomholt, 2019)

Additionally, a range of spaces for formal and informal meetings span the six office floors. This includes: 70 conference rooms; 136 focus rooms which each accommodate four employees; around 100 phone rooms for undisturbed calls; and numerous kitchen hubs with varied seating arrangements (Lomholt, 2019). Microsoft also aims to enable collaboration with the public. Publicly accessible spaces within the headquarters include a “digital eatery” cafeteria which is a hybrid café and showroom; a 400-seat canteen; conference rooms with the latest media technology; a 150-occupant hall; and four multi-purpose rooms that can accommodate around 700 people (Lomholt, 2019).

Finally, technology is the heart of Microsoft. Therefore, it is not surprising that Microsoft has incorporated technology into its design to maximise its office space and to assist employees. Research has found a limitation of activity-based workplace designs to be that employees do not utilise the different spaces to suit their tasks and that they can become territorial over certain spaces (Appel-Meulenbroek et al., 2011). To help overcome this potential issue, Microsoft utilises technology to see which spaces are most popular and those that are underutilised (ORTechnologies, n.d.). Management can then investigate why spaces are being under used and make suitable changes. There is also an app to find colleagues within the six-story office building, a common problem in large offices which utilise a desk-sharing concept (ORTechnologies, n.d.; Rolfö et al., 2018).

6.1.5.2 *Medibank Place, Melbourne, Australia*

Medibank, Australia's largest private health insurer, aspired to create one of the healthiest headquarters in the world to reflect their company's ethos (Mackenzie, 2015). Medibank Place, located in Melbourne's Docklands was designed with occupants' physical, mental and social health in mind (Mackenzie, 2015). Constructed in 2014, the 46,000sqm net lettable area (NLA) includes 26,000sqm NLA of Medibank workspaces (Hassell, n.d.). Medibank Place was designed through the collaboration of architects, landscape architects, and interior designers. The building was designed around four interconnected themes: health, collaboration, innovation, and inspiration (Mackenzie, 2015). Medibank Place was designed to create "a spirit of collaboration" within the organisation with an emphasis on group effort and teamwork. Designed to accommodate up to 2,610 people, 1,600 Medibank staff were brought together from six offices across Melbourne for the first time (Mackenzie, 2015).

The building aims to go beyond an activity-based workplace design, to create what Hassell (n.d.) label "healthy based working (HBW)". Employees are provided with the freedom to choose how and where they work from a selection of more than 26 different work settings which range from indoor quiet spaces to collaborative hubs to wifi-enabled balconies (Hassell, n.d.). Similar to flagship innovative companies such as Google, Medibank Place aims to be more than a place to work. The headquarters incorporates a range of other facilities to promote a healthy lifestyle including a multi-purpose sports court, an edible garden, and a demonstration kitchen which promotes healthy eating (Hassell, n.d.). Medibank Place also invites the public to utilise its timber amphitheatre, cafes, shops and a public park all of which provide a gateway to the Dockland's precinct (Hassell, n.d.). Moreover, a range of features have been designed with the occupant's health in mind. Medibank Place utilises circadian lighting which is designed to mimic natural daylight to help support employee's biorhythms (Hassell, n.d.). The headquarters is filled with 2,300 indoor plants, 520 plants on the façade, and two 25-metre high green walls (Hassell, n.d.). Not only do the indoor plants provide greenery in the heavily urban surround, but research suggests that plants can help relieve stress in office work environments (Toyoda et al., 2020). Finally, staff are encouraged to take the stairs as the two continuous staircases have been designed to be more convenient than the lifts (see Figure 6.2) (Hassell, n.d.).



Figure 6.2. Image of Medibank Place (Mackenzie, 2015)

Post-occupancy data suggests that Medibank Place is associated with positive outcomes for the employees. Since relocating into Medibank Place, 79% of employees reported working more collaboratively; 70% reported feeling healthier; 66% said they were more productive (Hassell, n.d.).

6.1.5.3 Moneypenny Headquarters, Wrexham, United Kingdom

Designed by AEW architects, Moneypenny Headquarters, aspires to be the “happiest workplace” in the United Kingdom (Ruthven, 2016). Constructed in 2016, the 91,000ft²/8,454.18m² Moneypenny Headquarters is located on a 10-acre semi-rural site in Wrexham, United Kingdom (ArchDaily, 2017). Employees are at the heart of Moneypenny’s business and Moneypenny endeavoured to create an office which reflects this. To create the UK’s happiest workplace, Moneypenny employees were invited to share their thoughts, ideas and suggestions during the design process which were then incorporated into the final design (Ruthven, 2016). This is a key strength of Moneypenny’s approach as research has found that employees are more trusting of management during an office change if they have had an input into its design and are a part of the transformation process (Morgan & Zeffane, 2003). The Moneypenny office was designed to focus on the people working within it, with an emphasis placed on bringing people together from multiple offices and inspiring them through design (ArchDaily, 2017). Moneypenny wanted to create an office environment which people really wanted to be in and provided the designers a brief which stipulated that they “ignore the norm and create a space that inspires” (ArchDaily, 2017).

The office design is thought to rival the Internationally renowned innovative office designs of companies such as Google and Apple (ArchDaily, 2017). Moneypenny headquarters comprises of two three-story wings attached to a 17m high central atrium referred to by Moneypenny employees at “The Middle” (ArchDaily, 2017). The Middle is the heart of Moneypenny headquarters and was designed to ensure that employees felt connected to the middle no matter where they were located within the building. This was achieved through the large picture windows looking directly into The Middle and bridge links connecting the two wings across The Middle. The Middle also includes a meeting room designed to resemble a treehouse, an indoor terrace and stadium seating (see Figure 6.3). The workplace is also filled with breakout areas, quirky furniture, meeting rooms, vegetable gardens and has its own pub. Furthermore, Moneypenny’s semi-rural location is maximised through the landscaped gardens which include a meadow, a woodland, an orchard, and a wetland, all of which can be accessed via a nature trail that connects the internal office environment to its surroundings (ArchDaily, 2017). Overall, Moneypenny headquarters aims to be a fun and welcoming workplace in which employees feel “inspired, enthused, and above all happy” (Moneypenny, 2020). Finally, Moneypenny claims to be “one of the most acoustically innovative buildings” in the UK with its combined use of “bespoke sound absorption and elimination technology”, an important consideration in what is traditionally a noisy call centre environment (Moneypenny, 2020) and a key complaint in open-plan work environments (e.g., Kaarlela-Tuomaala et al., 2009).



Figure 6.3. Image of “The Middle” at Moneypenny Headquarters (ArchDaily, 2017)

6.1.6 COVID-19 Adapted Work Designs

The COVID-19 global pandemic has affected how and where people work. Two keyways in which the pandemic has influenced office design are discussed below with case study examples.

6.1.6.1 COVID-19 adapted open-plan office and discussion of government regulations

Some organisations have chosen to modify their office work environments so that their employees are still able to attend their workplace during the global pandemic (e.g., Wilson, 2020). In-order to remain open, businesses must ensure that their office is designed in accordance with the rules and regulations set by the relevant governing authority. In Australia, these restrictions and requirements depend on the industry and vary across Australia's states and territories (Safe Work Australia, 2020b). Public health directions in Australia include: limits on public gatherings; physical distancing (e.g., 1.5m between people) and density requirements (e.g., 2 or 4 metres per person); room capacity limits; hygiene, cleaning and signage requirements; keeping records of contact details to assist contact tracing; and limits and restrictions on operations, including types of businesses or facilities remaining closed and limitations on activities (Safe Work Australia, 2020b). Furthermore, some businesses and organisations within Australia are required to have a "COVIDSafe" plan to operate. This plan should outline how the workplace: (1) will be prepared to prevent infection; (2) will respond if there is a COVID-19 case; and (3) how it will recover after infection (Australian Government Department of the Prime Minister and Cabinet, 2020).

Regardless of the specific rules and regulations applicable to a business; all businesses are required to do everything they reasonably can to limit the spread of COVID-19 (Safe Work Australia, 2020b). Measures include: ensure workers practice physical distancing, by keeping 1.5 metres between people and abiding by capacity limits; maintain a hygienic and clean workplace; remind workers to practice good hygiene and make hand sanitiser and cleaning products readily available; learn to spot the symptoms of COVID-19 (fever, cough, sore throat and shortness of breath); ensure workers do not come to work if they are unwell; train workers how to fit and use personal protective equipment appropriately; and provide flexible work arrangements to help reduce office capacity – e.g., staggered work times and alternate days in the office/home (Safe Work Australia, 2020b; Safe Work Australia, 2020e).

6.1.6.1.1 Six Feet Office, Amsterdam, Netherlands

Commercial real-estate company, Cushman & Wakefield, are experienced in helping businesses adapt to COVID-19 as they have successfully assisted the return of one million people to 10,000 offices in China (Chung, 2020). This case study demonstrates how Cushman & Wakefield modified their own open-plan office to be suitable for employees to work in during the COVID-19 pandemic. Led by Jeroen Lokerse, the “Six Feet Office” was developed within Cushman & Wakefield’s Amsterdam headquarters (Wilson, 2020). The office space was redesigned in one-week to encourage social distancing and better hygiene practices so that employees could still work in the office during the global pandemic. The project is fundamentally built around physical distancing to ensure that people remain at-least six feet away from each other at all times. The Six Feet Office uses its design and visual signs to encourage behaviour change (Wilson, 2020). Desks are physically spaced, and grey circles have been embedded into the carpet around each desk (see figure 6.4) to ensure that colleagues remain at-least six-feet away from each other (Wilson, 2020). Arrows have been placed on the floor to direct traffic around the office in a clockwise direction (Wilson, 2020). This one-way traffic approach was inspired by healthcare workers in hospitals (Wilson, 2020). Workers also place a paper placemat on their desks which is disposed of at the end of each day (Wilson, 2020). This is to help reduce the spread of COVID-19 on office surfaces. Cushman & Wakefield have also utilised technology to assist them with social distancing within the workplace. Beacons installed throughout the office are used to track employee movements throughout the workplace via their phones (Wilson, 2020). This helps to audit the office design’s efficiency. Furthermore, this technology can be used to audibly notify employees when they are too close to each other (Wilson, 2020). Such extreme measures may, however, be not so easily translatable to other countries and cultures which may resent this level of corporate control and monitoring over their movements.



Figure 6.4. Image of Cushman & Wakefield's Six Feet Office (Wilson, 2020)

There are concerns however, that physically distancing staff and increased hygiene measures may not be enough to contain the spread of COVID-19 as the virus has been shown to still be viable as an aerosol after three hours (van Doremalen et al., 2020) and to live on surfaces for up to seven days (Chin et al., 2020). This is particularly concerning for poorly ventilated and filtered office buildings (Wilson, 2020). Furthermore, high touch shared office areas such as bathrooms, kitchens, and lifts will need to be managed and regularly cleaned as these highly shared areas pose a heightened risk of spreading the virus (Safe Work Australia, 2020a). Finally, it is crucial that businesses promote and enforce that employees must stay home if they experience even the mildest of symptoms.

6.1.6.2 Work from home

Due to the COVID-19 global pandemic and the resulting widespread lockdowns, many businesses around the world were forced to close their offices. As a result, many businesses found themselves quickly adapting to remote work, with many working from home for the first time. Previously businesses may have considered or offered remote work options to some of their staff, but very few were entirely remote (OECD, 2020). Pre COVID-19, managers may have been apprehensive about adapting remote work options due to concerns around staff productivity, difficulties with managing remote employees, work health and safety regulations, and technology (Colley & Williamson, 2020a). COVID-19 and its associated lockdowns, forced many businesses to quickly adapt and enable workers to work from home as this was the only option for the business to remain open and continue its operations during the pandemic. It was as though the world had entered a global experiment

on remote working overnight. The following case study explores how Panasonic Corporation of North America adapted to work from home during the COVID-19 pandemic.

6.1.6.2.1 Panasonic Corporation of North America

Panasonic Corporation of North America began adopting mobile forms of work in 2011 with the introduction cloud computing initiatives, and security and privacy policies (Waddill, 2020). However, it wasn't until the COVID-19 pandemic that the majority of employees shifted to work remotely with stay-at-home orders in place. For many, this was their first time working from home. Panasonic was able to build on their existing digital HR strategy to assist the transition for the majority of their workforce to work from home. Panasonic's HR digital strategy includes a cloud-based human capital management (HCM) system which can be accessed by employees through the self-service portal, and collaboration software which enables communication, collaboration and knowledge-sharing between employees (Waddill, 2020). A communication strategy was implemented and included the use of messaging software and video podcasts to keep employees informed (Waddill, 2020). Moreover, the existing communication software which had previously been used for work collaboration, was also utilised for connection on a personal level to facilitate weekly updates, social events and informal communication (Waddill, 2020).

The majority of Panasonic's employees had laptops which they could take home. Panasonic also assisted employees to arrange additional equipment needs, such as employees who used a tower computer in the office or required dual monitors. Panasonic conducted a two day "dry run" to test the system's capabilities and to mitigate any potential load issues for the network (Waddill, 2020). No major issues occurred during the dry run, which reassured Panasonic that their employees should not have any issues when trying to access the systems remotely. Finally, Panasonic were able to utilise their existing work-from-home policy so that there were no significant interruptions to workflow (Waddill, 2020).

The following observations for Panasonic employees were made during COVID-19. Employees reported difficulty unplugging from work, with some working much longer hours than before, negatively affecting their work-life balance (Waddill, 2020). In-contrast to what many may have expected, productivity did not decrease, in-fact it may have actually increased during COVID-19 (Waddill, 2020). A shift in purpose is occurring with a greater sense of we are "rowing the boat together" towards a unified goal. Employee engagement has also soared with employees "100 percent engaged" during their allocated work hours. Finally, Panasonic's HR has created the following initiatives to help combat the sense of

isolation that is often associated with remote work: online wellness incentives; bulletins; sharing ideas for taking care of self and family; access to audible books on best practices working remotely; and regular check ins (Waddill, 2020).

As a result of the transitions made in response to COVID-19, anticipated future modifications to Panasonic's HR processes and procedures include: (1) incorporating more flexibility around work hours and location into Panasonic's work-from-home policy; (2) reducing paper usage; (3) adjusting metrics and objectives for performance assessment measures tied to remote workers' productivity, regardless of location; (5) hiring agile and adaptable staff; (6) using the existing HCM to conduct interviews and onboard virtually; (7) adding a management-level self-service to the self-service portal; and (8) reinforcing the positive cultural changes that have occurred as a result of this experience (Waddill, 2020).

6.1.7 Discussion

The current paper aimed to explore how offices have developed over the last decade. Many organisations have incorporated innovative designs in an attempt to adapt to the continually changing work landscape, to help maximise their office spaces, and to minimise the impact of the widely researched negative outcomes associated with the most recent era of open-plan designs. The paper examined three case studies from businesses around the world who had implemented innovative designs into their shared work environments and how they had overcome common office problems. The authors then discussed the current global pandemic COVID-19 and how it is driving a global revolution around how and where we work. This paper examined two possible modifications to workplaces: (1) the adaptation of existing offices to aid physical distancing and increase hygiene practices; and (2) the uptake of work-from-home arrangements.

There is no doubt that how and where we work is currently under a major transformation as a result of COVID-19. This transformation to remote work has predominantly been enabled by the significant upsurge in knowledge-based work and increased IT capabilities over the last few decades. Therefore, the majority of more traditional office-based work can now be conducted from anywhere Internet is available (Joroff, 2002). It is important, however, to acknowledge that the option to work remotely is limited to types of work which only require Internet access to complete (Lund et al., 2020). Hence there are many occupations which cannot be conducted remotely (Lund et al., 2020). The COVID-19 pandemic has caused the closure of many office buildings and the relocation of workers to work from home, often for the first time (Bick et al., 2020). This has resulted in

many people questioning the future of offices. Consequently, there are currently many questions and hypotheses, with very few answers at this stage.

With the swift and successful uptake of work-at-home arrangements in many businesses, some have questioned whether offices are necessary. Physical offices are a significant business cost (Pole & Mackay, 2009), and many workers complete long daily commutes, contributing to their busy time poor lives. Furthermore, contrary to concern, research during COVID-19 suggests that for many businesses, productivity has not been negatively affected. For example, a study of around 6,000 Australian Public Sector managers and employees reported that over 90% of managers believed that their teams were at least as productive when from working from home during the pandemic (Colley & Williamson, 2020b). The workers in the study also reported positive experiences working from home, with over two-thirds indicating the desire to continue working from home on a regular basis (Colley & Williamson, 2020b). In fact, some workers have reported that they do not wish to return to the office at all post COVID-19 (Lambert, 2020). Moreover, some businesses may decide that an office no longer suits their business' needs and that their employees can work remotely fulltime. In such cases, rather than paying the ongoing costs associated with occupying an office space fulltime, businesses may hire meeting spaces when required from a service provider. The removal of physical offices also raises questions around what will happen to the broader society if workers are no longer required to attend a physical workplace. Essentially work will become location independent, meaning that people will not be tied to a physical location to complete their work. As a result, people will no longer need to live in large expensive cities and businesses will be able to recruit based on talent, rather than location. The flow on effects of this onto the broader community, surrounding businesses, transport, infrastructure, and the potential to recruit foreign workers is vast and will require a thorough investigation.

Another option is that businesses may move towards a 'hybrid office' which combines a physical office with the flexibility to also work remotely (Kaufman et al., 2020). Thereby aiming to maximise the benefits from both physical offices and work-from-home arrangements. In a hybrid office design, workers are able to work from home to complete independent work tasks – especially those which are more cognitively demanding; and then attend the office for collaborative tasks and to fulfil their social needs (Ro, 2020). In this hybrid model, offices could be designed as “collaborative hubs” and have ‘core’ times that teams must be in the office to collaborate (Kaufman et al., 2020; Ro, 2020). Outside of these hours, workers would have the flexibility to work in the office or remotely (Ro, 2020). Such

hybrid designs would fulfil the need for a distraction free environment to complete cognitively demanding work, while also helping overcome some of the social isolation issues and difficulties completing highly collaborative tasks that can arise from working remotely. Thereby, providing workers with more choice to select a workspace based on their task needs and personal preferences. Consequently, this could enable employees to work where they are most productive. Businesses are also likely to explore the need to retain their large and often costly office premises if they find a work-from-home arrangement is appropriate for their business and employees. It may be that a smaller “collaborative hub” is more suitable for their business’ work structure if they no longer need to provide individual desks because a large proportion of their workforce is working remotely at any given time.

Alternatively, there is a growing discussion around the concept of the “third space”—a workplace that is not an employee’s home or office (Kingma, 2016). Example places include co-working spaces, libraries and cafes (Brown, 2017). The third space can provide a viable solution for people who do not want to work from home but desire to have more flexibility around where they work as well as the benefit of potentially working in a location closer to their home with a shorter commute time. The third space may also become a popular option for people who work in organisations which have become entirely remote.

Importantly, the shift towards remote forms of work (both from home and “third” space locations) has implications on business’ WHS requirements. In Australia, businesses have a responsibility to ensure that their employees are safe while working, regardless of where they are working from (Safe Work Australia, 2021). Therefore, businesses may need to develop “remote work” policies and procedures to ensure that their employees’ remote workspaces are safe and fulfil all WHS requirements.

With all this choice, it is essential to consider the purpose of a business’ office space. Decision makers must carefully consider the type of work being conducted within their businesses and ask themselves ‘why’ they want to have a particular office space. Businesses should consider: What is the purpose of this office arrangement? Is it appropriate for the task, our people and our culture? Would another design be more suitable? Moreover, it is vital to remember that while where and how we work is changing, why we work remains the same.

Regardless of the office approach selected, it is essential that the psychological impact of the work arrangement is considered. Research has shown that the work environment has an influence on a range of worker outcomes including physical and mental health (e.g.,

Oommen et al., 2008), job satisfaction (e.g., de Croon et al., 2005; Oommen et al., 2008), satisfaction with the work environment (e.g., Bergström et al., 2015; Kim & de Dear, 2013), productivity (e.g., Oommen et al., 2008), ability to concentrate (e.g., Oommen et al., 2008), social interactions (e.g., Morrison & Macky, 2017), employee attraction to a business (Coster, & Govan, 2015), and staff turnover (e.g., Oommen et al., 2008). Importantly, a poorly designed and unsuitable workspace can have many negative impacts on employees and their productivity, which can quickly outweigh any potential savings that a cost cutting strategy may initially present on paper. Thus, decision makers should carefully consider the specific needs of their employees and business when selecting an office work arrangement. Going forward, a range of factors should be considered when choosing an office. These include: the type of work being completed; the perceived importance for collaboration; and their employee's personalities. COVID-19 has opened the door to flexible work arrangements and has made us question the role of an office. It is now up to businesses and individuals to grasp this opportunity and reap the benefits of working more purposely and efficiently. As we move into the future, it is hoped that decision makers will question the purpose of their work environments and select an environment that is tailored to their needs in order to facilitate their business' specific work tasks and to benefit the employees, business, and wider community.

7 Summary and Conclusion

7.1 Key Findings and Contributions

This thesis investigated the association between office design and occupant outcomes. It includes a detailed systematic review on the topic, which has served as both synthesis and critiques of the current literature. It also examined the office design – occupant outcome association further through the examination of a range of possible factors (i.e., type of work and individual differences) and their role in explaining why people have very different experiences working in open-plan office designs. The thesis also explored future directions in office design and, in particular, how the current global pandemic, COVID-19, is influencing how and where people work both now and into the future.

The project involved five specific research questions:

1. How is office design related to occupant outcomes (including health, work, and social)?
2. To what extent does the type of work (i.e., cognitively demanding work) moderate the association between office design and occupant outcomes (including health, work, and social)?
3. How does perceived importance of collaboration to complete work relate to social outcomes in the workplace?
4. To what extent does personality (introversion / extraversion) moderate the association between office design and occupant outcomes (including health, work, and social)?
5. How is the global pandemic, COVID-19, influencing how and where people work now and into the future?

This final chapter summarises how these research questions were addressed with reference to relevant chapters and the theoretical and practical implications of the findings. This is followed by a summary of the overall insights gained from this research and how it builds upon existing literature and a discussion of the project's limitations and possible future directions.

Chapter 2 provided an introduction to the thesis topic by examining definitions of office configurations and knowledge work. This section was used to inform the decision to adopt a dichotomic classification of office configurations: single-occupant enclosed offices

and shared or open-plan offices defined as those with more than one occupant. The chapter then provided a brief overview of studies that have examined the association between office design and occupant outcomes to date. It was argued that the association between office design and occupant outcomes is complex and cannot be easily nor accurately described by a single theory and that a combination of theories must be considered. A discussion of the major theoretical contributions underpinning the link between office design and psychological, work and social outcomes was then provided. Major theoretical perspectives included: social facilitation theory, distraction-conflict theory, cognitive load theory, belongingness and social connection, and person-environment fit theories. Finally, Chapter 2 concluded with a brief overview of the global pandemic, COVID-19, and its influence on how and where people work.

Chapter 3 showed that office designs are associated with a range of worker outcomes. Specifically, that compared to single-occupant enclosed offices, working in open-plan office designs is associated with more negative outcomes on multiple measures relating to health, satisfaction, productivity, and social relationship. The chapter contained a published systematic review on the published literature on workers' health, satisfaction, productivity, social and other outcomes in various open-plan office designs compared to a single occupant enclosed office. The review aimed to summarise the existing research to assist informed decisions by showing how office design is associated with a range of outcomes which may appear to outweigh potential benefits. This systematic review was unique in that it specifically required papers to have a clearly defined single-occupant enclosed office as a comparison to an open-plan office design. Unlike previously conducted reviews on the topic, this enabled a common ground for all of the included studies to be compared to, strengthening the interpretation of the findings. The results of the present review support the findings of the two systematic reviews on the topic conducted a decade previously (i.e., de Croon et al., 2005; Oommen et al., 2008). This suggests that, despite the inclusion of activity-based office designs, the fundamental differences between single-occupant enclosed offices and work environments shared by at-least one other occupant still remain. Such significant differences include occupants in open-plan/shared work environments reporting poorer physical and psychological health outcomes (i.e., decreased overall health and increased stress) and decreased levels of satisfaction with the physical office environments (i.e., greater noise and distractions, poor privacy, lighting and glare issues, and poorer temperature control). Most notably, the review demonstrated that the empirical research does not support the popular claim made by architects and designers that open-plan work environments increase communication and collaboration between colleagues (Goldstein, 2006; Waber et

al., 2014). Despite co-workers reporting greater knowledge of co-workers in open-plan work environments, most studies indicated negative effects on social relationships and interactions. Nonetheless, the illusion of increased collaboration and social interactions in open-plan work environments is still a key driver in manager's choice to utilise a shared work environment.

Furthermore, the findings highlight the importance of considering the wide-reaching effects of the work environment on both organisational and employee outcomes. Despite initially advertising cost savings, the long-term effects of open-plan workplace designs on a range of employee behaviours may far outweigh any initial savings over time. This demonstrates the importance of taking a longer-term perspective when selecting an office design. Decision makers need to choose work environments that are appropriate and suitable for the workers within it.

Finally, despite noting significant associations for many key outcomes, the review demonstrated the variability in individual's experiences working in open-plan office designs with many studies reporting mixed or opposing findings for the same outcome. In this sense, the review confirmed our initial hypothesis that, although open-plan offices may generally be associated with an array of negative outcomes, people have different experiences working in open-plan offices. This observation then led to the question as to why some people do well when working in open-plan work environments, while others struggle? What are the design and job factors as well as the employee characteristics that distinguish people into either thriving or struggling in their open-plan work environment? The remainder of the thesis aimed to explore these questions further through the development of an International survey study on knowledge workers experiences working in different office configurations.

Chapter 4 described in detail the International survey study for the Social and Psychological Adaptation to Open-Plan Workplace Designs project. The survey was purposely designed with a few unique features. First, the study combined all offices that are shared with at-least one other occupant and defined them as an open-plan work environment. Second, the survey study was published online and collected data from workers from a range of different office configurations, occupations, organisations, and Western cultures. This enabled the phenomena to be investigated at a higher, global level to see whether there are any fundamental differences/features of open-plan offices that show through regardless of these other variables. A key feature of the survey study was that it measured type of work by the types of tasks people complete in their job, rather than by their occupation title. This enabled the comparison of very different occupations, and accounted for the reality that two

people with the same occupation or job title can complete very different work tasks on a day-to-day basis. Nevertheless, data on participant's occupation title was still collected to ensure that they were knowledge workers and hence fulfilled this component of the inclusion criteria. The survey also asked respondents about their most recent previous office as it was hypothesised that people who had most recently worked in a single-occupant office may struggle more in an open-plan office than someone who had most previously worked in another shared work environment. The survey also collected data on possible adaptive behaviours and awareness of 'common' office protocols. Finally, the survey aimed to gather a well-rounded view of workers' experiences in open-plan and single-occupant offices. To this end, the survey adopted the WHO's (2020a) holistic view of health, collecting data on workers' physical, psychological, and social health. The survey also examined a range of work outcomes – productivity and satisfaction both with the work environment and work in general. The survey's construction was guided by the literature, utilising previously published measures where possible.

Chapter 5 contained four studies which explored the various factors that contribute to peoples varied experiences in open-plan work environments. The chapter commenced by exploring the role that different types of work (i.e., work tasks that are more cognitively demanding), the perception that collaboration is important to complete your work, and individual differences (i.e., personality trait extraversion/introversion) have on moderating peoples experiences working in open-plan workplace designs. The findings supported our hypotheses that the office design – occupant outcome association is complex and is influenced by a range of moderating variables. Notably, type of work was found to negatively moderate the association between open-plan offices and occupant outcomes, with people who complete more cognitively demanding tasks, reporting significantly lower levels of physical and psychological health, productivity, and satisfaction across a range of variables. This suggests that some types of work are better suited to some work environments than others.

These findings are consistent with broader ideologies that promote the development of activity-based workplaces, which are designed around the concept of choosing the right space for the work task being completed (Appel-Meulenbroek et al., 2011; Göçer et al., 2018). Such work environments often incorporate a range of different workspaces. They can include quiet work areas for focused independent work, collaborative spaces, meeting rooms, and small phones booths for individual calls. Despite their positive intentions, activity-based workplaces have received complaints and have not been as successful as hoped (Appel-Meulenbroek et al., 2011). For example, organisations who have adopted activity-based

working have reported: space under usage (Appel-Meulenbroek et al., 2011); employees not selecting different workspaces throughout the day to suit their work task (Appel-Meulenbroek et al., 2011); inconvenience of moving workspaces and packing everything away when not using a space (e.g., clean-desk policy) (Göçer et al., 2018; Rolfö et al., 2018); incorrect use of space (e.g., people conversing in a quiet work area) (Göçer et al., 2018; Rolfö et al., 2018); not enough available spaces of a particular type (Rolfö et al., 2018); poor space design (Rolfö et al., 2018); loss of personalisation/belonging/connection to a desk/physical space (Göçer et al., 2018); territorial behaviours (Appel-Meulenbroek et al., 2011; Göçer et al., 2018; Rolfö et al., 2018); the use of meeting rooms as private offices (Göçer et al., 2018); and difficult to locate a colleague (Rolfö et al., 2018). Clearly more research is needed to investigate how many of these challenges can be overcome so that organisations can successfully implement the model of activity-based working as an alternative to more traditional forms of open-plan workplace design.

Another alternative to overcome the poorer outcomes associated with completing more cognitively demanding work in open-plan work environments is the utilisation of increased technological capabilities to work remotely. As a result of the global pandemic, COVID-19, working from home and the concept of hybrid offices are becoming increasingly popular. They are also providing a possible solution to people who struggle to complete cognitively demanding work in an open-plan office. In a hybrid office model, workers can utilise remote workspaces (often their homes) to complete cognitively demanding tasks and then the open-plan office becomes a place for collaboration between colleagues. It is as though the home office is becoming the “traditional cellular” single-occupant enclosed office of the 21st Century. Accordingly, the hybrid office model may fulfil workers’ desire to have their own office space, which many have been missing since being relocated into an open-plan office. Nonetheless, hybrid offices can also provide businesses with the financial benefits of lower rents for smaller spaces and decreased operating costs. It will be interesting to see how overtime workers adapt to their hybrid approach, and whether the hybrid office can help office workers achieve the “best of both worlds”. Nonetheless, as with all office designs, the successful uptake of a hybrid office will require careful planning, the consideration of a range of factors, and further research to examine the office design – occupant outcome for hybrid office designs.

Chapter 5 also examined the influence of workers’ perception of collaboration being important to complete their work on their social outcomes. The study revealed that workers will collaborate and socially interact with others if they perceive collaboration to be

important to do their work, regardless of whether they occupy a single-occupant enclosed office or an open-plan office design. These findings contradict the popular claim advocated by architects that open-plan offices will increase the number of interactions within an organisation and will create a collaborative culture (Goldstein, 2006; Waber et al., 2014). Rather, these findings suggest that it is the workers own perception of collaboration being important which influences their social behaviours, not their office design. Accordingly, organisations should endeavour to emphasise the importance of collaboration for their operations and aim to build a culture which values and perceives collaboration to be important if they want to see high levels of socialisation within their organisation. For some organisations, this could involve a significant cultural change and is far more complicated than simply redesigning their physical office workspace. Building an organisational culture which values collaboration takes time, a lot of effort, and exemplification from leadership (Adler et al., 2011). Additionally, organisations should conduct a thorough examination of the work their organisation completes and assess whether their organisation actually needs and would benefit from greater levels of collaboration, rather than increasing collaboration for collaborative sake. Furthermore, given the sharp rise in the number of people working remotely and organisations considering remote work options on a prolonged basis, further research should be conducted to investigate whether this phenomenon also extends to remote work.

Humans also have different preferences and needs for social interaction. This difference is commonly differentiated by the personality trait extraversion/introversion, whereby extraverts often feel energised from social interactions, and introverts prefer solitary activities (Oseland, 2009; Yadegari & Alinaghi, 2020). Chapter 5 demonstrates that the office design – occupant outcome association is also moderated by individual differences such as personality (extraversion/introversion). The included study compared the experiences of extraverts and introverts in open-plan offices. Supporting our hypothesis, the results demonstrated that extraverts have significantly more positive experiences working in open-plan offices than introverts. Compared to introverts, extraverts reported higher scores on perceived productivity and numerous satisfaction measures, most notably those relating to satisfaction with overall work environment, overall job satisfaction, and noise conditions, and on all measures of social interaction. This suggests that introverts may be overwhelmed and overstimulated by the constant presence of others in open-plan workplaces.

The availability of increasing options to work remotely may come as a welcome relief to some introverts who feel drained and overwhelmed by the constant social interactions that

are often present in open-plan and shared work environments. It will be interesting to see if and how personality differences, in-particular extraversion/introversion, prevail and moderate worker outcomes in remote work settings. Furthermore, unique problems have arisen from working remotely. For example, many people have reported “Zoom fatigue” during the pandemic (Fosslien & West Duffy, 2020). This fatigue is partly due to back-to-back meetings without incidental exercise in between, and the pressure to constantly maintain one’s “social image” as you are visible on the screen for the entire meeting’s duration (Fosslien & West Duffy, 2020). More research should be conducted to investigate individual differences (e.g., extraversion/introversion) in workers’ experiences working remotely including their preference, enjoyment and “success” of working from home, as well as their susceptibility to various problems, including Zoom fatigue.

Chapter 5 also explored the role of individual differences (e.g., extraversion/introversion) in how different office workers adapt to their shared work environments. It was found that compared to introverts, extraverts were generally more aware of the protocols and adaptive strategies available to help them adapt to shared environments. However, it is unknown whether this difference can be attributed to differences between introverts and extraverts, or whether comparatively introverts in the sample actually had less adaptive features available in their workspace than extraverts. Thus, it is possible that introverts would use more adaptive features if they were available in their workspace. Nonetheless, the difference in utilised adaptive strategies by introverts and extraverts may in fact be due to personality differences whereby introverts may be less aware of such strategies because they are less likely to apply to them, i.e., many related to controlling noise levels. On the other hand, introverts may genuinely be less aware of or reluctant to use the strategies available to help them adapt. Given introverts’ significantly lower scores on a range of work and social outcomes in shared-work environments, further research should be conducted to examine why introverts utilised less adaptive strategies, and whether the usage of adaptive behaviours could increase their experiences working in shared work environments. Furthermore, the findings suggest that early identification of personality differences could help optimise office environments for different employees in a way that facilitates their strengths and preferences.

Chapter 6 explored how office designs continue to change and develop over time. In particular, the chapter examined how organisations around the world have explored various ways to overcome some of the more common problems associated with open-plan work environments that have been discussed in this thesis. The chapter then explored how the

global pandemic, COVID-19, is rapidly transforming office design into a new era and presented two possible ways organisations have adapted their organisations in-order to operate during the pandemic. Most notable is the sudden rise in the number of organisations adopting remote work practices, mainly due to widespread lockdowns forcing the closure of their office workspaces.

There is no doubt that the world is quickly transcending into a new area of office design. The previous year, 2020, saw the world placed into a giant global remote work experiment with many businesses forced into adopting remote work practices to remain open. As a result, managers, decision makers, and employees alike are all questioning the purpose of the office and whether we truly need to be tied to a physical location to work. The concept that work can be location independent is becoming increasingly common. Once viewed as a luxury for digital nomads, who glamorised working by a beach on their laptops, the ability to work for anywhere is quickly becoming a reality for many knowledge workers around the world.

The pre-COVID decade saw the rise of location independent workers often referred to as “digital nomads”. Digital nomads were predominately Millennials working on start-ups who travelled the world and operated their businesses online from countries with lower living expenses (Thompson, 2018). Coinciding with this, was a significant rise in co-working spaces, whereby workers, often digital nomads, would come together to a fixed location to utilise the office facilities (i.e., high speed internet and printing facilities), and to bounce ideas of one another (Garrett et al., 2017). Much like what the office could become to organisations who choose to utilise a hybrid office approach, co-working spaces provided digital nomads with a place to collaborate and fulfil their social needs (Garrett et al., 2017). For these reasons, the present movement towards remote working and hybrid offices is very similar to the way in-which digital nomads have been working over the last decade.

Now the concept of being location independent for your work is no longer restricted to digital nomads but is becoming the reality for many knowledge workers working in some of the nation’s largest companies (e.g., Fernyhough, 2020; Smith, 2020). Consequently, due to the successful uptake of remote work during the pandemic, many companies have decided to permanently adopt remote working for at-least a couple of days a week (hybrid office), with some considering the need for a physical office (Ro, 2020; Thomas et al., 2020).

It must be questioned, however, whether the move towards remote work will become “the next failed office fad”. Much like how the rapid uptake of open-plan offices led to many unwanted negative outcomes, it is possible that remote work could have many negative outcomes over the long run if not done well. It is unclear whether, in 20 years, concerns might also be raised about remote working and its effects on social connections and productivity and work / life balance. The movement towards a society that predominantly works remotely has the potential to have wider reaching impacts than on just the individual organisation and its office occupants. Rather, a widespread uptake of remote work will likely affect the broader society (e.g., growth in rural regions, infrastructure reallocation, and the closure of businesses that rely on city foot traffic to operate). Many of these changes may be difficult to reverse. In order to help minimise this risk, it is vital that organisations consider the individual needs of their business and staff when deciding which office design and work approach to adopt. Organisations should consider a range of factors when deciding whether remote work is appropriate for them, e.g., the type of work they complete, their staff’s individual differences (e.g., personality), and their culture. The organisation must also ensure that they have the technological capabilities to support remote work. Most importantly, decision makers must ask themselves what they want to achieve from their office work location/set up, i.e., what is the purpose of their workspace? This purpose should be held at the core of all subsequent decisions, and the office work location should be designed accordingly, with all the above factors considered.

7.2 Limitations and Future Directions

The limitations of each individual study have been discussed within the papers presented in the previous chapters. Accordingly, to minimise repetition, this section will focus more broadly on the limitations of the Social and Psychological Adaptation to Open-Plan Workplace Designs project and the potential areas for future research.

The main limitation of this project was the combination of all office arrangements with more than one occupant into the single category, open-plan office. Consequently, the category, open-plan office was very diverse and contained a range of different office configurations with very different design characteristics. Despite the amount of research into different office designs and the numerous attempts by authors to classify the various office configurations (e.g., Bodin Danielsonm & Bodin, 2008), no clear and widely accepted definition of the different office configurations appears to exist. The absence of a clear definition of what constitutes each office design is widespread across the literature and is

problematic because it limits the ability to compare studies and study outcomes on different designs.

Nevertheless, the solution to this problem is complicated for a range of compounding reasons. First, it is clear that people categorise offices differently and what one may classify as a particular design, another may classify as something else. Furthermore, unless a checking system is in place, (e.g., the researcher confirms each selected office configuration), it is challenging to ascertain whether offices are being classified consistently by different respondents. In addition, given the small nuances in different designs, it can be difficult to distinguish between minute differences between the configurations. Finally, office designs continue to change and evolve at a rapid rate. Thus, it is difficult for the literature and its definitions to keep up with the current office configurations. Even if a comprehensive and widely accepted definition of the various office designs was created, it would very likely become out of date in a short-time frame. All of these factors contribute to the lack of a comprehensive and widely accepted definition of office configurations, as well as limit the ability to accurately compare respondent responses both within and across studies on different office designs.

Furthermore, the aim of this research was to investigate whether certain individual differences might moderate the relationship between office type and occupant outcomes. For example, the research examined whether the type of work, the perception of collaboration and introversion/extraversion influenced the relationship between office design and a range of occupant outcomes at a macro-level (single vs. shared) before exploring the nuances of different office types at a more granular level. Subsequent research could endeavour to further explore the relationship between the various configurations and dimensions of open-plan office designs, and a wide range of occupant outcomes, with the influence of different moderating variables. Such research should take into account the difficulties of measuring specific office features as outlined above.

Another limitation of this research project is that the data in the Social and Psychological Adaptation to Open-Plan Workplace Designs project was collected via a cross-sectional design. Although the use of a cross-sectional design enabled the researchers to access a large diverse sample and simultaneously collect data on a range of independent variables, causation cannot be inferred from any of the research conducted in this thesis (Sedgwick, 2014). Therefore, due to the nature of the data collected, we could only imply that there is an association between different factors and not causation (Sedgwick, 2014). Thus,

while one can say that there is a relationship between people who work in an open-plan work environment and a given factor (e.g., completing cognitively demanding work tasks) having poorer outcomes, we cannot conclude that that factor is the reason why a worker is having a more negative experience working in an open-plan office environment. Therefore, the results must be interpreted with caution alongside an awareness that there are many possible reasons why workers have the experiences they have in open-plan work environments. Furthermore, as discussed in this thesis, there are a range of factors which could influence the office design – occupant outcome association – this thesis only examined three of them. Nonetheless, the knowledge of moderating factors is beneficial in better understanding the office design – occupant outcome association. Thus, further research should be conducted to investigate the role of other potentially moderating factors on people's experiences working in open-plan work environments to help gain a greater understanding of why some people thrive, while others struggle in open-plan work environments.

This research project utilised convenience sampling methods via an online survey to collect its data. There are two key limitations with this approach: 1) people with strong views on the topic may self-select to complete the survey; and 2) people who received a small monetary payment for completing the survey may have rushed through and not adequately read the survey.

First, people with strong negative views on open-plan office designs may have been more motivated to complete the survey and thus negatively skewed the results. Despite the possibility that this may have occurred, particularly for the respondents who were recruited via flyers and word of mouth without any monetary reward, the median responses for all outcomes revealed that on average responses were moderate. This suggests that it is unlikely that the sample was skewed towards people with strong views against open-plan offices, and thus the data is unlikely to be significantly affected by this first limitation.

Second, respondents were recruited for the survey study through two key means: advertising via flyers and word-of-mouth; and the panel recruitment service, Prolific. Respondents who completed the survey through Prolific received a small honorarium of four pounds for completing the survey. The researchers were concerned that some respondents may have quickly completed the survey to receive the payment in as little time as possible. However, research into crowdsourced survey samples suggests respondents provide data of a compatible quality to non-crowdsourced samples and are not primarily driven by the financial incentives (Buhrmester et al., 2011). Furthermore, to help deter this behaviour,

researchers can refuse payment if they feel the survey has not been completed properly and restrict their tasks from users with high refusal rates (Buhrmester et al., 2011). Nonetheless, the researchers for the Social and Psychological Adaptation to Open-Plan Workplace Designs project were alert for this behaviour, screening out responses which were not varied (e.g., only selected one response option on the Likert type scales), and/or were completed in a very short timeframe suggesting that the respondent had not adequately read all of the included questions. Despite all the controls put in place, there is always the risk that a respondent did not properly complete the survey and this response was included in the final data set.

The study did, however, have a number of strengths. The first of these strengths of this thesis was the analysis of type of work by actual tasks completed at work, rather than by occupation or job title. This is significant for two main reasons. First, jobs and occupations vary greatly in the type of work completed on a daily basis. Thus, two people with the same job title may complete extremely different tasks at work. Similarly, people with different job titles may complete almost identical tasks. The analysis of specific work tasks enables the accurate collection of data on the work being completed. Second, the collection of tasks rather than occupation or job title enables the analysis of ‘global’ effects of particular tasks to be undertaken, regardless of one’s occupation. This means that the collection of job tasks also expands the potential relevance of any findings to a wider range of people because it is not limited to a particular occupation or job title. Therefore, future research should endeavour to move past simply measuring work by one’s occupation and job title, and collect information on the specific tasks that people complete in their day to day jobs. This will enable a more in-depth analysis to be conducted on the relationship between the tasks people do at work and various outcomes, as well as increase the extrapolation of any findings.

Much of the previous research on the office design – occupant outcome association has focused on measuring a few key work outcomes (i.e., productivity, job satisfaction, satisfaction with overall work environment) at a time, with some not including any measures of occupant health (e.g., Frontczak et al. 2012; Leder et al. 2016; Lee, 2010). This thesis aimed to ascertain a comprehensive analysis of the office design – occupant outcome association, through the use of the WHO’s holistic definition of health (World Health Organisation, 2020a), alongside a broad range of work outcomes. Future research should aim to collect data on a wide-range of occupant outcomes and adopt a holistic view of health, when researching the office design – occupant outcome association. Such analysis will help organisations understand the wide-reaching impacts that their decisions on office design have on their occupants. Additionally, this may help decision makers realise that the ‘true’ cost of

an office design is often hidden in intangible outcomes which in the long-run, often outweigh any initial cost savings promoted by open-plan office designs.

Overall, this thesis highlighted the complex nature of the office design and occupant outcome association. Most notably, this thesis demonstrated that a range of factors moderate the relationship between office design and occupant outcomes. Whilst this thesis explored three moderating factors: work type, perception of collaboration, and personality (extraversion/introversion) in detail, other possible moderators should be explored in the future. For example, the influence of personality differences on the office design – occupant outcome association should be examined further with the inclusion of other personality traits. This will help organisations gain a better understanding of the various factors and individual differences that play a role in the ‘success’ of any chosen office design. Moreover, an increased knowledge of the relationship between office design and occupant outcomes will hopefully enable organisations to design and select office solutions which are tailored to their organisational and workforce needs to allow more productive and healthy working environments.

The thesis also collected data on various adaptive behaviours and office protocols to investigate how people adapt to their changing work environments. The development of our understanding of how people adapt to their work environment is particularly important given office work environment’s current high rate of change and the reality that people are often placed in work environments that are not suitable to their needs or in-line with their preferences. Thus, more research should be conducted on how people adjust to and can manipulate their work environment to improve their outcomes.

7.3 Concluding Remarks

Overall, the results of this thesis illustrate the complex nature of the office design – occupant outcome association. It is evident that people have very different experiences working in open-plan office environments. Additionally, the global pandemic, COVID-19, has resulted in a significant uptake of remote forms of work. Given the wide-reaching effects of office designs on both human and business outcomes, it is vital that more attention is paid to the range of possible factors which contribute to workers’ varied experiences in different work environments, including remote forms of work. In particular, research is now needed to examine the longer-term impact of remote work arrangements on both organisational and employee outcomes, as well as the broader impacts on society. Further exploration of

possible moderating variables and adaptive behaviours is also needed to increase our understanding of the office design – occupant outcome association. The need for this research is crucial as we enter the next era of office design characterised by the rise of remote working options whereby many businesses reassess the need and purpose of their existing physical office spaces. It is only through thorough and appropriate research that we will be able to ensure the optimisation of office work environments and that the transition towards remote work is beneficial for both organisations and their employees in the future.

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9 Appendices

9.1 Survey for the Social and Psychological Adaptation to Open-Plan Workplace Designs

Demographics							
2. What is your age? <table><tbody><tr><td>☐ 18-24</td><td>☐ 45-54</td></tr><tr><td>☐ 25-34</td><td>☐ 55-64</td></tr><tr><td>☐ 35-44</td><td>☐ 65+</td></tr></tbody></table>		☐ 18-24	☐ 45-54	☐ 25-34	☐ 55-64	☐ 35-44	☐ 65+
☐ 18-24	☐ 45-54						
☐ 25-34	☐ 55-64						
☐ 35-44	☐ 65+						
3. What is your gender? <table><tbody><tr><td>☐ Male</td><td>☐ Female</td></tr><tr><td colspan="2">☐ Or Specify</td></tr><tr><td colspan="2"> </td></tr></tbody></table>		☐ Male	☐ Female	☐ Or Specify			
☐ Male	☐ Female						
☐ Or Specify							
4. Is English your first language? <table><tbody><tr><td>☐ Yes</td></tr><tr><td>☐ No</td></tr></tbody></table>		☐ Yes	☐ No				
☐ Yes							
☐ No							
5. Do you speak any languages other than English at home? <table><tbody><tr><td>☐ Yes</td></tr><tr><td>☐ No</td></tr></tbody></table>		☐ Yes	☐ No				
☐ Yes							
☐ No							
6. If yes, please list							
7. What is your highest level of completed education? <table><tbody><tr><td>☐ Less than Year 12</td><td>☐ Bachelor Degree</td></tr><tr><td>☐ Year 12</td><td>☐ Higher than Bachelor Degree</td></tr><tr><td colspan="2">☐ Other post-school qualification (e.g. VET/TAFE certificate, apprenticeship, diploma)</td></tr></tbody></table>		☐ Less than Year 12	☐ Bachelor Degree	☐ Year 12	☐ Higher than Bachelor Degree	☐ Other post-school qualification (e.g. VET/TAFE certificate, apprenticeship, diploma)	
☐ Less than Year 12	☐ Bachelor Degree						
☐ Year 12	☐ Higher than Bachelor Degree						
☐ Other post-school qualification (e.g. VET/TAFE certificate, apprenticeship, diploma)							
8. Approximately how many hours of <u>paid work</u> do you work each week?							
9. What is the title of your occupation? (e.g., lawyer)							
10. What is your job title?							

11. Regardless of company/organisation, how long have you worked in your current occupation?

- | | |
|--------------------------------------|------------------------------------|
| ☐ <3 months | ☐ 3 - <5 years |
| ☐ 3 - <6 months | ☐ 5 - <10yrs |
| ☐ 6 - <12 months | ☐ 10+ years |
| ☐ 1 - <3 years | |

12. How long have you worked with your current organisation/company? (Regardless of occupation)

- | | |
|--------------------------------------|------------------------------------|
| ☐ <3 months | ☐ 3 - <5 years |
| ☐ 3 - <6 months | ☐ 5 - <10yrs |
| ☐ 6 - <12 months | ☐ 10+ years |
| ☐ 1 - <3 years | |

13. How long have you worked in your current office configuration? (Regardless of occupation and company)

- | | |
|--------------------------------------|------------------------------------|
| ☐ <3 months | ☐ 3 - <5 years |
| ☐ 3 - <6 months | ☐ 5 - <10yrs |
| ☐ 6 - <12 months | ☐ 10+ years |
| ☐ 1 - <3 years | |

14. Approximately what percentage of work-time do you spend in your main office configuration/workstation?

- | | |
|-------------------------------------|-----------------------------------|
| ☐ Less than 20% | ☐ 70% – < 85% |
| ☐ 20% – < 50% | ☐ 85%+ |
| ☐ 50% – < 70% | |

15. Which of the following best describes your last office configuration? *Note: This is not the office you currently work in*

- | | |
|--|---|
| ☐ No previous office | ☐ Cubicle with low partitions |
| ☐ Private enclosed office | ☐ Open-plan |
| ☐ Shared enclosed office | ☐ Activity-based workspace |
| ☐ Cubicle with high partitions | ☐ Hot-desk |
| ☐ Other (please specify) | |

16. How long did you work in that office?

- | | |
|--|-------------------------------------|
| ☐ No previous office | ☐ 1 - <3 years |
| ☐ <3 months | ☐ 3 - <5 years |
| ☐ 3 - <6 months | ☐ 5 - <10 years |
| ☐ 6 - <12 months | ☐ 10+ years |

17. Have you OR do you currently, work in an enclosed office?

- ☐ Yes - on my own
- ☐ Yes - shared with others
- ☐ Yes - on my own & shared with others
- ☐ No

18. If yes, how long ago?

- | | |
|--|---|
| ☐ Currently | ☐ 1 - <3 years ago |
| ☐ <3 months ago | ☐ 3 - <5 years ago |
| ☐ 3 - <6 months ago | ☐ 5 - <10 years ago |
| ☐ 6 - <12 months ago | ☐ 10+ years ago |

19. If yes, how long in total did you work in an enclosed office for?

- | | |
|--------------------------------------|-------------------------------------|
| ☐ <3 months | ☐ 3 - <5 years |
| ☐ 3 - <6 months | ☐ 5 - <10 years |
| ☐ 6 - <12 months | ☐ 10+ years |
| ☐ 1 - <3 years | |

20. Which of the following office configurations have you worked in? (Select all that apply)

- | | |
|---|---|
| ☐ Private enclosed office | ☐ Open-plan |
| ☐ Shared enclosed office | ☐ Activity-based workspace |
| ☐ Cubicle with high partitions | ☐ Hot-desk |
| ☐ Cubicle with low partitions | |
| ☐ Other (please specify) | |

Office Configurations

* 21. Select the office configuration that best represents your current office workspace.

*Note: If you work in more than one of these workspaces, select the one that represents your **Main** workspace. Please think about this workspace when answering the rest of the survey.*

☐ Enclosed office

☐ Hot-desk

☐ Open-plan

☐ Activity-based workplace / combi office / flexible / creative / innovative space

☐ Cubicle

Enclosed Office

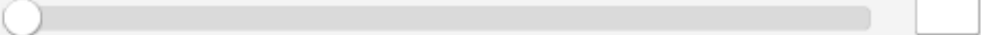
Taking too long? Exit at any time and return later using the same device and web browser.

For each of the following, indicate the characteristics of your enclosed office along the continuum.

My enclosed office:

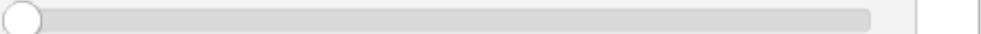
22. Wall Height

Can see over when sitting Floor to ceiling



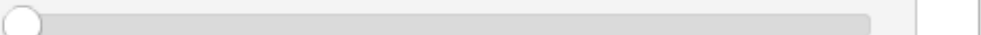
23. Walls

All clear glass All solid



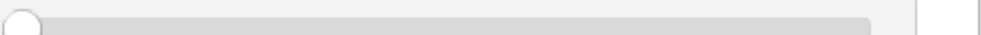
24. Door

No door All solid and acceptable to be closed anytime



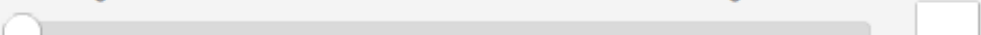
25. Shared

Shared with more than 10 people Not shared with anyone



26. Alone

I am never alone when working in the office I am always alone when working in the office



Open-Plan

Taking too long? Exit at any time and return later using the same device and web browser.

For each of the following, indicate the characteristics of your workstation in the open-plan office along the continuum.

My workstation in the open-plan office is:

27. Assigned

Temporary

Permanent (designated to
be used only by me)

☐☐

28. Detachable

Attached to other desks
on both sides and
opposite

Not attached to any other
desks

☐☐

29. Bench Desk

Part of a larger desk with
seating for > 10 workers

Not attached to any other
desks

☐☐

30. Space

No space separating me
from my neighbour

Lots of space separating
me from my neighbour

☐☐

31. Partitions

No partitions

Full height partitions
(cannot see over when
standing)

☐☐

32. Other Physical Barriers

i.e. plants, bookcases

Excluding partitions and
computer screens - There
are no physical barriers
between workers

☐

Excluding partitions and
computer screens - There
are lots of physical
barriers between workers

☐

33. Visual Privacy

I can easily see people
sitting next to me when
I'm sitting

☐

I cannot see people next
to me at all even when
standing

☐

34. Sound Privacy

I can easily hear people
next to me

☐

I cannot hear people next
to me at all

☐

Cubicle

Taking too long? Exit at any time and return later using the same device and web browser.

For each of the following, indicate the characteristics of your cubicle along the continuum.

My cubicle is:

35. Assigned

Temporary

Permanent (designated to
be used by only me)

☐☐

36. Detachable

Attached to other desks
on both sides and
opposite

Not attached to any other
desks

☐☐

37. Space

No space separating me
from my neighbor

Lots of space separating
me from my neighbour

☐☐

38. Partitions

No partitions

Full height partitions
(cannot see over when
standing)

☐☐

39. Partition Wall

All clear (completely
transparent)

All solid

☐☐

40. Other Physical Barriers

i.e. plants, bookcases

Excluding partitions and
computer screens - There
are no physical barriers
between workers

☐

Excluding partitions and
computer screens - There
are lots of physical
barriers between workers

☐

41. Visual Privacy

I can easily see people
sitting next to me when
I'm sitting

☐

I cannot see people next
to me at all even when
standing

☐

42. Sound Privacy

I can easily hear people
next to me

☐

I cannot hear people next
to me at all

☐

Hot-Desk

Taking too long? Exit at any time and return later using the same device and web browser.

For each of the following, indicate the characteristics of your hot-desk work environment along the continuum.

43. Workstation Type

Only one type of
workstation

Many different types of
workstations to choose
from

☐☐

44. Availability

Workstations are never
available when needed

Workstations are always
available when needed

☐☐

45. Suitability

The workspaces are not
suitable for my work

The workspaces are
suitable for my work

☐☐

46. Suitable and Available

Workspaces suitable for
my work are never
available

Workspaces suitable for
my work are always
available

☐☐

47. Preferred Workstation (Territoriality)

People always sit at the
same desk/workstation

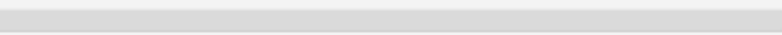
People never sit at the
same desk/workstation

☐☐

48. Secure Storage

Personal lockable storage
space is never available in
the office

Personal lockable storage
space is always available
in the office



Hot-desk: Most Commonly Used Workspace

The following questions refer to the place you most commonly choose to work at in the office.

For each of the following, indicate that place's characteristics along the continuum.

49. Assigned

Temporary	Permanent (designated to be used only by me)	
☐	<input type="range"/>	☐

50. Detachable

Attached to other desks on both sides and opposite	Not attached to any other desks	
☐	<input type="range"/>	☐

51. Bench Desk

Part of a larger desk with seating for > 10 workers	Completely detached desk	
☐	<input type="range"/>	☐

52. Space

No space separating me from my neighbour	Lots of space separating me from my neighbour	
☐	<input type="range"/>	☐

53. Partitions

No partitions	Full height partitions (cannot see over when standing)	
☐	<input type="range"/>	☐

54. Other Physical Barriers

i.e. plants, bookcases

Excluding partitions and
computer screens - There
are no physical barriers
between workers

Excluding partitions and
computer screens - There
are lots of physical
barriers between workers

☐☐

55. Visual Privacy

I can easily see people
sitting next to me when
I'm sitting

I cannot see people next
to me at all even when
standing

☐☐

56. Sound Privacy

I can easily hear people
next to me

I cannot hear people next
to me at all

☐☐

57. Approximately what % of total time spent in the office do you spend at this type of workstation?

Taking too long? Exit at any time and return later using the same device and web browser.

For each of the following, indicate the characteristics of your workplace environment along the continuum.

58. Workstation Type

Only one type of workstation	Many different types of workstations to choose from	
☐ ☐		

59. Availability

Workstations are never available when needed	Workstations are always available when needed	
☐ ☐		

60. Suitability

The workspaces are not suitable for my work	The workspaces are suitable for my work	
☐ ☐		

61. Suitable and available

Workspaces suitable for my work are never available	Workspaces suitable for my work are always available	
☐ ☐		

62. Task Needs

Workstation is always chosen based on current work task's needs	Workstation is never chosen based on current work task's needs	
☐ ☐		

63. Preferred Workstation (Territoriality)

People always sit at the
same desk/workstation

People never sit at the
same desk/workstation



64. Secure Storage

Personal lockable storage
space is never available in
the office

Personal lockable storage
space is always available
in the office



Activity-Based Workplace You Most Commonly use

The following questions refer to the place/workstation in the activity-based workplace you most commonly choose to use.

For each of the following, indicate that place's characteristics along the continuum.

65. Assigned

Temporary	Permanent (designated to be used only by me)	
☐	☐	

66. Detachable

Attached to other desks on both sides and opposite	Not attached to any other desks	
☐	☐	

67. Bench Desk

Part of a larger desk with seating for > 10 workers	Completely detached desk	
☐	☐	

68. Space

No space separating me from my neighbour	Lots of space separating me from my neighbour	
☐	☐	

69. Partitions

No partitions	Full height partitions (cannot see over when standing)	
☐	☐	

70. Other Physical Barriers

i.e. plants, bookcases

Excluding partitions and
computer screens - There
are no physical barriers
between workers

☐

Excluding partitions and
computer screens - There
are lots of physical
barriers between workers

☐

71. Visual Privacy

I can easily see people
sitting next to me when
I'm sitting

☐

I cannot see people next
to me at all even when
standing

☐

72. Sound Privacy

I can easily hear people
next to me

☐

I cannot hear people next
to me at all

☐

73. Approximately what % of total time spent in the activity-based workplace do you spend at this type of workstation?

Questions for People Working in Flexible Office Environments

The following questions are specific for people who work in flexible work environments – i.e. Activity-based workplaces and hot-desking arrangements.

74. During the past 4 weeks how much of the time did you:

	Never	Seldom	Sometimes	Often	Always
Choose your workspace based on task needs	☐	☐	☐	☐	☐
Choose your workspace based on comfort (i.e. window view, good air flow)	☐	☐	☐	☐	☐
Choose your workspace based on the other people sitting nearby (i.e. friends, people you are collaborating with)	☐	☐	☐	☐	☐
Stay at the same workstation all day	☐	☐	☐	☐	☐
Use the same workstation type in different locations in the same day	☐	☐	☐	☐	☐
Use different types of workstations in the same day	☐	☐	☐	☐	☐
Prefer to use the same workstation everyday	☐	☐	☐	☐	☐
Easily find a suitable space when needed	☐	☐	☐	☐	☐
Easily find others when you needed them	☐	☐	☐	☐	☐

75. How satisfied are you with the following aspects of your flexible work environment?

	Very dissatisfied	Dissatisfied	Neither dissatisfied nor satisfied	Satisfied	Very satisfied
Availability of workstations	☐	☐	☐	☐	☐
Suitability of workstations	☐	☐	☐	☐	☐
Variety of workstations	☐	☐	☐	☐	☐
Ease to find a suitable workstation	☐	☐	☐	☐	☐
Ease to relocate work (e.g. move papers, plug in laptop)	☐	☐	☐	☐	☐
Ability to find co-workers	☐	☐	☐	☐	☐

Identifying Types of Office Work

Many office-based occupations complete similar 'routine' tasks (i.e. basic emails, routine meetings (staff meetings), clerical work (photocopying)). We are interested in the 'non-routine' tasks that you complete. The following is a list of non-routine tasks that can occur in office-based work.

76. To what extent are these important features of the work you need to do as part of your profession?

	Not at all	Not very important	Moderately important	Important	Very important feature
Quiet, concentrated work involving reading and writing	☐	☐	☐	☐	☐
Light, non-cognitively demanding work involving reading and writing	☐	☐	☐	☐	☐
Quiet, concentrated work involving design	☐	☐	☐	☐	☐
Complex computational work (e.g., statistical analysis/mathematics, computer programming)	☐	☐	☐	☐	☐
Simple, non-cognitively demanding computational work	☐	☐	☐	☐	☐
Financial work (e.g., doing spreadsheets, dealing with budgets, accounts, financial reporting)	☐	☐	☐	☐	☐
Engineering / technical design work	☐	☐	☐	☐	☐
Design / graphical / presentation work on whiteboards, draft-boards or projectors	☐	☐	☐	☐	☐
Planning work and projects	☐	☐	☐	☐	☐
Working actively in a team to complete a task	☐	☐	☐	☐	☐
Composing complex emails	☐	☐	☐	☐	☐
Non-confidential conversations (in-person & phone)	☐	☐	☐	☐	☐
Confidential conversations (in-person & phone)	☐	☐	☐	☐	☐
Conference calls	☐	☐	☐	☐	☐
Meeting visitors	☐	☐	☐	☐	☐

77. Indicate **up to 3 non-routine tasks** to which you allocate the most time

- | | |
|---|---|
| ☐ Quiet, concentrated work involving reading and writing | ☐ Planning work and projects |
| ☐ Light, non-cognitively demanding work involving reading and design | ☐ Working actively in a team to complete a task |
| ☐ Quiet, concentrated work involving design | ☐ Composing complex emails |
| ☐ Complex computational work (e.g., statistical analysis/mathematics, computer programming) | ☐ Non-confidential conversations (in-person & phone) |
| ☐ Simple, non-cognitively demanding computational work | ☐ Confidential conversations (in-person & phone) |
| ☐ Financial work (e.g., doing spreadsheets, dealing with budgets, accounts, financial reporting) | ☐ Conference calls |
| ☐ Engineering/technical design work | ☐ Meeting visitors |
| ☐ Design/ graphical / presentation work on whiteboards, draft-boards or projectors | |

78. Indicate the tasks you complete which mostly involve **working actively with others** (*select all that apply*)

- | | |
|--|---|
| ☐ Quiet, concentrated work involving reading and writing | ☐ Financial work (e.g., doing spreadsheets, dealing with budgets, accounts, financial reporting) |
| ☐ Light, non-cognitively demanding work involving reading and writing | ☐ Engineering/technical design work |
| ☐ Quiet, concentrated work involving design | ☐ Design/ graphical / presentation work on whiteboards, draft-boards or projectors |
| ☐ Complex computational work (e.g., statistical analysis/mathematics, computer programming) | ☐ Planning work and projects |
| ☐ Simple, non-cognitively demanding computational work | ☐ Writing/composing complex emails |

Personality

Taking too long? Exit at any time and return later using the same device and web browser.

79. Answer the following questions

	Yes	No
Are you a talkative person?	☐	☐
Are you rather lively?	☐	☐
Can you easily get some life into a rather dull party?	☐	☐
Do you tend to keep in the background on social occasions?	☐	☐
Are you mostly quiet when you are with other people?	☐	☐
Do other people think of you as being very lively?	☐	☐

Health

80. In the past 4 weeks, about how often did you feel:

	None of the time	A little of the time	Some of the time	Most of the time	All of the time
Tired for no good reason	☐	☐	☐	☐	☐
Nervous	☐	☐	☐	☐	☐
So nervous that nothing could calm you down	☐	☐	☐	☐	☐
Hopeless	☐	☐	☐	☐	☐
Restless or fidgety	☐	☐	☐	☐	☐
So restless you could not sit still	☐	☐	☐	☐	☐
Depressed	☐	☐	☐	☐	☐
That everything was an effort	☐	☐	☐	☐	☐
So sad that nothing could cheer you up	☐	☐	☐	☐	☐
Worthless	☐	☐	☐	☐	☐

81. How much of the time during the past 4 weeks have you experienced the following which you feel were probably caused by your office conditions?

	Never	Seldom	Sometimes	Often	Always
Respiratory Problems	☐	☐	☐	☐	☐
Cold and Flu	☐	☐	☐	☐	☐
Gastro	☐	☐	☐	☐	☐
Headache	☐	☐	☐	☐	☐
Eyestrain	☐	☐	☐	☐	☐
Neck Pain	☐	☐	☐	☐	☐
Back/Spine Pain	☐	☐	☐	☐	☐
Shoulder Pain	☐	☐	☐	☐	☐
Hand Cramps	☐	☐	☐	☐	☐
Other Musculoskeletal Problems	☐	☐	☐	☐	☐
Physical Exhaustion and/or Fatigue	☐	☐	☐	☐	☐
Concentration Difficulties	☐	☐	☐	☐	☐

82. How many times have you taken sick leave for a week or less during the past 12 months? *Do not count care of a sick child/carer's leave.*

83. How many times have you taken sick leave for longer than a week during the past 12 months? *Do not count care of a sick child/carer's leave.*

84. Approximately how many days have you in total been on sick leave during the past 12 months? *Do not count care of a sick child/carer's leave.*

- | | |
|----------------------------------|---------------------------------------|
| ☐ Not at all | ☐ 31-90 days |
| ☐ 1-7 days | ☐ 91 days or more |
| ☐ 8-30 days | |

85. During the past 4 weeks, how much do you agree that you have experienced the following?

	Strongly disagree	Disagree	Neither disagree nor agree	Agree	Strongly agree
I have felt fidgety or nervous as a result of my job	☐	☐	☐	☐	☐
Working here makes it hard to spend enough time with my family	☐	☐	☐	☐	☐
My job gets to me more than it should	☐	☐	☐	☐	☐
I spend so much time at work, I can't see the forest for the trees	☐	☐	☐	☐	☐
There are lots of times when my job drives me right up the wall	☐	☐	☐	☐	☐
Working here leaves little time for other activities	☐	☐	☐	☐	☐
Sometimes when I think about my job I get a tight feeling in my chest	☐	☐	☐	☐	☐
I frequently get the feeling I am married to the company	☐	☐	☐	☐	☐
I have too much work and too little time to do it in	☐	☐	☐	☐	☐
I feel guilty when I take time off from my job	☐	☐	☐	☐	☐
I sometimes dread the telephone ringing at home because the call might be job-related	☐	☐	☐	☐	☐
I feel like I never have a day off	☐	☐	☐	☐	☐
Too many people at my level in the company get burned out by job demands	☐	☐	☐	☐	☐

Satisfaction

Taking too long? Exit at any time and return later using the same device and web browser.

86. Indicate the extent to which you agree with each of the following statements in regards to your **office space adequacy**:

	Strongly disagree	Disagree	Neither disagree nor agree	Agree	Strongly agree
I have enough work surface area at my workspace	☐	☐	☐	☐	☐
It is easy to have a one-on-one conversation at my workspace	☐	☐	☐	☐	☐
I can easily accommodate a drop-in visitor at my workspace	☐	☐	☐	☐	☐
I have enough storage space for my work materials at my workspace	☐	☐	☐	☐	☐
I have enough storage space for my personal items in my workspace	☐	☐	☐	☐	☐

87. Indicate the extent to which you agree with each of the following statements in regards to your department layout:

	Strongly disagree	Disagree	Neither disagree nor agree	Agree	Strongly agree
The general office layout facilitates teamwork	☐	☐	☐	☐	☐
There is enough natural light at our workplace	☐	☐	☐	☐	☐
My work area is located close to people I need to talk to with my job	☐	☐	☐	☐	☐
My department's physical layout supports collaborative work	☐	☐	☐	☐	☐
I like the way my department's workspaces are configured	☐	☐	☐	☐	☐
The physical layout of my department helps make this a nice place to come to work	☐	☐	☐	☐	☐

88. Indicate the extent to which you agree with each of the following statements in regards to your meeting space:

	Strongly disagree	Disagree	Neither disagree nor agree	Agree	Strongly agree
Meeting space in my department is conveniently located	☐	☐	☐	☐	☐
There are adequate meeting spaces for collaborative work with others	☐	☐	☐	☐	☐
There are places for me to go if I need privacy	☐	☐	☐	☐	☐

89. I feel comfortable that my work is visible to my supervisor or boss.
(Select N/A if your work is not visible to your supervisor or boss)

Strongly disagree	Disagree	Neither disagree nor agree	Agree	Strongly agree	N/A
☐	☐	☐	☐	☐	☐

90. Please indicate your agreement with each of the following statements:

	Strongly disagree	Disagree	Neither disagree nor agree	Agree	Strongly agree
I enjoy working in my office building	☐	☐	☐	☐	☐
The office building provides an environment in which I can be productive	☐	☐	☐	☐	☐
The office building is a stimulating place to work	☐	☐	☐	☐	☐
It is difficult to hold a conversation in my office area	☐	☐	☐	☐	☐
When I'm working in my office area, people frequently initiate conversations with me	☐	☐	☐	☐	☐
When working in my office area, it is easy to indicate to others when I would rather not be disturbed	☐	☐	☐	☐	☐
Even at short notice, I am usually able to book a meeting room	☐	☐	☐	☐	☐
If my office area isn't suitable for the task I am working on I am typically able to find an alternative area	☐	☐	☐	☐	☐

91. How satisfied are you with the suitability of your workplace environment with regard to carrying out the following activities?

Tick N/A if you do not complete this type of work.

	Very dissatisfied	Dissatisfied	Neither dissatisfied nor satisfied	Satisfied	Very satisfied	N/A
Quiet, concentrated work involving reading and writing	☐	☐	☐	☐	☐	☐
Light, non-cognitively demanding work involving reading and writing	☐	☐	☐	☐	☐	☐
Quiet, concentrated work involving design	☐	☐	☐	☐	☐	☐
Complex computational work (e.g., statistical analysis/mathematics, computer programming)	☐	☐	☐	☐	☐	☐

	Very dissatisfied	Dissatisfied	Neither dissatisfied nor satisfied	Satisfied	Very satisfied	N/A
Simple, non-cognitively demanding computational work	☐	☐	☐	☐	☐	☐
Financial work (e.g., doing spreadsheets, dealing with budgets, accounts, financial reporting)	☐	☐	☐	☐	☐	☐
Design/ graphical / presentation work on draft-boards or projectors	☐	☐	☐	☐	☐	☐
Planning work and projects	☐	☐	☐	☐	☐	☐
Collaborating with colleagues and/or team-working	☐	☐	☐	☐	☐	☐
Interacting informally with colleagues	☐	☐	☐	☐	☐	☐
Formal meetings	☐	☐	☐	☐	☐	☐
Private/confidential in-person conversations	☐	☐	☐	☐	☐	☐
Private/confidential telephone conversations	☐	☐	☐	☐	☐	☐
Non-private telephone conversations	☐	☐	☐	☐	☐	☐
Conference calls	☐	☐	☐	☐	☐	☐
Meeting visitors	☐	☐	☐	☐	☐	☐
Meeting deadlines	☐	☐	☐	☐	☐	☐
Minimising errors	☐	☐	☐	☐	☐	☐

92. How satisfied are you with the following aspects of your immediate working environment in your office accommodation?

	Very dissatisfied	Dissatisfied	Neither dissatisfied nor satisfied	Satisfied	Very satisfied
Privacy from being overheard by others	☐	☐	☐	☐	☐
Privacy from being seen by others	☐	☐	☐	☐	☐
Typical noise levels	☐	☐	☐	☐	☐

93. How would you describe the level of disturbance when working in your office area, with regard to the following?

	Low	Medium	High
Noise from work-related/social conversations between colleagues	☐	☐	☐
Noise generated by people walking through the building	☐	☐	☐
Visual distraction from movement of people around the office	☐	☐	☐
Noise from colleagues heading to / leaving from meetings	☐	☐	☐
Noise generated by activity within the atrium area	☐	☐	☐

94. How satisfied are you that the following environmental conditions support your work?

	Very dissatisfied	Dissatisfied	Neither dissatisfied nor satisfied	Satisfied	Very satisfied
Equipment noise	☐	☐	☐	☐	☐
People noise	☐	☐	☐	☐	☐
External noise	☐	☐	☐	☐	☐
Privacy	☐	☐	☐	☐	☐
Overall environment	☐	☐	☐	☐	☐

95. How satisfied are you that the following facilities and amenities support your work?

(Select N/A if a facility or amenity is NOT available)

	Very dissatisfied	Dissatisfied	Neither dissatisfied nor satisfied	Satisfied	Very satisfied	N/A
Desk space and shape	☐	☐	☐	☐	☐	☐
Storage space	☐	☐	☐	☐	☐	☐
Circulation space	☐	☐	☐	☐	☐	☐
Layout	☐	☐	☐	☐	☐	☐
Formal meeting rooms	☐	☐	☐	☐	☐	☐
Reading and quiet areas	☐	☐	☐	☐	☐	☐
Informal meeting areas	☐	☐	☐	☐	☐	☐
Overall facilities	☐	☐	☐	☐	☐	☐

96. Thinking about the past 4 weeks, answer the following questions:

	No, never						Yes, all the time
Did you find it difficult to concentrate at work?	☐	☐	☐	☐	☐	☐	☐
Did you experience auditory distractions while at your workstation?	☐	☐	☐	☐	☐	☐	☐
Did you have adequate privacy?	☐	☐	☐	☐	☐	☐	☐
Did you experience visual distractions?	☐	☐	☐	☐	☐	☐	☐
Was your individual workspace too noisy?	☐	☐	☐	☐	☐	☐	☐

97. How satisfied are you with the following features of your workplace?

	Very dissatisfied	Dissatisfied	Neither dissatisfied nor satisfied	Satisfied	Very satisfied
Lighting	☐	☐	☐	☐	☐
Temperature	☐	☐	☐	☐	☐
Airflow/circulation	☐	☐	☐	☐	☐
Overall ambience	☐	☐	☐	☐	☐

98. Indicate the extent to which you agree with each of the following statements:

	To a very small extent	To a small extent	Somewhat	To a large extent	To a very large extent
Would you like to stay in your current place of work for the rest of your working life?	☐	☐	☐	☐	☐
Do you enjoy telling others about the positive aspects of your place of work?	☐	☐	☐	☐	☐
Do you feel that the problems at your place of work are yours too?	☐	☐	☐	☐	☐
Do you feel that your place of work is of great personal importance to you?	☐	☐	☐	☐	☐

99. Here are some statements about you and your job. How much do you agree or disagree with each?

	Strongly disagree	Disagree	Slightly disagree	Neither agree nor disagree	Slightly agree	Agree	Strongly agree
All in all, I am satisfied with my job	☐	☐	☐	☐	☐	☐	☐
I will probably look for a new job in the next year	☐	☐	☐	☐	☐	☐	☐
I often think about quitting	☐	☐	☐	☐	☐	☐	☐
In general, I like working here	☐	☐	☐	☐	☐	☐	☐
In general, I don't like my job	☐	☐	☐	☐	☐	☐	☐
If I had the chance, I would take a different job within this organisation	☐	☐	☐	☐	☐	☐	☐

100. Would you recommend working in your physical office/workspace to others in your profession?

Strongly not recommend					Strongly recommend
☐	☐	☐	☐	☐	☐

101. Overall, how satisfied are you with your work environment?

Very dissatisfied	Dissatisfied	Neither dissatisfied nor satisfied	Satisfied	Very satisfied
☐	☐	☐	☐	☐

Social

Taking too long? Exit at any time and return later using the same device and web browser.

102. How much of the time during the past 4 weeks have you experienced the following:

	Never/Hardly ever	Seldom	Sometimes	Often	Always
Have you had help and support from your colleagues?	☐	☐	☐	☐	☐
Have your colleagues been willing to listen to your work related problems?	☐	☐	☐	☐	☐
Have you had help and support from your immediate superior?	☐	☐	☐	☐	☐
Has your immediate superior been willing to listen to your work related problems?	☐	☐	☐	☐	☐

103. How much of the time during the past 4 weeks have you experienced the following:

	Never/Hardly ever	Seldom	Sometimes	Often	Always
Have you worked isolated from your colleagues?	☐	☐	☐	☐	☐
Have you felt it was possible for you to talk to your colleagues while you are working?	☐	☐	☐	☐	☐
Have you been part of a group in your work?	☐	☐	☐	☐	☐

104. How much of the time during the past 4 weeks have you experienced the following:

	Never/Hardly ever	Seldom	Sometimes	Often	Always
Had a good atmosphere between you and your colleagues?	☐	☐	☐	☐	☐
Had good co-operation between the colleagues at work?	☐	☐	☐	☐	☐
Have you felt part of a community at your place of work?	☐	☐	☐	☐	☐

105. How many people at your place of work can you talk to about something personal, which is important to you?

106. Indicate the extent to which you agree with each of the following statements:

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
I really feel I am part of the team	☐	☐	☐	☐	☐
It is easy to ask advice from anyone here	☐	☐	☐	☐	☐
I look forward to seeing the people at work each day	☐	☐	☐	☐	☐
My team members approach me when needed	☐	☐	☐	☐	☐
I feel comfortable sharing ideas with team members	☐	☐	☐	☐	☐

107. The team leader's main workspace is located:

- ☐ In a different building
 ☐ In a separate office/workspace connected to my work area
☐ On a different floor
 ☐ At their own desk in my work area
☐ On my floor **BUT** not connected to my work area
 ☐ Hot-desks with us

108. During the past 4 weeks how often did the team leader move around your work area?

Never	Less than weekly	1-3 times per week	4-5 times per week	Multiple times each day
☐	☐	☐	☐	☐

109. Indicate the extent to which you agree with the following statements:

	Strongly disagree	Disagree	Neither disagree nor agree	Agree	Strongly agree	N/A
I like having the team leaders located in my work area	☐	☐	☐	☐	☐	☐
I like having the team leaders walk around my work area	☐	☐	☐	☐	☐	☐
I like having my work visible to the team leaders	☐	☐	☐	☐	☐	☐

110. Indicate the extent to which you agree with each of the following statements:

	Strongly disagree	Disagree	Neither disagree nor agree	Agree	Strongly agree
I confer with my co-workers to discuss work-related issues	☐	☐	☐	☐	☐
Collaborating with co-workers is a common occurrence here at (the organisation)	☐	☐	☐	☐	☐
Co-workers in my office location seldom visit with one another about work-related issues	☐	☐	☐	☐	☐
Employees in my office location keep to themselves and have little interaction with others on work-related issues	☐	☐	☐	☐	☐
Co-workers often get together to brainstorm work-related issues	☐	☐	☐	☐	☐

111. During the past 4 weeks how often have you:

	Never	Less than weekly	1-3 times per week	4-5 times per week	Multiple times each day
Bounced ideas off co-workers	☐	☐	☐	☐	☐
Contributed ideas when you heard people around you had a problem	☐	☐	☐	☐	☐
Asked co-workers for help with a work-related matter	☐	☐	☐	☐	☐
Overheard useful information to complete your work	☐	☐	☐	☐	☐
Observed co-workers to learn how to complete a task	☐	☐	☐	☐	☐
Solved a problem together with a co-worker	☐	☐	☐	☐	☐
Shared a work experience with a colleague	☐	☐	☐	☐	☐

112. Indicate the extent to which collaboration with others in your workplace is important to complete your work.

Not important at all	Not important	Neither not important nor important	Important	Very important
☐	☐	☐	☐	☐

113. Indicate the extent to which you agree with each of the following statements:

	Strongly disagree	Disagree	Neither disagree nor agree	Agree	Strongly agree
I like the people I work with	☐	☐	☐	☐	☐
I find I have to work harder at my job than I should because of the incompetence of people I work with	☐	☐	☐	☐	☐
I enjoy my co-workers	☐	☐	☐	☐	☐
There is too much bickering and fighting at work	☐	☐	☐	☐	☐

114. How do you describe the morale of the staff in your workplace?

Very poor	Poor	Neutral	Good	Very good
☐	☐	☐	☐	☐

115. Indicate the extent to which you agree with each of the following statements:

	Strongly disagree	Disagree	Neither disagree nor agree	Agree	Strongly agree
I would be happy to spend the rest of my career with this organisation	☐	☐	☐	☐	☐
I feel as if this organisation's problems are my own	☐	☐	☐	☐	☐
I do not feel like 'part of the family' at my organisation	☐	☐	☐	☐	☐
I do not feel 'emotionally attached' to this organisation	☐	☐	☐	☐	☐
This organisation has personal meaning to me	☐	☐	☐	☐	☐
I do not feel a sense of belonging to my organisation	☐	☐	☐	☐	☐

Irritation Scale

Taking too long? Exit at any time and return later using the same device and web browser.

117. Below are a list of behaviours that people working in offices report experiencing.

Tick all of the following behaviours about which you have felt irritated by during the past 4 weeks, while working in your office/workspace.

- | | |
|---|--|
| ☐ Others' phone/email notification sounds/vibrations | ☐ Whistling, humming, mumbling and/or sighing |
| ☐ Co-worker constantly talking on the phone | ☐ Repetitive throat clearing/nose snuffling |
| ☐ Constant background chatter | ☐ Heavy breathing |
| ☐ Conversations at work desks | ☐ Chewing noises |
| ☐ Non-work related interruptions | ☐ Loud typing |
| ☐ Overly chatty co-worker | ☐ Pen clicking |
| ☐ Co-workers overlooking what you're doing | ☐ Foot shaking (shaking your desk) |
| ☐ Constant foot traffic past your desk | ☐ Odour – food, gym gear, body odour |
| ☐ Squeaky chairs | ☐ Co-workers messy desk |
| ☐ Music leaking through headphones | ☐ Co-worker invading your space |
| ☐ Music being played softly from speakers | ☐ Co-worker 'borrowing' your belongings |

Workplaces vary in a variety of different ways. The following is a list of features that may be available in your office.

Tick the following which you use in your office/workspace.

118. Facilities Features

- | | |
|---|---|
| ☐ Main computer is portable | ☐ A meeting or private work area can be booked at a regular time for personal use (just you) |
| ☐ Main phone is portable (not a fixed landline) | ☐ Quiet/silent work areas |
| ☐ Private phone booths/areas to speak on your phone | ☐ Relaxation facilities and zones |
| ☐ A meeting or private work area can be booked last-minute | ☐ Provision of other facilities - I.e. coffee shop/café, gym, landscaped outdoor gardens |
| ☐ A meeting or private work area can be booked at a regular time for group use | ☐ Loud and quiet areas are far apart- I.e. Lunch room is not right next to a quiet work zone |

119. Personalisation Features

- | | |
|---|--|
| ☐ Ability to decorate and personalise desk/workspace | ☐ Sit/stand workstations |
| ☐ Can load photos onto computer desktop | ☐ Movable furniture |
| ☐ Can construct physical barriers between co-workers - I.e. books, plants, photos, hang coats etc. | ☐ People regularly move the furniture to suit their needs |

120. Flexible Work Schedule Features

- | | |
|---|--|
| ☐ Flexible hours - I.e. Can use the office in less busy times | ☐ Can take your lunch break when you want |
| ☐ Ability to schedule your work tasks around how busy the office is - I.e. Complete complex tasks during quiet periods, and mundane/routine work during busy/peak periods. | ☐ Can work from home |
| ☐ Ability to avoid most annoying regular distractions - I.e. If you know that a colleague makes a loud phone call every morning, then you can use that time to do your photocopying and grab a coffee. | ☐ Can work from home when sick |

121. Social Features

- ☐ Group and team building activities
- ☐ Non-work social activities planned for co-workers
- ☐ There is a designated place for co-workers to eat lunch together
- ☐ There is a designated time when co-workers eat lunch together

122. Rules/Expectations

- | | |
|---|--|
| ☐ Quiet/silent work times – I.e. Silent work from 9-11am everyday | ☐ People know not to interrupt someone wearing headphones |
| ☐ Noise policy | ☐ Signage system – I.e. Individual signs above computers to say I'm busy – do not disturb |
| ☐ Food policy – I.e. No smelly food, no eating at desks | ☐ An instant messaging system whereby a co-worker notifies you before visiting your workstation |
| ☐ Unspoken rules – I.e. No eating at desk, no talking in open-plan work areas, don't interrupt people wearing headphones | ☐ An instant messaging system whereby you can notify a co-worker if they are violating any office norms |
| ☐ Expectations around phone calls and conversations in the office | ☐ The office is regularly cleaned, provision of hand sanitiser & anti-bacterial wipes |
| ☐ Headphones are allowed | |

Protocols

123. The following is a list of items that may have established expectations about appropriate conduct in the workplace. Check each of the following which have established expectations in your work area.

- | | |
|---|--|
| ☐ Face to face conversational noise | ☐ Respecting the privacy of others |
| ☐ Telephone conversational noise | ☐ Use of speakers |
| ☐ Meeting noise | ☐ Use of headphones (e.g. don't interrupt someone wearing headphones) |
| ☐ Use of "breakout rooms" | ☐ Personal space "markers" (e.g., plants, photos, posters) |
| ☐ Use of private study rooms and spaces | ☐ Borrowing materials (e.g., manuals) |
| ☐ Use of social spaces and/or common areas | ☐ Clean desk policy |
| ☐ Odours (e.g., food, cologne, perfume) | ☐ People work from home when sick |
| ☐ Appropriate traffic flow for workers and/or visitors | |

Open-Ended Questions

124. Overall, what is the best feature of your office environment?

125. Overall, what is the worst feature of your office environment?

126. What is the main thing your company can do to improve your office work environment?

127. Is there anything else you'd like to tell us about your office environment?