DOCTOR OF PHILOSOPHY

Employee Physical Activity Promotion

Bridging the Gap Between Research and Practice through the Development of Wellness@Work; a Co-created Workplace Physical Activity Social Network

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Employee Physical Activity Promotion: Bridging the Gap Between Research and Practice through the Development of Wellness@Work; a Co-created Workplace Physical Activity Social Network

By

Anthony Thompson

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Abstract

Globally, physical activity levels have declined sharply and it has been estimated that up to 42% of individuals within developed countries are classified as being physically inactive. Insufficient physical activity is a substantial health risk and has been associated with negative psychophysiological outcomes including cardiovascular disease, diabetes and depression. Whilst there are many contributors to physical inactivity the workplace has been identified as a particularly significant contributor. Consistently high levels of sedentary behaviour have been documented within many modern workplaces, with employees spending up to 81% of working hours seated in white collar roles. Given that approximately 58% of global workforce will spend one third of their adult life at work, the workplace has been identified as a key domain in which researchers can deliver interventions to promote physical activity. Despite this, evidence for the efficacy of workplace physical activity interventions has been mixed. One potential explanation for this is an underutilisation of participatory approaches during intervention design. Within organisational research, concerns have been expressed regarding a widening gap between research and practice. Whilst interventions may be academically robust they may lack sufficient relevancy to the employees that they are intended to support. To address these issues this thesis adopted a pragmatic, participatory stance and drew upon co-creation methodologies to develop a new workplace physical activity intervention that would meet the needs of employees. This was achieved via four research phases.

Phase one involved a meta-analytic review of workplace physical activity and sedentary behaviour intervention literature. As noted, evidence for the efficacy of such interventions has been mixed. To add clarity, the meta-analysis included only studies that had objectively measured physical activity and sedentary behaviour after six months; helping to overcome limitations of behavioural overestimation through self-report and novelty effects present within previous reviews. In light of the pragmatic stance of the author, included studies were also coded for the presence of behaviour change techniques (BCTs) and meta-regression and sub-group moderator analysis conducted to determine whether the number and type of BCTs used within interventions were associated with efficacy. This enabled the meta-analysis to identify not only whether interventions worked but also how. Results from phase one indicated that interventions were effective at increasing physical activity and decreasing sedentary behaviour after six months. A significant negative correlation was identified between the number of BCTs used and intervention effect sizes for physical activity interventions but no correlation was identified for sedentary behaviour focused interventions. Intervention effect sizes were larger when the BCTs information about health consequences and adding objects to the physical environment had been used and when the BCTs commitment, self-monitoring of behaviour, instruction on how to perform the behaviour, credible source and material reward had not been used. Combined, phase one identified tangible ways in which practitioners could alter published interventions without unduly compromising efficacy.

Phase two involved a co-creation workshop designed to gain insight into what employees perceive to be the barriers and facilitators of physical activity within the workplace. 14 employees from a variety of occupational backgrounds completed two activities: the co-creation CUbe (a form of mobile brainstorming) and photovoice. Integrated visual thematic analysis was conducted to synthesise the data. Themes identified through integrated visual thematic analysis spanned intrapersonal, interpersonal, organisational and environmental levels. At the intrapersonal level themes identified that good mental and physical health may act as pre-requisites to intervention engagement. At the interpersonal level colleagues were identified as a source of support by making activity enjoyable and acting as role models. At the organisational level, themes primarily explored the promotion of physical activity and job design. Finally, at the environmental level themes considered the built environment and the distance between working locations. Combined, the themes suggested that workplace physical activity is a complex, and context dependent, behaviour. As such, one-size-fits all interventions are unlikely to be successful. Instead, interventions targeting different barriers and facilitators may be required to capture the needs and requirements of a broader range of employees.

Phase three involved a second co-creation workshop where the co-creators were asked to design physical activity interventions. 13 employees, 11 of which returned from phase two, completed a poster presentation activity. Qualitative content analysis was conducted to analyse the data. Consistent with the findings of phase two, interventions spanned the intrapersonal, interpersonal, organisational and environmental levels. The co-created interventions were also coded for the presence of BCTs to determine whether the behaviour change strategies used by employees differ to those used by the authors of the studies included in the meta-analysis of phase one. It was identified that whilst there were commonalities, such as adding objects to the environment, there were also discrepancies. For example, employees utilised the BCT monitoring of emotional consequences whilst this BCT was not present within any of the studies in phase one. Alongside BCTs, qualitative content analysis was used to identify common implementation strategies described by the employees. Again, commonalities were identified between the evaluation strategies used by researchers, such as measuring step counts, but differences were also noted too, such as the co-creators using mental well-being as a measure of intervention effectiveness. Combined, this phase empowered participants to develop interventions relevant to their needs whilst also highlighting specific areas in which a gap between research and practice may exist.

In phase four, the co-created solutions were synthesised into a singular intervention, a workplace physical activity website called Wellness@Work, through a process of iterative developments. Wellness@Work contained information collected through the prior research phases. The feasibility of Wellness@Work was assessed by 148 employed participants who watched a video demonstration of the website and completed a modified Unified Technology Acceptance and Use 2 (UTAUT2) questionnaire to determine factors associated with the behavioural intention to use the website. Structural equation modelling was conducted on the collected data, which revealed that

79% of the variance in behavioural intention to use the website could be explained by the UTAUT2 constructs. Performance expectancy and hedonic motivation were positively associated with behavioural intention to use whilst social influence was also positively associated but only for female participants. Findings suggest that Wellness@Work may be a viable intervention that would be used by employees in a variety of occupations.

Through the four research phases, the overarching aim of the thesis was met. It was determined that co-creational approaches can be used to successfully to produce tangible interventions that are relevant to employees. In a research area which has historically underutilised participatory and democratic approaches this thesis has contributed both a more nuanced understanding of workplace physical activity and strengthened the voice of employees within the literature. Through BCT coding, researchers and practitioners have also been provided with a tangible list of BCTs that influence intervention effectiveness and are relevant to employees. Such information can help to bridge the gap between research and practice by demonstrating which aspects of interventions should be added and which can be amended to enhance impact for employees.

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Presentations & External Engagement

EAWOP (2019) – Poster presentation 'Are Workplace Interventions Designed to Target Physical Activity and Sedentary Behaviour Effective? A meta-analysis'

EAOHP (2020) – Presentation 'Asynchronous Co-creation: Exploring the Perceived Barriers & Facilitators of Activity Permissive Workspaces' [Accepted]

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Chapter 1 - Introduction

Global levels of physical activity have declined rapidly over the past two decades. Between 2001 and 2016 global physical activity levels have remained consistently low with recent estimates suggesting that 27.5% of the world's population is insufficiently physically active; a figure which rises sharply to 42.3% in high-income Western countries (Guthold et al., 2018). Many contributors to physical inactivity and sedentary behaviour have been identified including the rise of information communication technology, non-active modes of transportation and the urbanisation of built environment (Assah et al., 2011; Pratt et al., 2012; Sallis et al., 2012). It has been argued that sedentariness and physical inactivity have now become embedded into the fabric of many modern environments (Levine, 2015). When considered against the negative health consequences of physical inactivity, such declines are problematic from a public health perspective. Indeed, in response to declining global levels of physical activity and increasing levels of sedentary behaviour the World Health Organisation has set the challenge of decreasing global insufficient physical activity levels by 15% by 2030 (World Health Organisation, 2018). Whilst a laudable goal, recent global population-based surveys have strongly indicated that, based upon current trends, this target is likely to be missed and urgent action is needed to support individuals in becoming more physically active (Guthold et al., 2018).

1.2 Physical Activity & Sedentary Behaviour

Physical activity has been defined as "bodily movement produced by skeletal muscle contraction that requires energy expenditure above basal levels" (Fletcher, et al., 2018, p. 1623). It is often viewed as distinct from exercise, which typically involves physical activity that is planned, repetitive, and structured with the main objective of improving fitness (Fletcher et al., 2018). As such, physical activity encompasses a wide variety of diverse activities including; walking, housework, carrying shopping and gardening (Murphy et al., 2013; Piercy et al., 2018). Physical activity has dominated the lifestyle of hominids and humans throughout evolutionary history (Malina & Little, 2008) and the human body has evolved in such a way that key biological systems cannot develop or function optimally without being activated by regular physical activity (Booth et al., 2008). Indeed, insufficient physical activity has been associated with a host of deleterious health outcomes including cardiovascular disease (Ahmed et al., 2012), diabetes (Joseph et al., 2016), stroke (Howard & McDonnell, 2015) and certain types of cancer (Kohler et al., 2016). Insufficient physical activity represents a substantial health risk and has been identified as the fourth biggest risk factor for global mortality, responsible for approximately 6% of deaths annually (World Health Organisation, 2009). Furthermore, contemporary research has indicated that insufficient physical activity may be associated with higher incidence of mental health conditions such as anxiety and depression (Bélair et al., 2018). Clearly, the importance of physical activity to health and well-being cannot be understated.

A subtle, but important, distinction has been made concerning the difference between sedentary behaviour and physical activity. Historically, sedentary behaviour has been regarded as one extreme end of a continuum of physical activity (Laport et al., 1984). However, increasingly sedentary behaviour is being viewed as a distinct behaviour in its own right (Owen et al., 2008). Sedentary behaviour has been defined as any waking behaviour characterized by an energy expenditure of ≤1.5 METs while in a sitting or reclining posture (2lay et al., 2017). This distinction means that, paradoxically, one can be both highly physically active and highly sedentary (Owen et al., 2010). Within the literature, such individuals have been affectionately named ‘active couch potatoes’ and represent those who are physically active during certain parts of the day but also have long bouts of sedentary time (Tremblay et al., 2010). Systematic reviews and meta-analyses appear to support the distinction between physical activity and sedentary behaviour identifying sedentary behaviour as an independent risk factor, outside of too little physical activity, for cardiovascular disease and all-cause mortality (Patterson et al., 2018; Wilmot et al., 2012). Therefore, it has been argued that too much sitting is not be the same as too little physical activity and physical activity research should acknowledge the important impact that sedentary behaviour can have on an individual's health (Katzmarzyk et al., 2009; Owen et al., 2010).

1.3 Trends in Occupational Physical Activity and Sedentary Behaviour

The workplace has been described as a microcosm of society and has the advantage of being able to target large sections of the population who are ordinarily difficult to reach with traditional physical activity initiatives, such as males or individuals from lower socioeconomic groups (Anderko et al., 2012; Grimani et al., 2019). Workplace interventions can capitalise on pre-existing communication channels and social support networks, making them efficient to develop interventions around (Edmunds & Clow, 2016; Plotnikoff et al., 2005). Given that approximately 57% of the world's population is engaged in at least one type of formal employment (International Labour Organisation, 2020) and that approximately 58% of global workforce will spend one third of their adult life at work (World Health Organisation, 1995), it is unsurprising that the workplace has been identified as a key domain where one is able to systematically reach a large and captive audience of the adult population (Grimani et al., 2019).

However, the workplace has also been identified as a significant contributor to physical inactivity. Since 1945 in many westernised countries there has been a significant shift away from predominantly manufacturing based economies and towards white collar, service orientated industries (Philipson & Posner, 1999). White collar occupations are often sedentary, providing limited opportunities for employees to be physically active and involving long bouts of sitting (Church et al., 2011; Jans et al., 2007). Indeed, consistently high levels of sedentary behaviour and low levels of physical activity have been demonstrated in such roles, with studies documenting employees spending 81% (Parry & Straker, 2013), 77% (Thorp et al., 2012) and 71% (Clemes et al., 2014) of working hours performing sedentary behaviour. Indeed, over the past five decades occupational-related energy expenditure has decreased by over 100 calories per day, with technology driving a transition to less physically demanding job tasks (Church et al., 2011). Within the United Kingdom (U.K)., occupational physical activity levels are projected to decrease substantially by 2030, driven by an increase in sedentary working practices (Ng & Popkin, 2012). Such trends have contributed to a profound shift in research focus within this domain. Historically, researchers have expressed concerns about the potential health impact of physically demanding job roles whereas many contemporary authors now actively advocate increasing physical activity within the workplace (Calderwood et al., 2016). Outside of protecting individuals from deleterious health outcomes, reversing the trend towards occupational physical inactivity may also have organisational benefits as certain studies have indicated that physically active employees; take fewer sickness absence days (Amlani & Munir, 2014), are more productive (Puig-Ribera et al., 2015) and have less intention to quit (Haslam et al., 2019). Given increasingly high levels of physical inactivity across occupations, and the potential organisational benefits of an active workforce, many employers are turning to workplace health promotion programmes as a strategic investment to protect the well-being of both employees and the organisation.

1.4 Workplace Physical Activity and Sedentary Behaviour Interventions

Workplace health promotion programmes are employer led initiatives which seek to improve the health and well-being of employees through the implementation of interventions targeting common health behaviours (Goetzel & Ozminkowski, 2008). Within such programmes, physical activity and sedentary behaviours are often key targets (Plotnikoff & Karunamuni, 2012; Rongen et al., 2013). Interventions are often incredibly diverse ranging from simple prompts to move(Cooley & Pedersen, 2013) through to complex multi-level interventions (Watanabe & Kawakami, 2018). In 2019, the global corporate wellness market was estimated to be valued at 57.2 billion USD, a figure which is expected to increase to 97.4 USD by 2027 (Grand View Research, 2020).

However, despite an increase in both academic and organisational interest surrounding workplace physical activity and sedentary behaviour interventions, evidence for the efficacy remains mixed. Systematic literature reviews have been inconclusive in establishing overall effectiveness reporting that workplace physical activity and sedentary behaviour interventions result in no significant improvements (Chau et al., 2010), exert small effects (Taylor et al., 2012) and exert strong effects (Proper, Koning, et al., 2003) on behavioural outcomes. Evidence exploring organisational level outcomes of workplace physical activity interventions have also been mixed with a selection of studies indicating that there is no persuasive evidence that such interventions enhance employee productivity or directly contribute to fewer sickness absence days (Odeen et al., 2013; Pereira et al., 2015). Several explanations have been posited to account for the inconsistent efficacy of workplace physical activity interventions including interventions attracting those who are already active (Nooijen et al., 2020); ineffective intervention communication strategies (Brinkley, McDermott, Grenfell-Essam, et al., 2017) and an over-reliance on self-report measures leading to inaccurate estimates of workplace physical activity (Pedersen et al., 2016).

Whilst the evidence base is mixed, early indications do suggest that interventions can be effective but may be limited by not be reaching employees who would benefit the most. Existing interventions have often been critiqued for predominantly recruiting employees who are already physically active and generally report low rates of employee participation, limiting the representativeness of research findings (Marshall, 2004; Ryde et al., 2013). Given that physical inactivity has been associated with negative outcomes at an individual, organisational, and societal level, the importance of developing interventions which attract and engage a wider demographic of employees cannot be understated.

Physical activity and sedentariness are known to be complex health behaviours influenced by a variety of different determinants including social support, the built environment and perceived enjoyability (Buchan et al., 2012; Dollman, 2018). This has led to both being labelled as ‘wicked problems' (Signal et al., 2013). Due to their complexity, 'wicked problems' are those that have multiple causes, are continually evolving, have no singular solution and require the input of multiple perspectives in order to be tackled effectively (Blackman et al., 2006; Gordon et al., 2017). Despite this, workplace physical activity and sedentary behaviour interventions have historically under-utilised participatory methods during intervention design (Parry et al., 2013). By failing to engage employees during the intervention design stages, researchers and organisations may miss contextual cues about the priorities, goals and needs of participants that influence the likelihood of uptake and engagement. Indeed, a recent systematic review of systematic reviews concluded that workplace health promotion research should adopt participatory approaches that involve employees during the design and implementation of interventions to help facilitate higher engagement rates (Pieper et al., 2019). Such conclusions echo wider calls for more democratic approaches to workplace physical activity research by actively including stakeholders in the research process (Popp et al., 2021).

1.5 Democratisation of Research

The democratisation of research has been identified as one of the key methodological challenges of the 21st century (Crow, 2012). Increasingly, authors are becoming critical of traditional models of research which position the people who are the focus of studies as participants, and those who research them as experts with special insight to analyse and evaluate their experiences (Edwards & Brannelly, 2017). Health promotion researchers have also become acutely aware that policy and service changes designed purely by external experts can fail to achieve the desired change within the targeted individuals and communities (Green, 2001; Liebenberg, 2018). As such, there has been significant interest in a fundamental paradigm shift towards more participatory health research practices (Wright et al., 2018). Whilst there are many different approaches towards participatory health research, its key distinguishing feature is that individuals, whose lives and work are the focus of the investigation, are actively involved in the research process throughout

(Verloigne et al., 2017). As this chapter has noted, authors have identified that there has been an under-utilisation of participatory research practices within workplace physical activity and sedentary behaviour research to date; a factor which may be contributing towards the mixed efficacy of interventions within this domain. Indeed, evidence suggests that engaging individuals in the development of health initiatives can lead to positive changes on health-related outcomes, reduce inequalities in health research and can be more effective that 'one size fits all' interventions (de Rosis et al., 2020; Durand et al., 2014).

There are many approaches to involving stakeholders in health behaviour change research ranging from simple consultation, where the aim is to seek advice and information (Dickert & Sugarman, 2005), through to more substantial and active involvement such as co-creation(Leino & Puumala, 2021). Whilst all participatory approaches have merit, co-creation has been identified as a promising strategy for understanding and exploring complex health behaviours including physical activity and sedentariness (Leask et al., 2017). Co-creation has been defined as 'the collaborative generation of knowledge by academics working alongside stakeholders from other sectors' (Greenhalgh et al., 2016) and involves the adoption of sustained creative and interactive processes to combine professional and local knowledge (Leino & Puumala, 2021). Co-creational approaches empower stakeholders across the research process to help identify and define both the problems being experienced and the solutions to overcome them (Wollenick, 2012). Whilst there is no singular approach to performing co-creation, individuals can be engaged in the research process through a multitude of methods including; brainstorming, storytelling and prototyping using Lego bricks (Degnegaard et al., 2015; Schulz & Geithner, 2013); making it possible to adapt research designs to the populations and contexts under consideration. Co-creational approaches have been used successfully to increase physical activity levels in a variety of populations including older adults (Leask et al., 2017) and adolescent females (Verloigne et al., 2017). However, a dearth of literature exists applying co-creation methods to workplace physical activity and sedentary behaviour. Given the underutilisation of participatory methods within workplace physical activity research, calls for more democratc research practices and the relative effectiveness of co-created interventions over 'one size fits all' solutions; adopting a co-creational approach to interventional development represented an important paradigm shift for research conducted within this domain.

1.6 Framework for the Development of Complex Interventions

Within intervention development research, it is important to ensure that the intervention development process is conducted in a manner which maximises the chances of success and produces interventions that considers the needs of the target population (O'Cathain et al., 2019). One way in which this can be achieved is by using an intervention development framework. One of the most influential has been the Medical Research Council's (MRC) (2019) framework for the development and evaluation of complex interventions. The framework outlines four key phases involved in complex intervention creation: development, feasibility, evaluation and implementation. During the development phase existing evidence should be reviewed to identify what is currently known about similar interventions and their effectiveness; should no existing systematic literature reviews be available, or if the reviews require updating, then one will need to be conducted as part of the development process (Craig et al., 2008). An appropriate theoretical perspective should also be used to guide intervention development and, where possible, primary research studies conducted with relevant stakeholders to identify mechanisms of behaviour change(Medical Research Council, 2019). The intervention design process should remain iterative, and a series of studies may be required to refine the design before full scale implementation(Craig et al., 2008). During the feasibility phase issues such as the acceptability and mode of delivery of the intervention should be considered; it is important to note that feasibility assessments need not require a scale model to be produced but rather should focus on addressing areas of uncertainty identified during the development process (Craig et al., 2008). During the evaluation phase a variety of experimental and non-experimental designs should be considered. Non-conventional approaches, those rarely used in the field of enquiry, can also be considered with the final evaluation design being determined based upon the specific characteristics of the intervention study (Medical Research Council, 2019). During the implementation phase short and long-term evidence for intervention efficacy should be documented and disseminated for research and practice; stakeholders should also be involved to ensure that the implementation process is relevant (Medical Research Council, 2019).

As the MRC framework provides a tangible guide to support the development and evaluation of interventions, it is well placed to add overarching structure to co-creational based intervention design. Combining the MRC framework with co-creation methods may represent a viable strategy for maximising the chances of intervention success whilst simultaneously accommodating the needs and requirements of the target population.

1.7 Summary

Insufficient physical activity is a significant non-communicable disease and has been associated with a range of negative physical and mental health outcomes including cardiovascular disease (Ahmed et al., 2012), diabetes (Joseph et al., 2016), certain cancers (Kohler et al., 2016) and increased rates of anxiety and depression (Bélair et al., 2018). Global trends have shown a steady decline in population physical activity levels (Guthold et al., 2018) and the workplace has been identified as a key contributor of this (Parry & Straker, 2013). The workplace has also been identified as a viable domain in which such behaviours could be feasibly tackled due to its ability to tap into a captive audience of diverse adults in a setting where social and communication structures have already been established (Anderko et al., 2012). Whilst there has been a growing interest in the development of workplace physical activity interventions by both researchers and organisations alike, evidence for their efficacy has been inconsistent. Furthermore, physical activity and sedentariness are complex behaviours and require the input of multiple stakeholders to be understood and solved more effectively (Blackman et al., 2006; Gordon et al., 2017). Despite this, many workplace interventions in this domain have underutilised participatory approaches (Ryde et al., 2013). There therefore exists an important gap within the literature. Employees need to be more actively involved in the intervention development and evaluation process. Through active involvement, interventions may better reflect the needs and requirements of employees leading to increased intervention efficacy and engagement.

1.8 Knowledge Production

A core tenet of scientific enquiry is the production of knowledge, and this is a fundamental component of any PhD thesis (Bøgelund, 2015). Two core approaches to knowledge production have been posed: mode 1 and mode 2(Gibbons, 2013). Mode 1 research typically reflects the traditional approach to scientific knowledge production, with research questions developed by academics whose studies add to and extend previous research and theory. Whereas mode 2 research takes a more participatory, democratic, stance to knowledge production: highlighting the importance of involving stakeholders across the research process from initial problem formulation through to data collection and solution ideation.

Further delineating the concepts of mode 1 and mode 2 research (Anderson et al., 2001) developed a model to explain how research can become disconnected from practice. The model comprised of four types of research: puerile, popularist, pedantic and pragmatic. Puerile science represents that which is of low methodological quality and of low relevancy to organisations. The authors identify puerile science as a threat to the integrity organisational research and should be minimised as much as possible. In a similar vein, popularist research represents that which may be high in practical relevance but lacking the robust and rigorous methodologies, making their findings questionable. Pedantic science represents that which is of high methodological quality but addresses an issue of limited relevancy and significance for organisations themselves. As such, findings produced from pedantic science do not often cross from research into practice, potentially widening the researcher-practitioner gap Finally, pragmatic science seeks to produce knowledge that is both high in real-world relevancy and academic rigour. Anderson *et al.* (2001) identify pragmatic science as the cornerstone of organisational research, leading to the development of robust practical interventions that are grounded in good science, helping to reduce the research-practitioner gap. Within pragmatic science, co-creation methodologies have been cited as an important tool in the development of interventions that are both relevant and robust (Popp et al., 2021).

In the context of a widening gap between research and practice, workplace physical activity research is at a key inflection point. Organisations have a clear interest in promoting the health of employees as documented by the substantial investment in well-being interventions (Grand View Research, 2020). Yet, as noted, academic efforts to develop viable workplace physical activity interventions have produced mixed results. Furthermore, intervention research within this domain has historically underutilised participatory approaches (Ryde et al., 2013) and so the predominant paradigm has been typified by mode 1, pedantic research-based practices. Whilst such practices have undoubtedly contributed to new knowledge, to develop interventions that are both academically rigorous and contextually relevant to the stakeholders whom it may affect, a shift towards mode 2, pragmatic science practices are required. Therefore, an overarching aim of the thesis was to help bridge the gap between research and practice by actively involving a variety of stakeholders across the research process to produce knowledge that is both rigorous and relevant.

1.8.1 Research Question Development

In light of the pragmatic science stance of the research, it was deemed important to develop research questions that were not only academically rigorous but would also produce knowledge of pragmatic relevance to researchers, practitioners, organisations and employees. To begin this process, it was deemed important by the researcher to explore the current state of workplace physical activity and sedentary behaviour intervention literature. As noted, the evidence for intervention efficacy has been mixed within this domain and previous reviews have often mixed subject and objective measures or looked at short-term behaviour change. In light of this research questions one and two were posed:

RQ1: Are interventions designed to increase employee workplace physical activity levels effective at increasing objectively measured step counts post six months?

RQ2: Are interventions designed to decrease employee workplace sedentary behaviour levels effective at decreasing objectively measured sitting time post six months?

Whilst informative, it was identified by the author that the answers to research questions one and two would produce knowledge akin to mode one pedantic science as it would inform readers whether interventions were effective but provide no context as to why and how they may or may not work. This was important to note as whilst published interventions may work in the specific organisational context in which they were studied, such effectiveness does not necessarily translate into the diverse settings in which many practitioners operate (Rasmussen et al., 2018). From a position of pragmatic science, it was deemed important by the author to extract the behaviour change techniques (BCTs), or 'active ingredients', used within the interventions. This would facilitate more nuanced analyses to help determine whether the number of BCTs used, a proxy for intervention complexity, was associated with intervention effectiveness and whether the presence or absence of individual BCTs within interventions increased or decreased intervention efficacy. Such information would provide both researchers and practitioners with tangible information as to how interventions could be designed to enhance efficacy, as well as provide a list of BCTs that practitioners could add or remove to adapt interventions without compromising efficacy. Combined, this led to research questions three, four, five and six:

RQ3: Are the number of BCTs used within workplace physical activity interventions significantly correlated with intervention effectiveness?

RQ4: Are the number of BCTs used within workplace sedentary behaviour interventions significantly correlated with intervention effectiveness?

RQ5: Does the presence or absence of BCTs commonly used across the included papers moderate intervention efficacy for physical activity focused interventions?

RQ6: Does the presence or absence of BCTs commonly used across the included papers moderate intervention efficacy for sedentary behaviour focused interventions?

The answers to the aforementioned research questions would serve as an initial benchmark of the current state of the literature to which the planned co-creation research could be compared. To begin the process of co-creation an important first step was to formulate the problems and opportunities faced by employees in relation to being physically active at work. By empowering employees to identify influences of physical activity within the workplace a more nuanced and contextualised account of what helps and hinders employees could be produced. This led to the development of research question seven:

RQ7: What do employees perceive to be barriers and facilitators of physical activity and sedentary behaviour within occupational roles?

The information produced through answering research question seven would help to provide a better understanding of factors that could be potentially targeted by interventions. Intervention development would therefore form the second element of the co-creation process. In contrast to other studies of barriers and facilitators, such as those by (Chau et al., 2019) and (Bardus et al., 2014), the co-creational approach adopted within this thesis meant that participants would also be directly involved with solution generation. The direct involvement of the participants in both the problem formulation and solution generation stages was consistent with the author's position as pragmatic scientist and would help to directly address the calls for more democratised research practices. To support both researchers and practitioners in understanding how employees believe physical activity behaviours can be changed the co-created interventions were coded for the presence of BCTs. The coding of BCTs would also allow for consistencies and inconsistencies to be identified between the behaviour change strategies used by published studies included within the meta-analysis and those used by employees themselves. Combined, this led to the development of research question eight:

> *RQ8: What behaviour change strategies are present within interventions designed by employees and how do they differ from those identified within the studies included in the meta-analysis?*

To help bridge the gap between research and practice, it was deemed important by the researcher to also explore how the participants envisaged the co-created interventions would be implemented. Translating interventions into practice is an important aspect of ensuring that interventions reach their intended populations, but the process of implementation is often under-reported in intervention development studies (Lopez-Patton et al., 2015).

Alongside implementation, intervention evaluation also plays a key role in determining intervention efficacy. Historically, researchers have determined the criteria that has been used to determine intervention effectiveness, typically including outcome measures such as self-reported physical activity and objectively measure step counts through devices such as pedometers (Johnson et al., 2018). Such practices are akin to pedantic science, bypassing the criteria that employees themselves use to judge intervention effectiveness. To help overcome these limitations research questions nine and ten were developed:

> *RQ9: What implementation strategies are present within employee descriptions of the co-created interventions?*

RQ10: What criteria do employees perceive as being important in determining the effectiveness of the co-created interventions?

The information obtained through research questions one through ten would then serve as a platform to develop a new digital workplace physical activity promotion intervention. The intervention, designed in conjunction with the co-creators, could then be shared with a larger pool of participants to explore whether employees intended to use it. This would enable to the researcher to identify whether co-created interventions were a viable alternative to those derived purely via researchers. In line with the pragmatic stance of the researcher, it was deemed important to also identify potential socioecological characteristics that may influence the behavioural intention to use the intervention. This would be achieved through the adoption of the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2), which has identified variables that can potentially influence new technology adoption (Venkatesh et al., 2012). Through exploring the influence of such variables, it would be possible to provide practitioners with tangible list of socioecological factors that would be important to target when implementing the intervention in organisations. Combined, this led to the development of research question eleven:

RQ11: Which variables from within the UTAUT2 influence employees' behavioural intention to use the co-created intervention?

An overview of each research question, where it has been addressed within the thesis and the overarching approach used to answer it can be found in table 1. Further information relating to the specific details of each methodology and analytical strategy can be found within their respective chapter.

Table 1- Overview of Research Questions Addressed within the Thesis

Research Question	***Chapter addressed***	***Method used to address research question***
RQ1: Are interventions designed to increase employee workplace physical activity levels effective at increasing objectively measured step counts post six months?	2	Random-effects meta-analysis of intervention studies that have objectively measured physical activity in workplace settings and reported outcomes post six months
RQ2: Are interventions designed to decrease employee workplace sedentary behaviour levels effective at decreasing objectively measured sitting time post six months?	2	Random-effects meta-analysis of intervention studies that have objectively measured sedentary behaviour in workplace settings and reported outcomes post six months
RQ3: Are the number of BCTs used within workplace physical activity interventions significantly correlated with intervention effectiveness?	2	Random-effects meta-regression exploring the relationship between the number of BCTs present and intervention effect sizes within the studies included in research question one.
RQ4: Are the number of BCTs used within workplace sedentary behaviour interventions significantly correlated with intervention effectiveness?	2	Random-effects meta-regression exploring the relationship between the number of BCTs present and intervention effect sizes within the studies included in research question two.

Research Question	***Chapter addressed***	***Method used to address research question***
RQ5: Does the presence or absence of BCTs commonly used across the included papers moderate intervention efficacy for physical activity focused interventions?	2	Sub-group moderator analysis comparing intervention effect size when a BCT was present versus when the same BCT was removed for the interventions included within research question one.
RQ6: Does the presence or absence of BCTs commonly used across the included papers moderate intervention efficacy for sedentary behaviour focused interventions?	2	Sub-group moderator analysis comparing intervention effect size when a BCT was present versus when the same BCT was removed for the interventions included within research question two.
RQ7: What do employees perceive to be barriers and facilitators of physical activity and sedentary behaviour within occupational roles?	4	A first co-creation workshop, comprised of employees from different industries, utilising arts-based methods (Co-creation CUbe and Photovoice) to articulate perceived barriers and facilitators. Integrated visual thematic analysis used to identify common themes across co-creation groups.
RQ8: What behaviour change strategies are present within interventions designed by employees and how do they differ from those identified within the studies included in the meta-analysis?	5	A second co-creation workshop empowering the co-creators to design and describe an intervention that could overcome the identified barriers and facilitators. The co-created interventions were coded for the presence of BCTs and then compared

		to the BCTs present within the studies included in research questions one and two.
Research Question	***Chapter addressed***	***Method used to address research question***
RQ9: What implementation strategies are present within employee descriptions of the co-created interventions?	5	Qualitative content analysis of the co-creator's descriptions of their interventions to identify implementation strategies present across co-creation groups
RQ10: What criteria do employees perceive as being important in determining the effectiveness of the co-created interventions?	5	Qualitative content analysis of the co-creator's descriptions of their interventions to identify evaluation strategies present across co-creation groups
RQ11: Which variables from within the UTAUT2 influence employees' behavioural intention to use the co-created intervention?	7	A video demonstration of the co-created intervention delivered to employees followed by an adapted UTAUT2 questionnaire. Structural equation modelling – partial least squares used to assess factors influencing behavioural intention to use the co-created intervention.

1.8.2 Thesis Structure

The thesis is comprised of eight chapters, an overview of which can be seen in figure 1. The current chapter introduced the background context, rationale and overarching aims of the thesis. Specifically, the chapter outlined the impact of physical activity and sedentary behaviour on both employee and organisational health; why the workplace is an important domain to tackle these behaviours and provided an overview of intervention efforts within this domain. The under-utilisation of participatory methods was identified and the rationale for co-creational approaches to intervention development given. The overarching aims of the thesis were also stated and an overview of the thesis structure provided.

Chapter 2- Meta-Analysis Exploring the Efficacy of Workplace Physical Activity and Sedentary Behaviour Interventions on Objectively Measured Outcomes. This chapter aimed to determine whether workplace physical activity and sedentary behaviour interventions produce sustained effects over time and to establish whether intervention complexity was associated within intervention effectiveness. Seeking to overcome the limitations of self-report measures and reduce the impact of novelty effects, the meta-analysis included only studies which had measured physical activity and sedentary behaviour objectively and reported outcomes after six months post-implementation. Included studies were also coded for the behaviour change techniques used and meta-regression was performed to determine whether the number of behaviour change techniques used influenced overall intervention efficacy.

Chapter 3- Co-Creation Strategy & Methodological Philosophy. This chapter elaborated upon the co-creational approach utilised within the thesis. It outlined the phases of the co-creation studies, the methodologies used within each phase and the analytical approaches adopted to analyse the data. The underlying methodological philosophy of pluralism was also discussed.

Chapter 4- Co-Defining the Problem: Identifying Barriers and Facilitators of Physical Activity and Sedentary Behaviour in the Workplace. This chapter introduced the first phase of the co-creation process; the identification of perceived barriers and facilitators of workplace physical activity. The chapter provided an overview of the arts-based methods used and synthesised the co-creator's responses in a pluralistic manner. Content analysis, visual analysis and thematic analysis were utilised to provide a robust and comprehensive exploration of the barriers and facilitators perceived by the co-creators. This enabled the study to identify aspects of the working environment related to physical activity permissiveness.

Chapter 5- Co-designing and Co-refining the Solution: Intervention Design. This chapter outlines the second phase of the co-creation process; intervention development. Within this chapter, the co-creators build upon the barriers and facilitators identified within chapter 4 to design and develop a series of new workplace physical activity interventions. Using qualitative content analysis, the chapter provides an overview of intervention features desired by employees and outlines how employees believe intervention efficacy should be measured.

Chapter 6- Co-refine: The Development of Wellness@Work. This chapter outlines the iterative process involved in working with the co-creators to design a new workplace physical activity intervention entitled Wellness@Work. Each iteration of the new intervention is described and an overview of what the final intervention contained has been provided.

Chapter 7- Exploring the Behavioural Intention to Use Wellness@Work . This chapter describes the pre-implementation evaluation of *Wellness@Work*, derived from the co-created materials produced within chapters 4 and 5. Using structural equation modelling, the chapter explores factors that influence the acceptability of and behavioural intention to use the new co-created intervention.

Chapter 8- Discussion. This chapter summarises the main findings and original contributions of the research studies included within the thesis. The strengths and limitations of the thesis were outlined alongside suggestions for future developments and applications of the research.

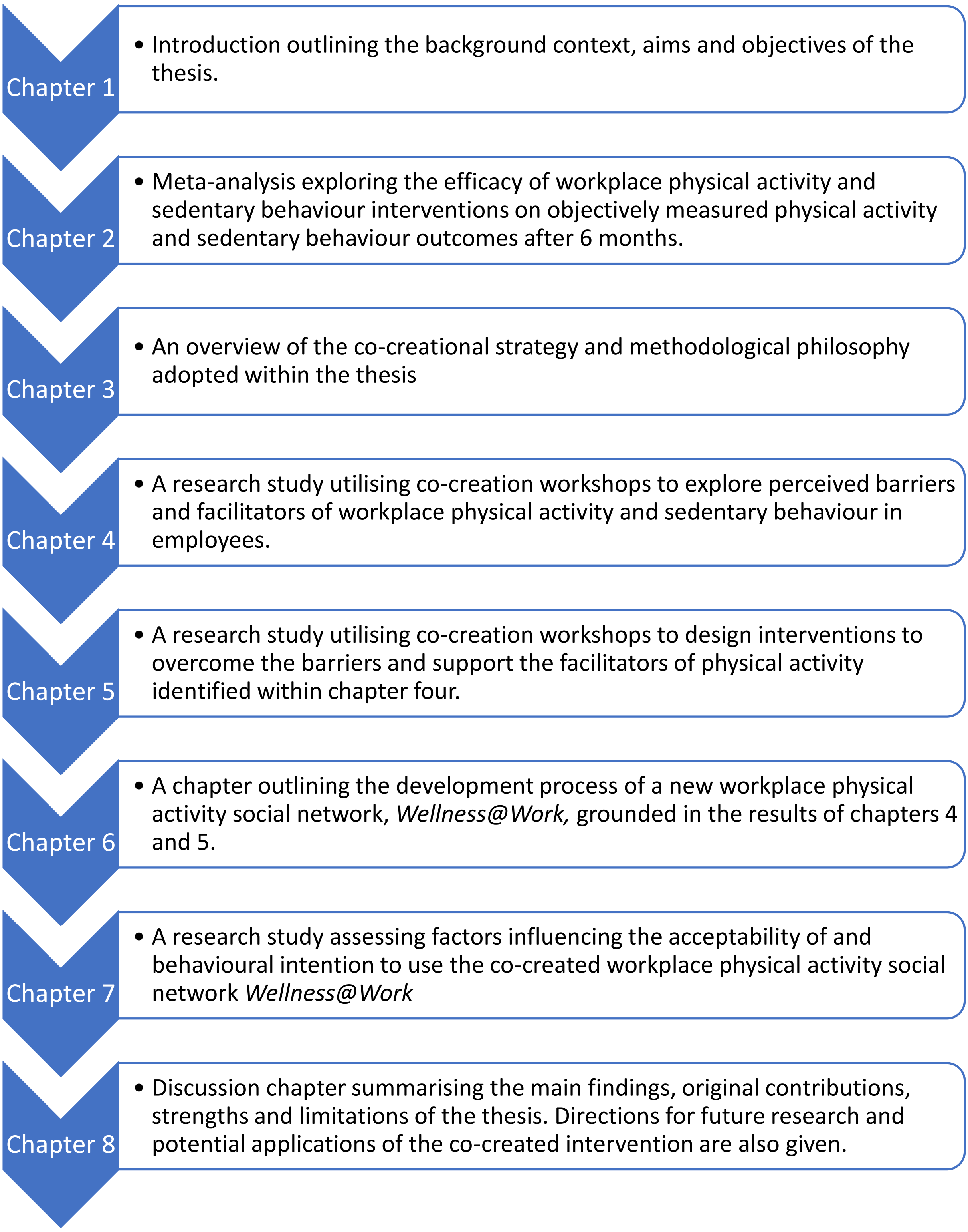


Figure 1.1: Thesis Structure

Chapter 2 – Meta-Analysis Exploring the Efficacy of Workplace Physical Activity and Sedentary Behaviour Interventions on Objectively Measured Outcomes.

2.1 Introduction

As outlined in chapter one, over the past several decades numerous workplace physical activity and sedentary behaviour interventions have been developed. Such interventions have been incredibly diverse including encouraging individuals to self-monitor activity levels via pedometer use (Mansi et al., 2015), promoting active travel (Dubuy et al., 2013), installing sit-stand workstations (Alkhajah et al., 2012), adding stair use prompts to buildings (Eves et al., 2006) and giving individual face-to-face counselling sessions (Proper et al., 2003). Furthermore, many workplace physical activity interventions have become increasingly complex and multi-componential (Quintiliani et al., 2007). Organisations have increasingly viewed workplace physical activity promotion interventions as strategic investments due to evidence suggesting that active employees take fewer sickness absence days (Amlani & Munir, 2014), are more productive (Puig-Ribera et al., 2015) and have lower intention to quit (Haslam et al., 2019). However, as with any strategic investment, the benefits and costs must carefully be considered. Given that it has been estimated that comprehensive workplace health promotion programmes cost approximately $200 per employee per month (Pratt et al., 2004), it is unsurprising that there has been significant demand from employers to ascertain which workplace health promotion programmes, or specific components of programmes, are effective and provide the greatest financial returns for their organisation prior to implementation (Lerner et al., 2013).

Over the past decade, a number of systematic reviews and meta-analyses have been conducted to ascertain the effectiveness of workplace physical activity and sedentary behaviour interventions (Chau et al., 2010; Chu et al., 2016; Hutcheson et al., 2018; Hutchinson & Wilson, 2012; Malik et al., 2014; Mulchandani et al., 2019; Rongen et al., 2013; Taylor et al., 2012; To et al., 2013; Verweij et al., 2011). Such reviews have been inconclusive in determining the overall effectiveness of workplace physical activity and sedentary behaviour focused interventions. Whilst some have established that workplace physical activity interventions can improve employee health and organisational outcomes (Malik et al., 2014), others have found limited to no effects (J. Y. Chau et al., 2010).

Whilst each has undoubtedly contributed to the understanding of workplace intervention efficacy, reviews have been incredibly diverse in relation to the types of studies, methods and outcomes included. For example, Rongen et al. (2013) and Hutchinson & Wilson (2012) took a holistic view exploring the efficacy of more generalised workplace health promotion and combined nutrition and physical activity interventions respectively. Through the inclusion of interventions targeting multiple health behaviours, it becomes challenging to disentangle which component was responsible for any identified changes in physical activity behaviour. Other reviews, such as those conducted by Mulchandni et al. (2019), Chu et al. (2014) and Verweij et al. (2011) eschewed direct measures of physical activity behaviours in favour of psychophysical health outcomes such as cardiometabolic health, mental health and weight. These reviews have contributed evidence for the efficacy of interventions on improving specific health outcomes but provide limited to no discussion on the extent to which physical activity behaviours themselves were altered and how. Conversely, the review conducted by Hutcheson et al. (2018) focused upon a singular type of intervention, environmental interventions and their impact upon sedentary behaviour. Whilst this review contributed a highly focussed understanding of how one type of intervention may influence sedentary behaviour, the efficacy of wider physical activity interventions and alternate, non-environmental, sedentary behaviour interventions was not considered. The review also did not consider long-term behaviour change, limiting the applicability of the study to short-term changes in behaviour. Whilst reviews such as those conducted by Malik et al. (2014) and To et al. (2013) have focused upon physical activity interventions and changes to physical activity behaviours, both included a mixture of self-reported and objectively measured outcomes. It has been documented that participants tend to over-estimate physical activity levels when self-report measures are used, potentially exaggerating the efficacy of interventions included within these reviews (Monyeki et al., 2018).

Whilst each of the aforementioned systematic reviews and meta-analyses have contributed to the wider understanding of workplace physical activity and sedentary behaviour intervention efficacy, authors have highlighted a number of key limitations including the accuracy of the measurement methods used (Haskell, 2012), the duration length of the interventions (NICE, 2006) and the quality of intervention reporting (Bauman et al., 2002). Many systematic reviews have not provided commentary on which aspects of the included interventions may have been responsible for changes in physical activity and sedentary behaviours (Malik et al., 2014; To et al., 2013). As such, the reviews identified whether interventions worked but not how and why, making them of limited use to researchers and practitioners who are seeking to design new interventions or adapt and enhance existing ones. Given the author’s position as a pragmatic scientist, this represented a fundamental limitation that needed to be addressed. The potential impact of each of the aforementioned limitations has been considered in more detail below.

2.1.1 Physical Activity and Sedentary Behaviour Measurement

A variety of different measurement methods exist to measure both physical activity and sedentary behaviour. Such measurement methods are often categorised as either self-report or objective measures (Carson et al., 2017; S.-H. Liu et al., 2016; Prince et al., 2008). Self-report measures ask participants to recall their levels of physical activity or sedentary behaviour over a specified time-period and can comprise of tools such as questionnaires, diaries, logs and interviews

(Sallis, 2010). Conversely, objective measures seek to provide direct data on physical activity and sedentary behaviour using technology such as pedometers and accelerometers (Troiano et al., 2008). Historically, self-report measures have been the most common method of physical activity assessment in research (Castillo-Retamal & Hinckson, 2011) and have been used in studies spanning over 50 years (Epstein et al., 1976). Self-report tools are also becoming increasingly popular in the measurement of sitting time and sedentary behaviour (Dall et al., 2017). The widespread use of self-report measures within physical activity and sedentary behaviour research has often been linked to their practicality, cost-effectiveness, and ease of administration (Haskell, 2012; Martins et al., 2017; Strath et al., 2013). Despite this, self-report measures of physical activity are vulnerable to inaccuracies across a variety of populations and settings (Cerin et al., 2016; Monyeki et al., 2018; Prince et al., 2008).

Self-report measures of physical activity can be impacted by social desirability and social approval effects (Adams, 2005), unreliable memory recall (Shephard, 2003), floor effects (Watts et al., 2013) and ambiguous terminology (Herbolsheimer et al., 2018). More specifically, self-report measures of physical activity appear to be less robust in their measurement of light to moderate levels of physical activity (Jacobs et al., 1993). This has led to concerns that self-report measures can obscure true physical activity levels and that more valid, accurate and reliable measures should be sought when evaluating the effectiveness of interventions in this domain (Prince et al., 2020). In a direct comparison of self-report and objective measures Urda, Larouere, Verba, & Lynn (2017) established that office workers significantly underestimated the amount of time that was spent performing sedentary behaviour when self-reporting; leading the authors to caution researchers against the use of self-report data when making universal recommendations about behaviour change. Wareham, van Sluijs, & Ekelund (2005) echo this sentiment suggesting that previous systematic reviews on physical activity, which have primarily drawn upon studies with subjective methods, have been unable to quantify physical activity adequately and therefore may be contributing to a lack of clarity about the true impact of interventions in this domain. Despite the substantive contribution that self-report measures have made to the understanding of physical activity and sedentary behaviour, objective measures may help to reduce the potential for measurement error and help to increase the precision of collected data by overcoming some of the aforementioned difficulties such as poor memory recall and variations in the ability to subjectively quantify physical activity levels(Ainsworth et al., 2015; Riddoch et al., 2007).

2.1.2 Intervention Duration

It has been well established that physical activity contributes to many desirable health outcomes such as reduced risk of cardiovascular disease, diabetes and depression (Ahmed et al., 2012; Bélair et al., 2018; Joseph et al., 2016; Rhodes et al., 2017). However, for individuals to benefit from these outcomes physical activity has to be performed regularly and sustained over time (Kahlert, 2015; Moholdt et al., 2018)**.** Despite this, approximately half of those who engage with a physical activity intervention drop out within the first six months (Dishman, 2001; Dishman et al., 1985)**.** To *et al* (2013) suggest that, in the short-term, interventions may benefit from a novelty effect leading to increased interest and excitement about the potential for the intervention to help facilitate desired behaviour change. However, as the length of the intervention increases initial enthusiasm wanes and participants may return to their accustomed habits. Therefore, short-term interventions may have an impact upon physical activity adoption but not physical activity maintenance (Nigg et al., 2008)**.** Indeed, individuals who have adopted new physical activity behaviours for less than six months are at the greatest risk of relapse and are significantly more likely to relapse than those who have maintained their physical activity behaviours for longer than six months (Horiuchi et al., 2013). Previous systematic reviews and meta-analyses evaluating the effectiveness of workplace physical activity interventions have included both short-term and long-term interventions simultaneously (Neuhaus, Eakin, et al., 2014; Reed et al., 2017; To et al., 2013). Given that sustained physical activity is key to obtaining long-term beneficial health outcomes an important distinction needs to be made between short-term interventions designed to increase physical activity adoption and longer-term interventions designed to increase sustained maintenance of physical activity behaviours (Nigg et al., 2008; Rothman, 2000)**.** Abraham & Graham-Rowe (2009) echo this sentiment suggesting that future systematic reviews and meta-analyses should aim to evaluate long-term workplace physical activity interventions to ascertain whether behaviour change is maintained or whether interventions may need to be repeated or boosted over time.

2.1.3 Intervention Reporting

One of the greatest criticisms directed towards health-related behaviour change interventions is that the reporting of intervention content is often short, inexact and overly reliant on broad level descriptions of components (Michie et al., 2011). In part, this lack of detail has been attributed to space constraints imposed by research journals restricting the amount of detail that authors can provide (Michie, Fixsen, et al., 2009). However, there have also been inconsistencies in how authors have described the specific behaviour change techniques used within interventions, with different labels being used for similar techniques and vice versa (Dombrowski et al., 2012). The combination of these two issues can have far reaching consequences when it comes to establishing the effectiveness of interventions. Firstly, without this information it can be difficult for researchers to explain how and why any given intervention works. Understanding how and why an intervention works is crucial to the development of new knowledge, new theories, and the development of more effective interventions overall (Michie et al., 2013). A lack of detail also restricts the ability for researchers to conduct high fidelity replication studies (Abraham & Michie, 2008), making it more difficult to establish the overall effectiveness of an intervention. Finally, a lack of clear reporting with regards to behaviour change techniques can lead to distortions between the researchers who design the interventions and the practitioners who eventually go on to implement them (Riley et al., 2008). Michie et al. (2009) argue that the use of inconsistent terminology when reporting behavioural change techniques used in research can have a serious implication on an intervention’s reported effectiveness. For example, the authors argue that an intervention described as 'behavioural counselling' can mean very different things to different groups who are implementing or evaluating a given intervention. It is clear to see that any attempt to establish the effectiveness of an intervention will need to identify and report the behaviour change techniques that have been used in a clear and consistent manner. To this end, Michie et al. (2013), developed the behaviour change technique taxonomy (BCTT). The BCTT represents a consensually agreed, international, common language to describe behaviour change techniques (BCTs). The BCTT contains 93 hierarchically clustered BCTs and has been shown to be a valid and reliable taxonomy (Michie et al., 2013). Therefore, the BCTT may represent a fruitful avenue in understanding how and why interventions may work within the domain of workplace physical activity and sedentary behaviour. In addition to a more systematic and thorough approach to intervention description, authors have also called for a greater examination of the utility of BCTs in facilitating longer term behaviour change (Samdal et al., 2017). It has been noted that many workplace interventions designed to target physical activity and sedentary behaviour are often complex and the nature of their implementation can require several detailed steps and a variety of different BCTs to be used (Power et al., 2021). Despite this, a dearth of literature has explored whether the number of BCTs used within an intervention is associated with intervention effectiveness. The current review therefore sought to address this gap by accounting for not only which but also how many BCTs are present within workplace physical activity and sedentary behaviour interventions.

2.1.4 Research Aims

The meta-analysis expanded upon previous quantitative syntheses in several key areas. Firstly, in response to the identified limitations of subjective measures the current meta-analysis included only empirical studies that have utilised objective measures. Secondly, the review determined whether any changes to employee physical activity or sedentary behaviour levels are sustained over time.

Thirdly, the BCTT was used in a meta-analysis to provide a more comprehensive description of intervention content. Finally, detailed insight into which aspects of interventions were most likely to be associated with overall interventional effectiveness were examined using sub-group analysis and meta-regression of the BCTs within this domain. The aim was to provide a more accurate overview to the extent to which workplace interventions and specific BCTs are effective at increasing and maintaining physical activity and decreasing sedentary behaviours for at least six months. In light of this, the research questions were as follows:

1. Are interventions designed to increase employee workplace physical activity levels effective at increasing objectively measured step counts post six months?
2. Are interventions designed to decrease employee workplace sedentary behaviour levels effective at decreasing objectively measured sitting time post six months?
3. Are the number of BCTs used within workplace physical activity interventions significantly correlated with intervention effectiveness?
4. Are the number of BCTs used within workplace sedentary behaviour interventions significantly correlated with intervention effectiveness?
5. Does the presence or absence of BCTs commonly used across the included papers moderate intervention efficacy for physical activity focused interventions?
6. Does the presence or absence of BCTs commonly used across the included papers moderate intervention efficacy for sedentary behaviour focused interventions?

2.2 Method

The *a priori* protocol for this meta-analysis was registered in Prospero (https://www.crd.york.ac.uk/prospero/display_record.php?ID=CRD42018016977). To ensure the rigor of the review the PRISMA-P framework (Moher et al., 2015) was adopted during the design of the review's methodology.

2.2.1 Search Strategy

A comprehensive and systematic search of multiple academic databases was conducted to facilitate evidence location and reduce the risk of bias (Conn, Isaramalai, et al., 2003). Following consultation with a subject specialist librarian at Coventry University, key words, subject headings, and search operators relevant to the research aims were determined. In line with other systematic reviews and meta-analyses, Boolean logic was also used to combine search phrases and terms (Guure et al., 2017; Middelweerd et al., 2014). The following six electronic academic databases were initially searched on 31st July 2018; PsychInfo, Academic Search Complete, Business Source Complete, CINAHL, MEDLINE and SPORTDiscus. An example database search has been provided in appendix 1. OpenGrey was also searched to identify potential sources of grey literature which may have not been indexed within the academic databases. Searches across all databases yielded 14,792 results which were imported into EndNote X9 reference management software.

2.2.2 Exclusion Criteria

To ensure that only studies directly relevant to the research questions were included, a list of 12 exclusion criteria were developed (see table 2). The rationale supporting each exclusion criteria can be found in appendix 2. Titles and abstracts of the studies identified through the database searches were screened against the exclusion criteria. If the paper was not excluded, or if it was unclear whether the paper met all exclusion criteria, the study was retained for full-text screening. The same exclusion criteria were used to screen the full texts of the remaining studies. Any studies that were not excluded during full-text screening were included into the final meta-analysis.

Table 2: Meta-Analysis Exclusion Criteria

Exclusion Criteria	Description
1	Exclude if the focus of the study was not explicitly about physical activity or sedentary behaviour.
2	Exclude if the study was either not conducted in a workplace or not endorsed by an employer.
3	Exclude if the intervention was designed to treat a pre-existing medical condition. For example, e.g. exercise or rehabilitation interventions to treat back pain, diabetes or cardiovascular disease.
4	Exclude if the study is not empirical (i.e. not based on primary evidence). Not conceptual, review or philosophical only. Include grey literature e.g., published conference abstract, thesis, protocol, book, book chapter.
5	Exclude if the study is not an intervention.
6	Exclude if the study did not include adult participants between the ages of 18 and 65 years.
7	Exclude if the participants were not explicitly in a form of employment during the intervention e.g. unemployed, full-time education or retired. Include if in any form of employment, including full-time, part-time, employed, self-employed.
8	Exclude if the outcomes of the intervention did not aim to increase physical activity or reduce sedentary behaviour.

Exclusion Criteria	Description
9	Exclude if unable to extract the data, e.g., if an intervention includes multiple components, such as healthy eating and physical activity, but the results for physical activity are not reported separately.
10	Exclude if the study is focussed exclusively upon sport, fitness or the biological outcomes of physical activity.
11	Exclude if only subjective outcome measures were used
12	Exclude if follow up period is less than six months

2.2.3 Study Selection

Duplicate studies were removed using EndNote's duplicate removal function which was then followed by a manual check for duplicate references by researcher AT. Automated and manual duplicate detection methods have been used successfully in previous meta-analytical research (Witt & Schmidt, 2014). This process led to 4,931 duplicate references being removed. The titles and abstracts of the remaining 9,861 references were screened for inclusion by two authors (AT and AH[1]). Through title and abstract screening, a total of 9,603 studies were excluded. The full texts of the remaining 258 studies were then screened. AT screened 100% of the full texts and AH screened a 10% sample with 11 final full texts included in the review. The percentage of inter-rater agreement between the two reviewers was 96.67% representing excellent agreement. Disagreements were resolved through discussion. A PRISMA (2009) flow diagram outlining the identification and selection of eligible studies within the review has been provided in figure 2.1.

[1] AH was a doctoral researcher specialising in health behaviour change research. AH had no prior involvement with the research conducted within the thesis and therefore acted as an independent second reviewer.

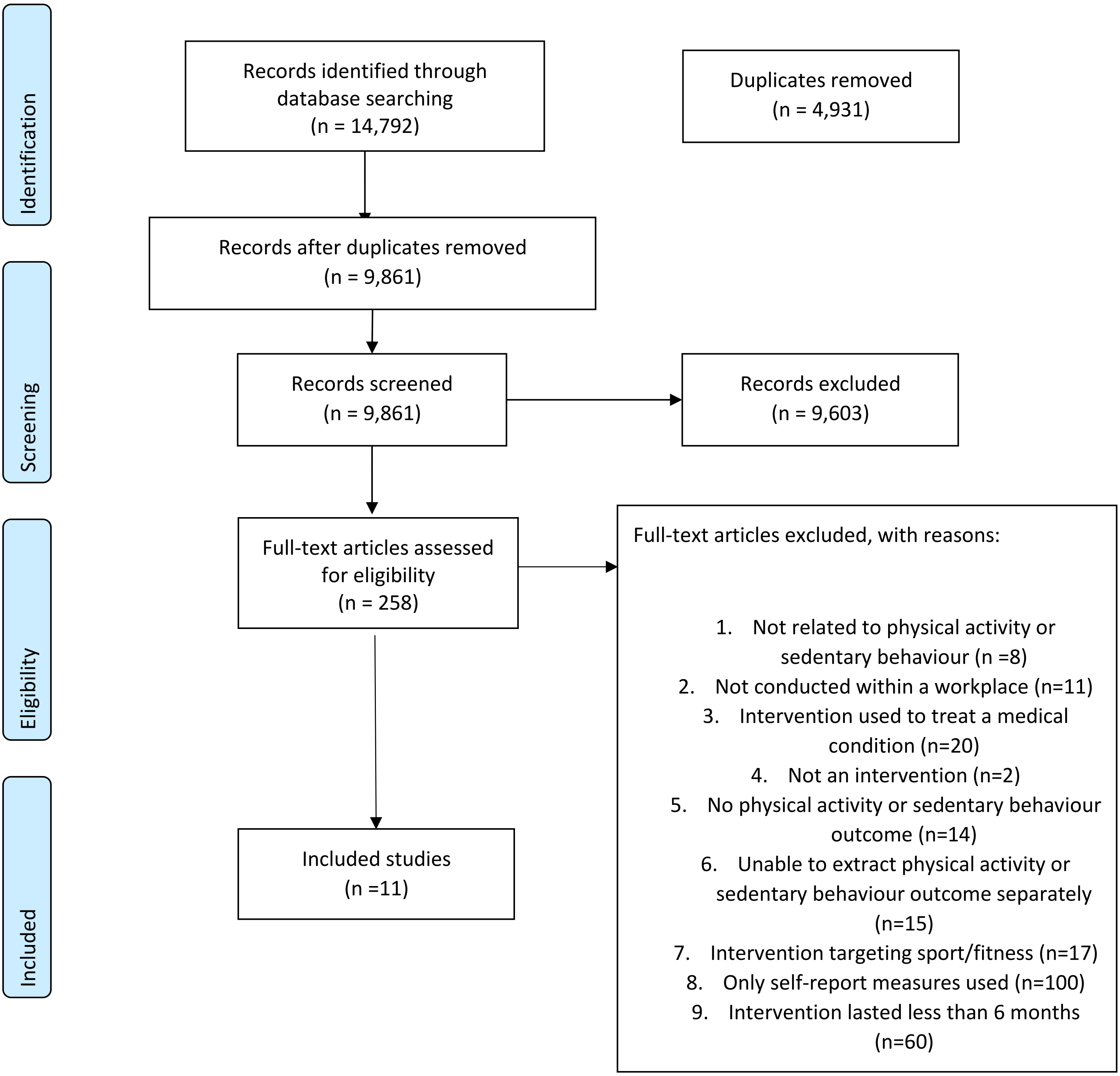


Figure 2.1: PRISMA Flow Diagram of Identification and Selection of Eligible Studies

2.2.4 Data Extraction

A data extraction form was created a priori. Information was extracted in relation to; the characteristics of the organisation (geographical location, organisation size, organisation sector), the characteristics of the participants (number of participants, mean age and standard deviation, percentage of females, number of dropouts), characteristics of the intervention (brief intervention description, whether the intervention was co-designed, control groups, intervention groups, data collection tools) and outcome data.

2.2.5 Behaviour Change Technique Coding

Each of the included interventions were coded for the presence of BCTs from within the BCTT V.1. Two authors, AT and AH, coded each of the included studies independently. Any disagreements were resolved via discussion between AT and AH. Disagreement discussions primarily centred around the BCTs *'5.1- Health consequences'* and *'12.5 – Adding objects to environment'.* In relation to BCT *'5.1- Health consequences',* discussions explored whether health consequences only included negative consequences or whether positive consequences should also be considered. It was agreed that, for the current study, only negative health consequences were to be coded under this BCT. In relation to BCT '*12.5 – Adding objects to environment*', discussions centred around whether giving participants pedometers counted as adding an object to the environment. Previous research has coded pedometers under this BCT (Finne et al., 2018). Therefore, the current study also viewed the inclusion of pedometers as objects which had been added to the environment.

2.2.6 Quality Assessment

Study quality was assessed via the Effective Public Health Practice Project Quality Assessment Tool for Quantitative Studies (EPHPP, 2004). The assessment tool rates studies on six overarching criteria: selection bias, study design, confounders, blinding, data collection method and withdrawals and dropouts. Each criterion is attributed one of three possible ratings; weak, moderate or strong dependent upon how many points the study accrues within each criteria of the assessment tool. A global study rating is then calculated whereby a paper is classified as strong if it received no weak ratings, moderate if it received one weak rating and weak if it received two or more weak ratings across the six criteria. This assessment tool has strong content validity and strong test-retest reliability, with established inter-rater agreements across two testing sessions of $\kappa=0.74$ and $\kappa=0.61$ (Thomas et al., 2004). Within the current study, AT completed the quality assessment of all included studies. AH completed quality assessment on a 50% sample of included studies. Both researchers completed the quality assessment independently. There was 100% agreement between the researchers on the global study ratings awarded to the papers assessed.

2.2.7 Analytical Strategy

Prior to data analysis the risk of publication bias and study heterogeneity was explored. Publication bias was assessed via fail-safe N, a statistical test that seeks to detect the number of additional 'negative' studies that would be required to increase the p value to a statistically non-significant level (Rosenthal, 1979). For the outcome of average steps per workday 73 additional 'negative' studies would be required and for the outcome average number of minutes spent sitting per workday an additional 201 'negative' studies would be required. Funnel plots were also consulted (appendix 3). The funnel plots were broadly symmetrical suggesting the absence of publication bias (Sofi, et al., 2011) . Heterogeneity was explored via the I^2 statistic, a measure that estimates the amount of variability that is explained by differences between the included studies of rather than by sampling error (Higgins & Thompson, 2002). Generally accepted interpretations of I^2 suggest that I^2 values of ≥25%, ≥50% and ≥75% represent low, moderate and high levels of heterogeneity respectively Higgins et al. 2003. Within the current meta-analysis, the I^2 value for average steps per workday was 77%, and for average minutes sitting per work day was 93% suggesting high levels of heterogeneity. This was consistent with previous meta-analyses conducted within this domain (Conn et al., 2009; Malik et al., 2014). A standard random effects meta-analysis approach was adopted as this allowed for unexplained between-study heterogeneity when calculating overall treatment effects (Partlett & Riley, 2017).

To examine research questions 1 and 2 pre and post means, standard deviations, percentage change and/or 95% CI relating to the primary outcome measures of steps per day and time spent engaging in physical activity or sedentary behaviour were extracted. A random effects meta-analysis was conducted using Hedges' *g* as the effect size summary statistic. Hedges *g* was calculated from the data extracted from each of the included studies via the use of the computer programme Comprehensive Meta-Analysis, version 2 (Comprehensive Meta-Analysis, 2019). Hedges' *g* is a derivation of the standardised mean difference and has been recommended for use within social science research (Cochrane, n.d.).

To examine research questions 3 and 4, random effects univariate meta-regression was conducted to explore whether the number of BCTs present within the included interventions were associated with overall intervention effectiveness in physical activity focused interventions and sedentary behaviour focused interventions.

To examine research questions 5 and 6 random effects sub-group analyses were conducted to explore whether overall intervention effectiveness was enhanced by a BCT being present or absent. As previously noted, a key limitation of existing reviews has been that studies have provided commentary around whether interventions work but not how they work. This can make adapting interventions challenging for practitioners, as no tangible guidance exists on which aspects of published interventions are essential to intervention efficacy and which elements can be removed without unduly impacting the intervention. Through sub-group analysis a list of BCTs can be generated to provide practitioners with more concrete information as to which behaviour change strategies must be retained and which could be edited when implementing interventions to meet their client's specific needs. In line with previous research, a single BCT needed to be present within at least four different studies to be included within the sub-group analysis (Taylor et al., 2012).

2.3 Results

11 studies were included into the meta-analysis. The included studies were conducted predominantly within economically developed countries (United States of America n=6, Australia n=2, Finland n=1, Singapore n=1)) with one study conducted within an economically developing country (Brazil n=1), as determined by the United Nations World Economic and Prospects report (United Nations, 2019). A total of 2,308 people participated in the studies included within the meta-analysis. Sample sizes varied substantially between studies ranging from 12 to 800 participants. The majority of the participants within the included studies were female (68.75%). However, one study did not report the gender split of its participants (Taylor et al., 2010). The included studies were conducted in predominantly large organisations (54.45%). The majority of the included studies utilised multi-componential interventions (n=7). Those that did not involved the addition of treadmills to the employee's workspace (n=2) or a singular exercise class performed during break times (n=2). Seven of the included studies reported objectively measured step counts, two reported objectively measured sitting time and two studies reported both objectively measured step counts and sitting time. None of the included studies reported using co-creation methods explicitly. One study, (Aittasalo et al., 2017) adopted a semi-participatory approach where participants planned and implemented interventions that they had designed in conjunction with two interventions that had been developed by the researchers. An overview of the included studies and interventions has been provided in table 3.

Table 3: Included study summary table

Study	**Design**	**Location**	**Organisation Type**	**Organisation Size**	**Latest data collection timepoint**	**Total Participants (*n*)**	**% Female**	**Participant Average Age *M (SD)***	**% drop out at last time point**	**Brief Intervention Description**	**Objective Measure**
Aittassalo *et al* (2017)	Quasi-experimental	Finland	Banking services (n=2) Congress and concert centre (n=2) Media house (n=2) Climate control (n=1) Regional marketing (n=1) Training institute (n=1) Technology centre (n=1) Amusement park (n=1) Theatre (n=1)	Ranging from 13 - 107 employees	12 months	266	63.9%	42.6 (10.9)	51%	'Moving to Business' (MTB), a multi-componential workplace initiative targeting organisational, team and individual behaviours. Each worksite nominated an internal MTB group who worked with the researchers to plan and implement interventions that met the needs of their worksite. The research team also provided two pre-existing campaigns; 'Active Commuting to Work' and 'Active Working Day' for the MTB teams to implement.	Hookie AM13 accelerometer

Study	**Design**	**Location**	**Organisation Type**	**Organisation Size**	**Latest data collection timepoint**	**Total Participants (*n*)**	**% Female**	**Participant Average Age *M (SD)***	**% drop out at last time point**	**Brief Intervention Description**	**Objective Measure**
Allen *et al* (2012)	Quasi-experimental	USA	University	172 employees	12 months	64	90.63%	48.90 (10.25)	14.07%	Ten monthly lifestyle sessions delivered online and the distribution of pedometers.	Digi-WalkerSW-401 pedometer
Brackenridge *et al* (2016)	RCT	Australia	Property & Infrastructure	1525 employees	12 months	153	46%	38.9 (8)	44.5%	Weekly information booklet emailed to participants including; information about health implications, tips to sit less and stand more, comments and images of participants taking part in activites and an activity tracker.	activPal accelerometer

Study	**Design**	**Location**	**Organisation Type**	**Organisation Size**	**Latest data collection timepoint**	**Total Participants (*n*)**	**% Female**	**Participant Average Age *M (SD)***	**% drop out at last time point**	**Brief Intervention Description**	**Objective Measure**
Finkelstein *et al* (2016)	RCT	Singapore	Manufacturing (n=5) Research and development (n=2) Off-shore engineering (n=1) Computer technology (n=1) Human resources (n=1) Computer games (n=1) Healthcare provider (n=1) Government tax (n=1)	Not reported	12 months	800	53.8%	35.5 (8.48)	17.87%	Activity tracker with financial incentives.	Actigraph triaxial GT-3x accelerometer

Study	**Design**	**Location**	**Organisation Type**	**Organisation Size**	**Latest data collection timepoint**	**Total Participants (*n*)**	**% Female**	**Participant Average Age *M (SD)***	**% drop out at last time point**	**Brief Intervention Description**	**Objective Measure**
Healy *et al* (2016)	RCT	Australia	Government (17 offices)	>200 employees (n=5) 50-200 employees (n=6) <50 employees (n=3)	12 months	231	68.4%	45.6 (9.4)	30.3%	'Stand up Victoria' multi-component programme involving; email messages, sit-stand work desks, face to face health coaching and telephone health coaching	activPal3 accelerometer
John *et al* (2011)	Quasi-experimental	USA	University	Not reported	9 months	12	58.33%	46.2 (9.2)	0%	Treadmill workstations	activPal accelerometer
Koepp (2013)	Pre-post	USA	Financial Services	Not reported	12 months	36	69.44%	42 (9.9)	0%	Treadmill workstations	Actical accelerometer
Ribiero *et al* (2014)	RCT	Brazil	University Hospital	>15,000 employees	6 months	195	100%	45 (3)	24.11%	Pedometer and physical activity counselling	Digiwalker PW610 pedometer
Smith-McLallen *et al* (2017)	RCT	USA	Not reported	<200 employees	9 months	362	56%	49.51 (11.12)	43.1%	'Walking works', a walking programme including incentives, feedback, competitive challenges and monthly workshops.	NL-800 accelerometer

Study	**Design**	**Location**	**Organisation Type**	**Organisation Size**	**Latest data collection timepoint**	**Total Participants (*n*)**	**% Female**	**Participant Average Age *M (SD)***	**% drop out at last time point**	**Brief Intervention Description**	**Objective Measure**
Taylor *et al* (2010)	Pre-post	USA	Law Firm	14 employees	6 months	14	Not reported	Not reported	Not reported	'Booster breaks' a guided physically activity session delivered by employees daily before lunch breaks.	New Lifestyles DigiWalker SW200 pedometer
Taylor *et al* (2016)	RCT	USA	Not reported	Not reported	6 months	175	82%	43.4 (11.9)	42.3%	'Booster breaks' a guided physically activity session delivered by employees daily before lunch breaks.	New Lifestyles DigiWalker SW200 pedometer

2.3.1 Quality Assessment

The methodological quality of each of the included studies was assessed using the Effective Public Health Practice Project Quality Assessment Tool for Quantitative Studies (EPHPP, 2004). Two of the included studies were classified as strong quality (Finkelstein et al., 2016; Healy et al., 2016), four were classified as moderate quality (Brakenridge et al., 2016; Koepp et al., 2013; Ribeiro et al., 2014; Taylor et al., 2016) and five were classified as weak quality (Aittasalo et al., 2017; Allen et al., 2012; John et al., 2011; Smith-McLallen et al., 2017; Taylor et al., 2010). The strongest criterion was the data collection method in which all of the included studies were classified as being strong. The weakest criterion was for blinding in which eight of the included studies were categorised as weak. An overview of the included study's quality assessment ratings can be found in table 4.

Study	**Selection Bias**	**Study Design**	**Confounders**	**Blinding**	**Data Collection Method**	**Withdrawals & Dropouts**	**Global Rating**
Aittasalo *et al* (2017)	Moderate	Weak	Weak	Weak	Strong	Strong	Weak
Allen *et al* (2012)	Strong	Weak	Weak	Weak	Strong	Strong	Weak
Brackenridge *et al* (2016)	Strong	Strong	Strong	Weak	Strong	Moderate	Moderate
Finkelstein *et al* (2016)	Strong	Strong	Strong	Moderate	Strong	Strong	Strong
Healy *et al* (2016)	Strong	Strong	Strong	Moderate	Strong	Strong	Strong
John *et al* (2011)	Moderate	Moderate	Weak	Weak	Strong	Weak	Weak
Koepp (2013)	Strong	Moderate	Strong	Weak	Strong	Strong	Moderate
Ribiero *et al* (2014)	Strong	Strong	Strong	Weak	Strong	Strong	Moderate
Smith-McLallen *et al* (2017)	Strong	Moderate	Strong	Moderate	Strong	Weak	Weak
Taylor *et al* (2010)	Strong	Moderate	Strong	Weak	Strong	Weak	Weak
Taylor *et al* (2016)	Strong	Strong	Strong	Weak	Strong	Moderate	Moderate

Table 4: Quality Assessment Ratings of Included Studies

2.3.2 Random Effects Meta-Analyses

To address research questions 1 and 2, meta-analyses were performed on the included studies. Nine of the included studies contained objectively measured physical activity data in the form of average workday step counts (see table 5). Random effects meta-analysis was performed on this data and revealed a significant moderate positive effect for physical activity interventions in increasing the average number of steps taken during workdays post six months (Hedges g= 0.32, 95% CI 0.12 to 0.52, $p<0.05$). Figure 2.2 shows a forest plot of the effect sizes and 95% confidence intervals of the studies included within the workday step count meta-analysis.

Table 5: Intervention Workday Step Counts Pre and Post Intervention

Study	**Duration (months)**	***N* Baseline**	**Mean Baseline Workday Step Counts (SD)**	***N* Post-Intervention**	**Post-Intervention Mean Workday Step Counts (SD)**
Aittasalo *et al* (2017)	12	266	3802 (2377)	175	3968 (2354)
Allen *et al* (2012)	12	29	5253 (1644)	26	6878 (1645)
Brackenridge *et al* (2016)	12	66	2201.2 (748.3)	42	2635 (1831.75)
Finkelstein *et al* (2016)	12	396	8038.69 (2402.76)	330	8171.49 (3865.50)

Study	**Duration (months)**	***N* Baseline**	**Mean Baseline Workday Step Counts (SD)**	***N* Post-Intervention**	**Post-Intervention Mean Workday Step Counts (SD)**
John *et al* (2011)	9	12	2715.5 (622.85)	12	4332.25 (914.69)
Ribiero *et al* (2014)	6	48	10,083 (905)	48	10,719 (2383.17)
Smith-McLallen *et al* (2017)	9	184	8637 (3174.13)	123	9507 (3072.08)
Taylor *et al* (2010)	6	14	6596.76 (2522.39)	14	7119.31 (2360.09)
Taylor *et al* (2016)	6	76	7176 (4776.31)	69	6834 (4751.39)

Study name	Statistics for each study						
	Hedges's g	Standard error	Variance	Lower limit	Upper limit	Z-Value	p-Value
Aittasalo et al (2017)	0.070	0.058	0.003	-0.045	0.184	1.197	0.231
Allen et al (2012)	0.958	0.180	0.032	0.606	1.310	5.332	0.000
Brackenridge et al (2016)	0.271	0.204	0.042	-0.129	0.671	1.327	0.184
Finkelstein et al (2016)	0.244	0.095	0.009	0.057	0.430	2.556	0.011
John et al (2011)	0.868	0.249	0.062	0.380	1.357	3.484	0.000
Ribiero et al (2014)	0.498	0.207	0.043	0.093	0.903	2.408	0.016
Smith-McLallen et al (2017)	0.120	0.142	0.020	-0.158	0.397	0.845	0.398
Taylor et al (2010)	0.201	0.197	0.039	-0.185	0.587	1.019	0.308
Taylor et al (2016)	-0.092	0.188	0.035	-0.461	0.276	-0.491	0.623
	0.317	0.101	0.010	0.119	0.515	3.140	0.002

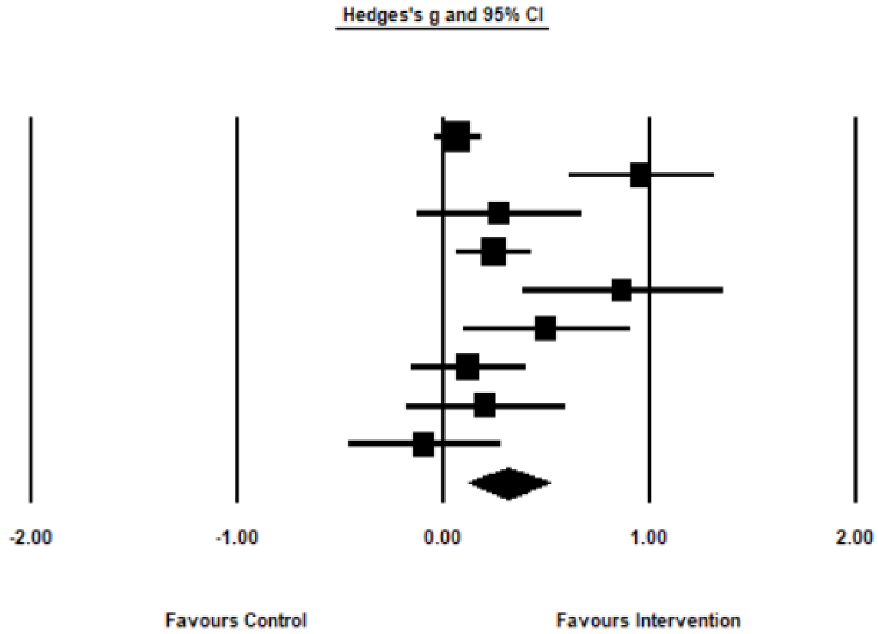


Figure 2.2: Forest Plot of Workday Step Count Meta-analysis

Five of the included studies contained objectively measured sedentary behaviour data in the form of average minutes spent sitting per workday (see table 6). Random effects meta-analysis was performed on this data and revealed a significant strong negative effect for sedentary behaviour interventions designed to decrease the average number minutes spent sitting during workdays post six months (Hedges g= 0.71, 95% CI -1.10 to -0.33, p<0.05). Figure 2.3 shows a forest plot of the effect sizes and 95% confidence intervals of the studies included within the workday step count meta-analysis.

Table 6: Intervention Workday Sitting Minutes Pre and Post Intervention

Study	**Duration (months)**	***N* Pre-Intervention Baseline**	**Pre-Intervention Mean Baseline Workday Sitting Minutes (SD)**	***N* Post-Intervention**	**Post-Intervention Mean Workday Sitting Minutes (SD)**
Koepp (2013)	12	23	1020 (75)	23	978 (95)
Brackenridge *et al* (2016)	12	66	453 (55.9)	66	417.5 (105)
Healy *et al* (2016)	12	136	381.1 (49)	96	322.8 (51.75)
John *et al* (2011)	9	12	651 (36.28)	12	596.75 (24.18)
Aittasalo *et al* (2017)	12	266	298.5 (81.3)	175	271.3 (79.2)

Study name	Statistics for each study						
	Hedges's g	Standard error	Variance	Lower limit	Upper limit	Z-Value	p-Value
Aittasalo et al (2017)	-0.337	0.060	0.004	-0.455	-0.220	-5.627	0.000
Brackenridge et al (2016)	-0.353	0.097	0.009	-0.543	-0.162	-3.630	0.000
Healy et al (2016)	-1.146	0.101	0.010	-1.344	-0.947	-11.315	0.000
John et al (2011)	-1.507	0.316	0.100	-2.127	-0.887	-4.765	0.000
Koepp (2013)	-0.459	0.165	0.027	-0.782	-0.137	-2.792	0.005
	-0.708	0.195	0.038	-1.090	-0.325	-3.626	0.000

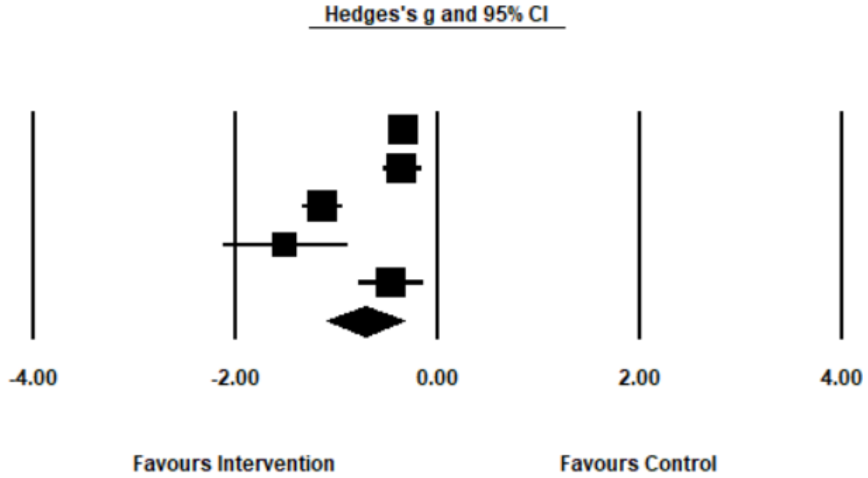


Figure 2.3: Forest Plot of Workday Sitting Minutes Meta-Analysis

2.3.3 Coding of BCTs

Prior to meta-regression and sub-group analyses each of the included studies were coded for both the number and type of BCTs utilised within the interventions. Goal setting, self-monitoring of behaviour, instructions on how to perform the target behaviour, social comparison and adding objects to the physical environment were the most used BCTs across interventions. Conversely, anticipated regret, vicarious consequences, reviewing behavioural goals and framing/reframing were drawn upon least frequently. An overview of all BCTs utilised within the included interventions has been provided in table 7.

Table 7: Behaviour Change Techniques Present in the Included Studies

	Aittasalo (2017)	**Allen (2012)**	**Brackenridge (2016)**	**Der Ananian (2015)**	**Finkelstein (2016)**	**Healy (2016)**	**John (2011)**	**Koepp (2013)**	**Meyer (2010)**	**Ribeiro (2014)**	**Schumacher (2013)**	**Smith-McLellan (2017)**	**Taylor (2016)**	**Taylor (2010)**	***Total number of studies using BCT***
1.1- Goal setting (behaviour)	X	X		X		X				X		X	X	X	8
1.2- Problem solving						X				X		X			3
1.3- Goal setting (outcome)					X	X									2
1.5- Review behaviour goal (s)						X									1
1.8- Behavioural contract														X	1

	Aittasalo (2017)	**Allen (2012)**	**Brackenridge (2016)**	**Der Ananian (2015)**	**Finkelstein (2016)**	**Healy (2016)**	**John (2011)**	**Koepp (2013)**	**Meyer (2010)**	**Ribeiro (2014)**	**Schumacher (2013)**	**Smith-McLellan (2017)**	**Taylor (2016)**	**Taylor (2010)**	***Total number of studies using BCT***
1.9- Commitment					X				X			X	X	X	5
2.1- Monitoring of behaviour by others without feedback	X														1
2.2- Feedback on behaviour			X		X	X						X			4
2.3- Self-monitoring of behaviour	X		X	X	X	X				X	X	X	X		9

	Aittasalo (2017)	**Allen (2012)**	**Brackenridge (2016)**	**Der Ananian (2015)**	**Finkelstein (2016)**	**Healy (2016)**	**John (2011)**	**Koepp (2013)**	**Meyer (2010)**	**Ribeiro (2014)**	**Schumacher (2013)**	**Smith-McLellan (2017)**	**Taylor (2016)**	**Taylor (2010)**	***Total number of studies using BCT***
3.1- Social support (unspecified)				X									X		2
3.2- Social support (practical)				X								X	X	X	4
3.3- Social support (emotional)				X									X	X	3
4.1 – Instruction on how to perform the behaviour	X		X			X				X		X	X	X	7
5.1- Information about health consequences		X	X		X					X					4

	Aittasalo (2017)	**Allen (2012)**	**Brackenridge (2016)**	**Der Ananian (2015)**	**Finkelstein (2016)**	**Healy (2016)**	**John (2011)**	**Koepp (2013)**	**Meyer (2010)**	**Ribeiro (2014)**	**Schumacher (2013)**	**Smith-McLellan (2017)**	**Taylor (2016)**	**Taylor (2010)**	***Total number of studies using BCT***
5.5- Anticipated regret												X			1
6.1- Demonstration of the behaviour	X												X	X	3
6.2- Social comparison	X		X		X							X	X	X	6
7.1- Prompts/Cues						X			X			X			3
8.1- Behavioural practice/rehearsal													X	X	2

	Aittasalo (2017)	**Allen (2012)**	**Brackenridge (2016)**	**Der Ananian (2015)**	**Finkelstein (2016)**	**Healy (2016)**	**John (2011)**	**Koepp (2013)**	**Meyer (2010)**	**Ribeiro (2014)**	**Schumacher (2013)**	**Smith-McLellan (2017)**	**Taylor (2016)**	**Taylor (2010)**	***Total number of studies using BCT***
9.1- Credible source			X		X	X							X	X	5
10.1 – Material incentive (behaviour)					X						X		X	X	4
10.2 – Material reward (behaviour)				X	X						X	X	X	X	6
12.5- Adding objects to the physical environment		X	X		X	X	X	X				X			7

	Aittasalo (2017)	**Allen (2012)**	**Brackenridge (2016)**	**Der Ananian (2015)**	**Finkelstein (2016)**	**Healy (2016)**	**John (2011)**	**Koepp (2013)**	**Meyer (2010)**	**Ribeiro (2014)**	**Schumacher (2013)**	**Smith-McLellan (2017)**	**Taylor (2016)**	**Taylor (2010)**	***Total number of studies using BCT***
13.2 – Framing/Reframing									X						1
16.3- Vicarious consequences			X												1
Total number of BCTS used within study	6	3	8	6	10	10	1	1	3	5	3	12	13	12	N/A

2.3.4 Meta-regression: Number of Behaviour Change Techniques

To address research questions 3 and 4, random effects univariate meta-regression analyses were conducted to explore whether the number of BCTs present within the included interventions were associated with intervention effectiveness.

2.3.4.1 Average steps per Workday

Meta-regression analysis indicated that there was a significant strong negative correlation between the number of BCTs used within the interventions and overall intervention effectiveness (β = -0.07, 95% CI -.012 to -0.16; p<0.05). This result indicated that after six months as the number of BCTs used within interventions increased the overall intervention effectiveness decreased. A scatterplot visualising the relationship between Hedge's g effect size and the number of BCTs used within the included interventions can be seen in figure 2.4.

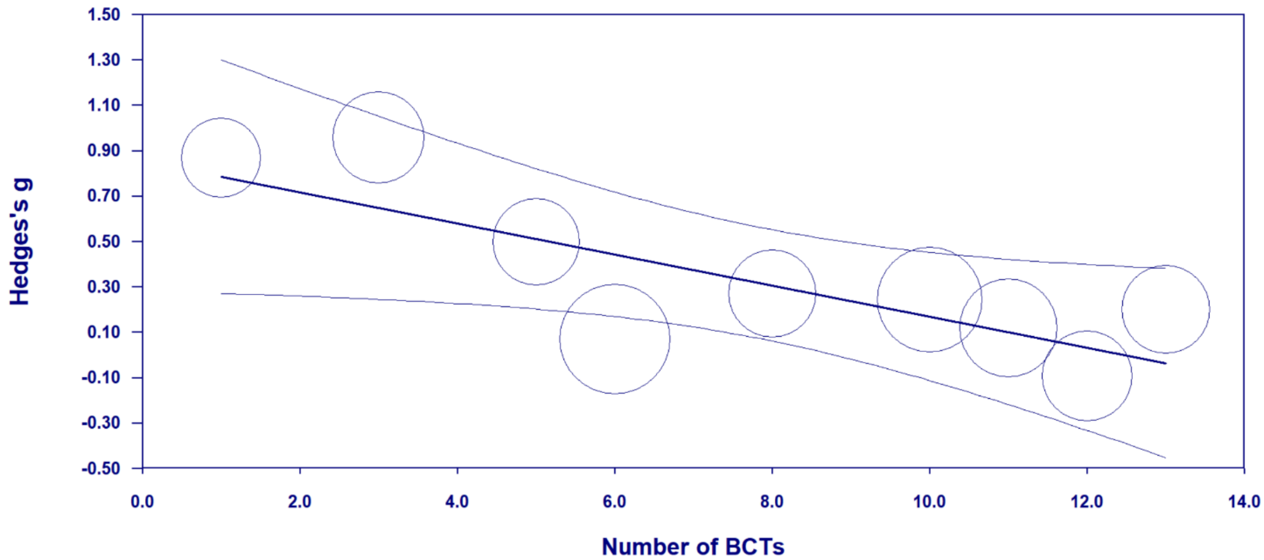


Figure 2.4: Meta-regression exploring number of BCTs and effect sizes of interventions designed to decrease average sitting time on workdays

2.3.4.2 Average minutes sitting per Workday

Meta-regression analysis indicated that there was no significant correlation between the number of BCTs used within the interventions designed to decrease average minutes spent sitting per workday and overall intervention effectiveness after six months (β = -0.01, 95% CI -0.10 to 0.12; *p*>0.05). A scatterplot visualising the relationship between Hedge's *g* effect size and the number of BCTs used within the included interventions can be seen in figure 2.5.

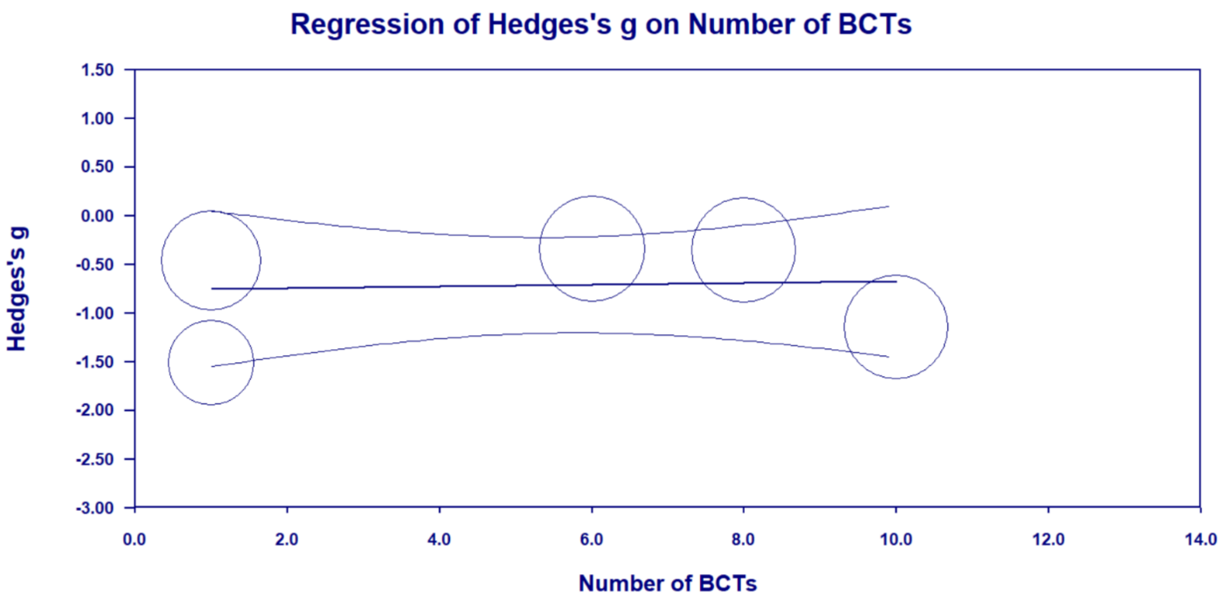


Figure 2.5: Meta-regression exploring number of BCTs and effect sizes of interventions designed to decrease average sitting time on workdays

2.3.5 Moderator Analysis

To address research hypotheses 5 and 6 sub-group moderator analysis was performed to explore the association between individual BCTs and intervention effectiveness. The moderator analysis used the Hedge's g effect size to assess the data and compare whether intervention effect sizes were larger or smaller dependent upon whether a particular BCT was present. In line with previous research, a single BCT needed to be present within at least four different studies to be included within the sub-group analysis (Taylor et al., 2012). On overview of intervention effect sizes, 95% confidence intervals and p-values when BCTs were present and absent can be found in table 8.

2.3.5.1 BCTs That Enhance Intervention Effect Sizes When Present (Steps Per Day)

Moderator analysis identified that effect sizes for interventions were larger when the BCTs ’5.1 information about health consequences’ and ’12.5 adding objects to the physical environment’ were present within interventions. The presence of the BCT ’5.1 information about health consequences’ within an intervention was associated with a statistically significant moderate positive effect size (Hedge’s g=0.48, 95% CI 0.76 to 0.19, p<0.05) as was the presence of the BCT ’12.5 adding objects to the physical environment’ (Hedge’s g=0.45, 95% CI 0.71 to 0.19, p<0.05), suggesting that interventions exerted larger effects when these specific BCTs were utilised.

2.3.5.2 BCTs That Enhance Intervention Effect Sizes When Absent (Steps Per Day)

Moderator analysis identified that effect sizes for interventions were larger when the BCTs ‘1.9 commitment’, ‘2.3 self-monitoring of behaviour’, ‘4.1 instruction on how to perform the behaviour’, ‘9.1 credible source’ and ’10.2 material reward’ were not present within interventions. The absence of the BCT ‘1.9 commitment’ was associated with a statistically significant moderate effect size (Hedge’s g=0.50, 95% CI 0.81 to 0.19, p<0.05) as was the absence of the BCT ‘2.3 self-monitoring of behaviour’ (Hedge’s g=0.56, 95% CI 0.89 to 0.22, p<0.05), BCT ‘4.1 instruction on how to perform the behaviour’ (Hedge’s g=0.62, 95% CI 0.91 to 0.31, p<0.05), BCT ‘9.1 credible source’ (Hedge’s g=0.46 95% CI 0.76 to 0.15, p<0.05) and BCT ’10.2 material reward’ (Hedge’s g=0.50 95% CI 0.81 to 0.19, p<0.05). No statistically significant changes to effect sizes were identified for the BCTs ‘1.1 goal setting’ and ‘6.2 social comparison’. However, intervention effect sizes were moderate when the BCT ‘1.1 goal setting’ (Hedge’s g=0.42 95% CI 0.80 to 0.04, p>0.05) was absent and large when the BCT ‘6.2 social comparison’ (Hedge’s g=0.78 95% CI 1.02 to 0.55, p>0.05) was absent compared to weak effect sizes when the same BCTs were present.

2.3.5.3 BCTs That Enhance Intervention Effect Sizes When Absent (Minutes Sitting Per Day)

Only one BCT, '12.5 adding objects to the physical environment', was present within at least four different studies that had measured minutes sitting per day. Moderator analysis identified that intervention effect sizes were larger when the BCT was present within an intervention (Hedge's g=-0.83, 95% CI -1.33 to -0.32, p<0.05) suggesting that interventions designed to reduce the amount of time employees spend sitting may be more effective when objects are added to the environment (see table 9).

Table 8: Moderator Analysis Average Steps per Workday

BCT	**Hedge's g effect size [present]**	**95% CI upper limit**	**95% CI lower limit**	**p**	**Hedge's g effect size [absent]**	**95% CI upper limit**	**95% CI lower limit**	**p**
1.1 Goal setting	0.28	0.54	0.01	<.05*	0.42	0.8	0.04	<.05*
1.9 Commitment	0.13	0.46	-0.21	>.05	0.50	0.81	0.19	<.05*
2.3 Self-monitoring of behaviour	0.21	0.42	0.00	>.05	0.56	0.89	0.22	<.05*
4.1 Instruction on how to perform the behaviour	0.16	0.38	-0.06	>.05	0.62	0.91	0.31	<.05*

5.1 Information about health consequences	0.48	0.76	0.19	<.05*	0.19	0.44	-0.7	>.05
6.2 Social comparison	0.12	0.21	0.03	<.05*	0.78	1.02	0.55	<.05*
9.1 Credible source	0.16	0.5	-0.18	>.05	0.46	0.76	0.15	<.05*
10.2 Material reward	0.13	0.46	-0.21	>.05	0.50	0.81	0.19	<.05*

Table 9: Moderator Analysis Average Minutes Sitting per Workday

BCT	**Hedge's g effect size present**	**95% CI upper limit**	**95% CI lower limit**	**p**	**Hedge's g effect size absent**	**95% CI upper limit**	**95% CI lower limit**	**p**
12.5 Adding objects to the physical environment	0.45	0.71	0.19	<.05*	0.15	0.44	-0.14	>.05

2.4 Discussion

This study aimed to explore whether interventions designed to increase physical activity or decrease sedentary behaviour within workplace settings were effective after six months. Random effects meta-analyses found that workplace interventions produced a statistically significant, moderate, positive effect for increasing the average number of steps taken during workdays and a statistically significant, strong, negative effect for decreasing the average number of minutes spent sitting during workdays. Workplace interventions therefore appear to be viable tools for increasing physical activity levels and decreasing sedentary behaviour in employees. Interventions were also coded using the BCTTv1 to identify the active ingredients that were responsible for facilitating behaviour change.

Prior to conducting the study, no directly comparable meta-regression exploring the number of BCTS used and physical activity or sedentary behaviour intervention effectiveness within workplace settings had been performed. One potential explanation for this is that, historically, many studies in workplace settings have not reported intervention content in sufficient detail to facilitate the identification of specific individual intervention components (Power et al., 2021). However, within non-workplace settings no significant correlations have previously been found between the number of BCTs used and intervention effectiveness in; healthy inactive adults (Howlett et al., 2019), cancer survivors (Finne et al., 2018) or adults in non-specific domains (McDermott et al., 2016). The current study provided consistent evidence for this trend finding no significant relationship between the number of BCTs used and intervention effect sizes of studies which aimed to decrease objectively measured workday sitting time. However, the significant strong negative correlation found between the number of BCTs used and intervention effect sizes of studies aimed at increasing objectively measured workday step counts was inconsistent. One potential explanation for this may be that a wide variety of environmental, personal and contextual demands influence the physical activity levels of employees in workplace settings (Coldrey, 2018)**.** Therefore, the motivation of employees to sustain behaviour change founded upon numerous techniques may wane over time due to the number of other demands found naturally within participant's workplaces.

Within the current study, the presence of the BCT '12.5 adding objects to the physical environment' was associated with enhanced intervention effectiveness at both increasing average daily step counts and decreasing average daily sitting minutes within the workplace. It has previously been identified that this BCT is a significant predictor of physical activity intervention effectiveness at 12 months in over-weight and obese adults (Samdal et al., 2017) and that the addition of pedometers to physical activity interventions has also been associated with larger effect sizes (Finne et al., 2018). Furthermore, interventions centred around adjusting the environment by adding objects to workspaces has also been shown to improve sedentary behaviour intervention effectiveness (Mackenzie et al., 2015). The findings of the current study were therefore consistent with the wider literature. However, it is important to note that the BCT 'adding objects to the physical environment' covers a relatively broad spectrum of potential actions (Roberts et al., 2018). This BCT could potentially be used to code interventions as diverse as adding expensive on-site gym equipment to giving employees relatively inexpensive pedometers. Future research may wish to explore and synthesise evidence to obtain a more nuanced understanding of which objects may be most effective and for whom within workplace settings.

It has been argued that behaviour change can be exceptionally difficult without high levels of commitment (Cradock et al., 2017). However, within health promotion research, there has been mixed evidence for the inclusion of formal participant commitments into intervention design (Bosch-Capblanch et al., 2007). Some reviews have found the BCT 'commitment' to be associated with significant increases to physical activity self-efficacy (Tang, 2017), whilst others have found that commitment-based interventions appear to be ineffective in increasing adherence to physical activity goals in both the short and long-term (Coupe et al., 2019). Within the current study, the absence of the BCT '1.9 commitment' was associated with a significant moderate positive effect size.

It has been suggested that autonomy and autonomous motivation are important determinants of physical activity behaviour and that interventions which enforce formal commitments may undermine the intrinsic motivation for some individuals to become more physically active (Coupe et al., 2019). Furthermore, in cases where long-term behaviour change is the goal, commitments may need to be regularly revisited to ensure relevancy after the initial commitment has been achieved (Rogers et al., 2014). Commitments can also vary substantially in the strength and specificity of the language used when making the commitment (Amrhein et al., 2003). Future studies may wish to take this into consideration when implementing this BCT into intervention design.

The BCT '2.3 self-monitoring of behaviour' is thought to be a cornerstone of effective physical activity interventions (Alley et al., 2016; Conroy et al., 2011). Previous systematic reviews have found the presence of this BCT to be linked to more successful physical activity outcomes (Dombrowski et al., 2012; Michie, Abraham, et al., 2009; Williams & French, 2011). It has been suggested that self-monitoring of behaviour may be key to the maintenance phase of behaviour change; enabling individuals to prevent relapse and adapt to challenging circumstances more easily (Dombrowski et al., 2012). However, in contrast to the aforementioned studies, a recent meta-analytic review by Howlett et al. (2019) did not find evidence to support that interventions containing the BCT '2.3 self-monitoring of behaviour' were more effective at increasing physical activity levels in sedentary populations. The current meta-analysis also echoed this finding. Sub-group analysis of pooled effect size estimates established a significant positive moderate effect size when the BCT '2.3 self-monitoring of behaviour 'was absent. Given that numerous studies have found self-monitoring or behaviour to be an important determinant of physical activity intervention effectiveness the findings of Howlett et al. (2019) and the current review are surprising. One potential explanation for these findings is that individuals may differ in their adherence to self-monitoring strategies. Burke et al. (2009) determined that there are three key categories of self-monitoring experience: well-disciplined, missing the connection and diminished support. Individuals within the well-disciplined category display high levels of adherence and a positive attitude towards self-monitoring their own behaviour resulting in substantial effort towards the target outcome. Those within the missing the connection category view self-monitoring as an externalised assignment and displayed moderate levels of adherence and moderate effort towards the target outcome. Finally, those within the diminished support category show poor adherence to self-monitoring strategies and are adversely affected by negative co-existing factors such as a lack of social support and competing responsibilities. Within the workplace, time pressures, high workloads and a lack of colleague support have been identified as barriers to physical activity (McEachan et al., 2008). In light of this, participants might be more inclined to fall into the diminished support category of self-monitoring experience when this particular BCT is used within demanding workplace settings. In line with the suggestions of Burke et al. (2009), future research should consider how participants integrate the process of self-monitoring their own behaviour and explore more individualised targeting of self-monitoring strategies to increase adherence.

A previous systematic review found significantly higher effect sizes were produced when the BCT '5.1 information on the consequences' was present in non-workplace based physical activity interventions (Williams & French, 2011). The current study also supported the inclusion of this BCT in workplace settings as intervention effectiveness was enhanced when the BCT was present. It has previously been hypothesised that the Theory of Planned Behaviour (Ajzen, 1991) can be used to inform why providing information about health consequences can increase physical activity (Pears et al., 2016). Beliefs about the likely consequences of the behaviour can influence an individual's attitude towards the target behaviour and subsequent likelihood of adopting the new behaviour (Ajzen, 1991). As interventions continue to be developed it is crucial that researchers strive to link behavioural interventions and BCTs to theoretical mechanisms of change (Michie & Johnston, 2012). It is hoped that the identification of effective BCTs within the current study will provide a foundation for future researchers to build from to explore such theoretical mechanisms of change.

In the current meta-analysis, the presence of the BCT '10.2 material reward' was found to be associated with weaker overall intervention effectiveness. In a systematic review of financial rewards on physical activity and sedentary behaviour, Barte & Wendel-Vos (2017) found that financial rewards had positive short-term effects. However, Hunter, et al (2018) found that the use of material incentives significantly reduced steps per workday. One potential explanation for such inconsistency may be that physical activity is a complex behaviour requiring multiple actions to be taken and rewarded (Barte & Wendel-Vos, 2017). Considering the short-term beneficial effects found within the Barte et al. (2017) systematic review and the non-significant long-term effects found within the current meta-analysis it may be the case that material rewards act as an extrinsic motivator which sparks behaviour adoption but not behavioural maintenance.

Within the current study, the absence of the BCT '9.1 credible source' was associated with enhanced intervention effectiveness. Sources can vary substantially in their perceived credibility ranging from high (e.g. doctors) to low (e.g. students) (Latimer et al., 2010). Highly credible sources are known to be capable of positively influencing attitudes and intentions towards exercise behaviour (Arora et al., 2006). Conversely, less credible sources produce limited consideration of physical activity-based messages and are less persuasive at influencing behaviour (Jones et al., 2003). Of the included studies which utilised the BCT '9.1 credible source' many trained employees as health champions. By virtue of their training these employees were classified as credible sources of information. However, as the absence of the BCT '9.1 credible source' was associated with enhanced intervention effectiveness, co-workers may be being perceived as less credible sources. This echoes wider qualitative research exploring the role of peer physical activity champions within workplace settings. Workplace physical activity champions often express disheartenment due to limited or little engagement from their co-workers in the desired physical activity behaviours (Edmunds & Clow, 2016). Whilst there has been some support for the use of internal employee physical activity champions (Conn et al., 2009), the current review would suggest that more research may be required to explore how such employees can influence behaviour and the mechanisms of change which could account for the variability in intervention effectiveness when they are used.

In populations of inactive adults, the BCT '4.1 instruction on how to perform the behaviour' has been associated with intervention effectiveness, particularly at six months (Howlett et al., 2019). However, it is important to note that such findings have not exclusively focussed upon the workplace. Contemporary research has shown that this BCT has synergistic effects with study settings and the context in which an intervention is delivered can have a substantial influence on overall intervention effectiveness (Bull et al., 2018). As the current review indicated that the absence of this BCT was associated with a significant moderate positive effect size, future researchers may wish to extend upon the work of Bull et al. (2018) and explore the potential synergistic effects of the workplace setting on this BCT's effectiveness. Furthermore, one potential explanation for this is that interventions focussed upon enhancing physical fitness and moderate to vigorous intensity exercise were excluded within the current study. Interventions which include the BCT '4.1 instruction on how to perform the behaviour' have typically been associated with exercise classes and higher intensity physical activity (Knittle et al., 2018). However, when exploring sedentary behaviour and lower-level physical activity, educational strategies such as providing instructions on how to perform the behaviour may become less effective (Wang et al., 2018). Therefore, physical activity intensity should be taken into consideration when interpreting the results of the current review.

Within the current review, the absence of the BCT '6.2 social comparison' was associated with a significant large positive effect size. This suggests that encouraging employees to compare their performance with their colleagues may not be an effective way for researchers to facilitate long-term physical activity behaviour change within the workplace. Similar findings have also been found in a review of walking promotion interventions where it was noted that many of the studies which utilised the BCT produced statistically insignificant effects (Bird et al., 2013). Social comparisons can certainly be a powerful tool to increase motivation toward physical activity (Patel et al., 2016) but they can also motivate individuals towards sedentariness if one compares themselves unfavourably to another (Keegan et al., 2016). Encouraging social comparisons which do not match an individual's personal preferences has also been found to be counter-effective in increasing physical activity levels (Mollee & Klein, 2016). Furthermore, physical activity can be a sensitive topic to discuss with others and participants have previously expressed concerns about sharing their physical activity progress with others out of embarrassment or concern that they have not met a pre-specified goal (Chang et al., 2016). More research is required to gain a more nuanced understanding of when social comparisons can be effective and who they can be effective for in workplace settings.

Within the current review, the absence of the BCT '1.1 goal setting' was associated with a statistically significant moderate effect size. Goal setting is a commonly used BCT within physical activity and sedentary behaviour intervention research (McEwan et al., 2016). However, research often produces conflicting results in relation to this BCT, with some studies indicating goal setting enhanced intervention effectiveness (Dishman et al., 2010) and others find limited support for its use (Shilts et al., 2004). It has previously been noted that specific goals are more likely to result in greater effort than non-specific goals (Locke & Latham, 2002). However, with the BCTTv1 action planning requires individuals to plan the context, frequency, duration and intensity of the target behaviour in advance (Michie et al., 2013). Given the dynamic nature and competing demands of workplace settings such detail may prove difficult for employees to achieve resulting in less specific, and therefore potentially less effective, goals being set. Some evidence for this can be found within the current review as none of the included studies were classified as having used action planning whilst 8 out of the 11 studies did use goal setting. Future workplace physical activity intervention research may wish to more fully explore the practicalities and potential of action planning in lieu of goal setting.

2.4.1 Strengths

Previous meta-analyses have identified that studies within the domain of workplace physical activity promotion have often used sub-optimal measures of physical activity; frequently relying upon unvalidated self-report measures making comparisons across interventions difficult (Conn et al., 2009; Dishman et al., 1998). Furthermore, employees often tend to over-estimate their levels of physical activity when interventions are assessed via self-report measures within the workplace (Pedersen et al., 2016). This is of particular importance to note as the validity of any given meta-analysis is heavily connected to the reliability and validity of the studies that it includes (Dekkers, 2018). Previous meta-analyses may therefore have over-estimated the effectiveness of workplace interventions due to the methodological limitations of self-report measures. The current meta-analysis addressed this issue by only synthesising evidence from studies that reported objective measures of physical activity and sedentary behaviour. Objective measures, such as pedometers and accelerometers have been found to be more precise and accurate than their self-report counterparts (Prince et al., 2008; Sallis, 2010). Therefore, the results of the current study may help to provide a more precise indication of the true impact of workplace physical activity and sedentary behaviour interventions.

In addition to an over-reliance on self-report measures, previous meta-analyses have also critiqued the extant literature for not describing intervention content fully, with limited details on the intended mechanisms of behaviour change (Dishman et al., 1998; Samdal et al., 2017). A dearth of literature exists exploring the moderating effects of BCTs on the effectiveness of workplace interventions designed to tackle both physical activity and sedentary behaviour. The current meta-analysis addressed this identified limitation by using a contemporary and cohesive taxonomy of behaviour change to code each of the included studies; the BCTTv.1 (Michie et al., 2013). The use of the BCTTv.1 helped to give additional context to not only identifying what works but also how each of the interventions work. Finally, previous reviews within the domain of workplace physical activity and sedentary behaviour have focused exclusively on English language studies only (Conn et al., 2009; Malik et al., 2014; Proper, Koning, et al., 2003). This is unsurprising given that the English language has been described as 'the universal language of science' (Morrison et al., 2012). Despite this, the reliance on English language only studies may not provide a true reflection of the corpus of available literature (Morrison et al., 2012). This may lead to what is known as the 'tower of Babel bias' (Grégoire et al., 1995). Therefore, recommendations have been put forward encouraging systematic reviewers to seek out both English language and non-English language studies for inclusion (Egger et al., 2003). The current meta-analysis did not apply language restrictions as an exclusion criterion. Whilst the final studies included into the review were all published in the English language, the assessment of non-English language studies during the screening stages reduced the risk of the tower of Babel bias from distorting the results.

2.4.2 Limitations

Substantial between group heterogeneity was found in both the outcome measures of average daily step counts (I^2= 77%) and average daily time sitting (I^2=93%). Therefore, the results of the current study should be interpreted with caution. However, substantial heterogeneity is a common finding across meta-analyses exploring physical activity and sedentary behaviour interventions (Conn et al., 2009; Murray et al., 2017; Reed et al., 2017) and is often attributable to diverse nature of the interventions that are necessarily included (Conn et al., 2009). It must also be noted that more than half of the studies which met the inclusion criteria we conducted within the USA. Similar patterns of geographical dispersion have been found in other worksite health promotion systematic reviews (Anderson et al., 2009). Whilst this is unsurprising given that almost half of North American organisations have been estimated to offer some form of workplace health promotion programme(Linnan et al., 2019); the results of the meta-analysis should be interpreted with caution as the findings may be limited to this specific population.

The current systematic review permitted the inclusion of a variety of study designs and sample sizes. Previous authors within the field of workplace physical activity have argued for the inclusion of studies with small sample sizes or less rigorous research methodologies, as such studies may capture novel intervention designs or harder to reach populations (Conn, Valentine, et al., 2003). Whilst this may be considered a strength of the current review, the inclusion of methodologically diverse studies was also reflected within the quality assessment scores. 45% of the included studies were determined to be of weak methodological quality using the EHPPP quality assessment tool. Previous systematic reviews within the domain of workplace health promotion have identified that methodologically weaker studies are more likely to produce larger effect sizes and therefore overestimate the impact of interventions (Rongen et al., 2013). Furthermore, it has been argued that methodologically weaker studies are more likely to produce dramatic findings and so are more likely to be published, potentially leading to publication bias (Alderson, 2000). Funnel plot analysis within the current review did not indicate substantial publication bias. However, as almost half of the included studies were determined to be of weak methodological quality the results of the current study should be interpreted in respect to this.

A common suggestion of meta-analytic reviews within workplace physical activity and sedentary behaviour is that future research should strive to produce high quality on-site RCTs (Neuhaus, Eakin, et al., 2014; Pereira et al., 2015; Rongen et al., 2013). Whilst RCTs undoubtedly contribute to high quality evidence they have also been critiqued for being impractical for many organisations due to issues of cost and spill-over effects leading to contamination (Rossi et al., 1999). This is further compounded by the rise of social media; visible profiles and online information sharing can compromise trial integrity in cases where participants work together to identify who may be receiving a placebo (Glickman et al., 2012; Ledford, 2018). Furthermore, participants are often reluctant to enrol in RCTs due to factors such as not wanting to submit to random allocation, lengthy or intrusive data collection methods or methods which do not meet participant needs (Gross & Fogg, 2001). Therefore, it has been argued that, in some instances, RCTs are not always possible or even the most appropriate approach for researchers to use (Hecksteden et al., 2018), particularly within workplace settings (Rossi et al., 1999). Indeed, it has been argued that trying to enforce strict RCT designs in complex interventions may contribute to weak effects and instead such studies should be reconceptualised to become more responsive to local context whilst still allowing for meaningful evaluations of traditional controlled designs (Hawe et al., 2004).

In light of the aforementioned limitations of RCTs, authors are increasingly involving key stakeholders throughout the research process to help co-design the research agenda and shape intervention design citing benefits such as increased relevancy, participant engagement, recruitment and retention (Boote et al., 2002; Lloyd et al., 2017; Minneci et al., 2016). Such collaboration between researchers and stakeholders may also facilitate knowledge translation, as research findings become disseminated to and understood by a much wider audience (Nowell, 2015; Straus et al., 2009). Given that a wide variety of environmental, personal and contextual demands influence employee physical activity levels within workplace settings (Coldrey, 2018), pragmatic research philosophies based upon co-create and integrated knowledge translation may offer a more practical alternative than simply suggesting more RCT based studies alone.

2.4.3 Conclusion

In conclusion, the current systematic review and meta-analysis found that workplace interventions designed to increase physical activity and decrease sitting time in employees were effective after six months. This lent strength to idea that the workplace is a viable domain to target such health behaviours. However, results also indicated that, after six months, as the number of BCTs used increased effect sizes of interventions intending to improve workday step counts decreased. Therefore, careful consideration should be given to the complexity of interventions when attempting to influence physical activity within workplace settings. Interventions that use fewer BCTs may be more effective at facilitating longer term behaviour change in relation to physical activity. However, this trend was not replicated for sedentary behaviour focused interventions. This lends further support to the distinction that physical activity and sedentary behaviour interventions are not interchangeable and represent separate aspects of activity behaviours.

The current systematic review and meta-analysis also provided an indication as to which BCTs are most likely to be impactful in helping employees to maintain the target physical activity behaviours. Intervention designers may find incorporating objects to the physical environment, providing information about health consequences and goal setting helps to enhance intervention effectiveness whilst offering material incentives, formal commitments, self-monitoring, providing instructions on how to perform the behaviour, using social comparisons and credible sources may be less effective in supporting physical activity behaviour change after six months. Therefore, the author echoes the suggestions of Olander et al. (2013), in the importance of considering the target population and study setting in determining the most appropriate BCTs for any given intervention and not making assumptions that the relationships found are a reflecting universal causal relationship of the BCTs themselves. It is also important to note that only 25 out of 93 potential BCTS within the BCTTV.1 were present within the included studies and so future research should therefore aim to test the impact of more diverse BCTS.

Chapter 3- Co-Creation Strategy & Methodological Philosophy

Based upon the findings of the meta-analysis conducted in chapter 2, workplace physical activity and sedentary behaviour interventions do appear to be effective in increasing employee physical activity levels and decreasing sedentary behaviour. Therefore, the continued development of interventions targeting these behaviours in the workplace appears justified. However, as identified within chapter one, physical activity and sedentariness are 'wicked problems' influenced by multiple, continually evolving, factors and requiring the input of multiple perspectives in order to be tackled effectively (Blackman et al., 2006; Gordon et al., 2017). This, in conjunction with increased calls for more democratic research practices (Crow, 2012), and the acknowledgement that workplace physical activity research has historically underutilised participatory methods (Parry et al., 2013), led the thesis to adopt a co-creational approach to workplace physical activity intervention development. This chapter outlines the co-creation methodology utilised and provides an overview of the underlying methodological philosophy.

3.1.2 Co-creation Framework

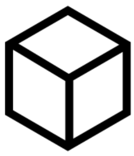
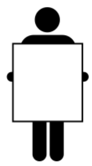
Whilst interest in the application of co-creational approaches to health behavioural problems has increased over time, many co-created interventions often fail to achieve their intended outcomes (Greenhalgh et al., 2016). One explanation which has been presented to explain this phenomenon is a potential lack of structure to guide the co-creation design process (Leask, Sandlund, et al., 2019). To help overcome this issue, Leask *et al* (2019) developed the PRODUCES framework. Akin to the PICO analysis used within systematic literature reviews, the PRODUCES framework provides a scaffold in which a co-creation research project can be designed around. The PRODUCES framework prompts researchers to consider seven different elements of co-creation research; the problem under consideration, the objective of the study, the design of the co-creation research, who the end users are intended to be, who the co-creators will be, how the outputs of the co-creation project will be evaluated and how the outputs of the co-creation project will be scaled. Table 9 summarises the key considerations of the co-creation research within the thesis in relation to the PRODUCES framework and provides an initial plan for the evaluation and scalability of the co-creation research outputs.

Table 9: PRODUCES Framework for Co-creating Workplace Physical Activity (adapted from: (Leask, et al., 2019)

PRODUCES Criterion	**Application to co-creation research within thesis**
PRoblem	Modern job roles are increasingly sedentary and employees are not engaging with sufficient levels of physical activity during the workday.
Objective	To design an intervention that will help employees to reduce sitting time and increase physical activity levels whilst at work.
Design	Arts-based methods: co-creation CUbes, photovoice and poster presentations.
(end)-**U**sers	Employees who wish to increase physical activity or reduce long bouts of uninterrupted sitting time during the workday
Co-creators	Employees from diverse organisations, managers and academics
Evaluation	Formative proof of concept through large scale survey
Scalability	Distributed Model

Building upon the PRODUCES framework, a series of co-creation workshops were designed to capture information that could be used to support the aim of designing a co-created workplace physical activity intervention. To achieve this, the three-phase process of co-define, co-design and co-refine developed by the Co-creating Welfare research project was adopted (The Co-creating Welfare Project Partners., 2019). In phase one, a series of co-creation workshops were held to enable the co-creators to co-define the perceived barriers and facilitators of physical activity and sedentary behaviour within the workplace. Within the workshops, two arts-based methodologies were utilised: co-creation CUbes and photovoice. Both co-creation CUbes and photovoice have been advocated as particularly useful methodologies in determining barriers and facilitators of behaviours (Hafoka & Carr, 2018; The Co-creating Welfare Project Partners., 2019). This approach enabled the co-creators to articulate their thoughts and experiences both verbally and visually resulting a better understanding of the co-creator's needs, resources, and sources of conflict. In phase two, a second series of workshops were held where the co-creators reviewed the barriers and facilitators from phase one and co-designed potential interventions to address them. To achieve this, the co-creators were asked to produce a poster presentation outlining the intervention, how it was believed to work, the resources required and how intervention effectiveness should be measured. In phase three, the information produced across the prior two phases was synthesised into a singular workplace physical activity intervention. The co-creators were provided with the opportunity to review the intervention and to suggest any changes that they wished to be made. A video exploring an early prototype of the agreed intervention was subsequently recorded and survey data collected to help co-refine the intervention to ascertain factors which may influence the adoption of the toolkit in workplace settings. A summary of the methodological strategy can be seen in table 10 and the following chapters will explore each phase in more depth.

Table 10: Intervention development process (adapted from Hidding et al., 2020)

	Phase 1: Co-define		**Phase 2: Co-design**	**Phase 3: Co-refine**
Aim	Examine common barriers and facilitators of physical activity encountered within the workplace	Provide visual context to salient barriers and facilitators of physical activity encountered within the workplace	Address the identified barriers and facilitators of physical activity by designing interventions to improve them	Establish the relationships which influence employee's behavioural intention to use the toolkit
Method	Co-creation CUbe 	Photovoice 	Poster Presentation 	Survey 
Procedure	Co-creators list the barriers and facilitators of workplace physical activity onto a co-creation CUbe whilst walking around the built environment	Co-creators photograph two barriers and two facilitators of physical activity and complete a worksheet describing the images taken	Co-creators review the CUbe and photovoice data produced by all co-creation groups and design an intervention to address them. Interventions are presented in the format of a poster presentation	Participants complete a demographic questionnaire and shown a video demonstration of the interventions. Participants then complete a modified UTAUT2 questionnaire & give qualitative feedback on the intervention
Analyses	Quantitative Content Analysis & Integrated Visual Thematic Analysis		Qualitative Content Analysis	Structural Equation Modelling: Partial Least Squares & Content Analysis

3.1.3 Methodological Philosophy: Pluralism

Considering the complex nature of physical activity behaviours and the complex social structures present within workplaces, a pluralistic approach to data collection and analysis was utilised. It has been noted that humans rarely express themselves exclusively through any singular medium or in a linear chain of cause and effect (Frost et al., 2011). Therefore, human experience may not be sufficiently captured by any singular method but instead may best be explored through the concurrent application of different methods and analytical approaches (Chamberlain et al., 2011). Such arguments form the foundation of pluralistic research, where it is posited that diverse approaches to data collection and analysis can produce knowledge that is complimentary rather than mutually exclusive (Frost et al., 2011) and can help to provide insights beyond those garnered through mono method approaches alone (Frost et al., 2010). As such, pluralistic studies have gained traction within social science research (Alasuutari, 2010), yet mono-method approaches remain the most dominant paradigm (Timans et al., 2019).

There are many possible types of pluralistic research including the use of multiple researchers, methods, and data analyses (Clarke et al., 2015). It could be argued that co-creation is inherently pluralistic because from the outset diverse stakeholders and disparate perspectives are sought to help produce, rearrange, and clarify information (Degnegaard et al., 2015). Furthermore, co-creation studies are often methodologically pluralistic; drawing upon multiple data collection methods to engage stakeholder creativity and explore salient issues from different perspectives (Jung-Joo et al., 2018). Research can also be analytically pluralistic, drawing upon multiple approaches to analyse the same data in different ways (Coffey & Atkinson, 1996). However, despite the pluralistic nature of co-creation research, analytical pluralism is often overlooked within many co-creation studies where only a single approach to data analysis is used (Giné-Garriga et al., 2019; Leask, Colledge, et al., 2019).

Proponents of pluralism argue that by drawing upon multiple analytical strategies, researchers can better explore different facets and types of order within the same data, revealing more about the inherent complexities of human behaviour(Coffey & Atkinson, 1996). Given that physical activity is a complex behaviour (Gabriel et al., 2012) and workplaces involve complex social structures (Letkemann, 2002), the co-creation process used within the current study adopted a pluralistic approach; drawing upon multiple participants, methodologies and forms of analyses to explore the complexities of workplace physical activity. The adoption of a pluralistic approach also built upon the work of Camargo-Borges & Rasera (2013), who argued that co-creation can be strengthened through pluralistic approaches, particularly during the development of organisational interventions; which was a key aim of the overarching thesis.

The following three chapters will outline the co-define, co-design and co-refine phases of the co-creation research project in detail. To support methodological pluralism, each of the chosen methodologies described within the chapters have been aligned with the general guidelines of the Co-creating Welfare research project (The Co-creating Welfare Project Partners., 2019) to ensure that each method was appropriate to the focus of the specific research phase.

Chapter 4 –Co-Defining the Problem: Identifying Barriers and Facilitators of Physical Activity and Sedentary Behaviour in the Workplace

4.1 Introduction

A key challenge faced by workplace health promotion programmes is that overall participation rates are relatively low and interventions can only be effective if employees actually participate (Lier et al., 2019; Mattke et al., 2015). Given the abundance of health communication messages outlining the benefits of a physically active lifestyle, both within academia and wider society, it is unlikely that low participation rates stem from a lack of awareness (Lachman et al., 2018). Indeed, within health research an intention-behaviour gap is often encountered whereby individuals do not act despite having developed the intention to change (Sheeran & Webb, 2016). Many contributors to the intention-behaviour gap have been identified including the perceived difficulty of the target behaviour (McEachan et al., 2016) and the availability of opportunities to perform the behaviour (Sheeran, 2002).

Previous research exploring the motivation behind participation and non-participation in workplace physical activity interventions has afforded some insight into potential barriers and facilitators that are salient to employees. For example, the social support of colleagues and perceived health benefits have been identified as potential facilitators (Planchard et al., 2018), whereas being busy and working in an organisational culture that does not encourage physical activity have been cited as potential barriers (Bardus et al., 2014; Nöhammer et al., 2014). Concerns have also been raised by both employers and employees around initiative overload, where numerous interventions have been implemented leading to disengagement (Chau et al., 2019);

leading the authors to suggest that participatory approaches may help to avoid overwhelming employees with irrelevant interventions. Such conclusions clearly align with the rationale for adopting a co-creational based approach to exploring barriers and facilitators of workplace physical activity.

Whilst the aforementioned studies have undoubtedly contributed to the understanding of perceived barriers and facilitators of workplace physical activity a number of potential limitations exist. Firstly, studies have often focussed exclusively upon the perceptions of white-collar office-based workers, leading authors to acknowledge that findings may not be representative of wider occupational roles (Edmunds et al., 2013; Knox et al., 2017). Indeed, drawing upon participants from diverse organisational types has been highlighted as an important step in strengthening research around workplace physical activity barriers and facilitators (Chau et al., 2019). By virtue of their nature, co-creation-based approaches seek to obtain thoughts and perceptions from diverse stakeholders and so are well placed to address this limitation.

Secondly, research in this area has typically used individual or focus group interview methodologies(Bardus et al., 2014; Planchard et al., 2018). Traditional approaches have been critiqued for being overly prescriptive and limiting methodological innovation (Barone & Eisner, 2011). Also, such methods have largely been consultative, meaning participants have had limited opportunities to actively contribute to both the problem identification and solution generation stages, potentially contributing to an increased gap between research and practice. Whilst traditional interview-based methodologies can provide valuable qualitative data, concerns have been expressed that the emotional and symbolic elements of participant's experiences can be lost when using methods that rely on purely on verbal competence (van der Vaart et al., 2018). This has led to calls for more creative, arts-based methods, to be used within qualitative research to more accurately capture the complex realities of participant's lives (van der Wardt et al., 2020; Woodgate et al., 2016).

Arts-based research methods refer to any social research or human inquiry that adapts the tenets of the creative arts as a part of the methodology (Jones & Leavy, 2014). Whilst relatively novel in the context of workplace physical activity research, arts-based research methods have been advocated for several reasons including the ability to overcome power dynamics between researcher and participants, helping to explore complex phenomena which are difficult to verbalise and the ability to increase participant engagement with the research topic (Coemans & Hannes, 2017). Given that physical inactivity has been identified as a 'wicked problem' which has multiple causes (Blackman et al., 2006; Gordon et al., 2017; Signal et al., 2013), adopting arts-based methods may help to capture more nuanced information that may have been missed through the traditional methods that have been used in prior research.

Given that previous research in this area has largely been consultative and restricted to traditional, verbally focussed methodologies the aim of this research phase was twofold. Firstly, to adopt arts-based methods to engage co-creators with the research topic using an alternative approach to conventional research methodologies within this area. Secondly, to co-define the barriers and facilitators of workplace physical activity and sedentary behaviour experienced by employees within occupational roles. Co-defining problems and issues faced by stakeholders is an important first step in addressing real-world problems (Hidalgo et al., 2021). It helps researchers to understand the current experiences of stakeholders and identify the barriers and facilitators that may influence subsequent behaviour change (Følstad, 2017). The identification of barriers and facilitators by employees themselves also aligned with the authors position as a pragmatic scientist, ensuring that the targets for intervention design during later research phases would be relevant to the population for whom they were designed. This research phase would also directly address wider calls for a better understanding of the barriers and facilitators that influence employee engagement with physical activity (Garne-Dalgaard et al., 2019). herefore, the primary research question being addressed within this phase of the co-creation project was 'What do employees perceive to be barriers and facilitators of physical activity and sedentary behaviour within occupational roles?'

4.2 Method

4.2.1 Participants

4.2.1.1 Recruitment strategy

Co-creators were recruited via a combination of purposive, opportunity and snowball sampling. To be eligible to participate within the study, co-creators must have been in employment at the time of participation. No restrictions on industry sector, employment contract type, paid or voluntary work were applied. This was done to ensure a breadth of potential responses were captured. Advertisements about the study were placed onto the social networking websites of LinkedIn and Facebook and via co-creation related blog posts on professional publication websites such as Business Insider. The researcher's professional network was also contacted, and co-creators were invited to share the study with people who they felt may be interested. Through this process 14 co-creators, who met the criteria outlined within the PRODUCES framework in chapter 3, enrolled on to the study.

4.2.2 Measures

4.2.2.1 Brainstorming: The Co-creation CUbe

Developed by Osborn (1953), brainstorming is a collaborative group-based idea generation method. The traditional approach to brainstorming typically involves presenting a small group of individuals with a topic to discuss and asking them to work collaboratively to generate as many ideas as they can and verbally express them one at a time (Barki & Pinsonneault, 2001). This is done whilst brainstorm participants are in the same room with one member often recording the ideas onto a flipchart or whiteboard (Byron, 2012). Brainstorming is founded upon four key principles; quantity of ideas, the welcoming of unusual ideas, ruling out criticism and combining and improving upon the ideas of the group; with the rationale being that groups working together will produce more ideas than individuals working alone (Osborn, 1953)**.** This is particularly salient when one considers that many modern problems and issues are complex, so much so that no single individual may have sufficient expertise, influence, or resources to address them alone (de Vreede et al., 2010). Group based ideation and decision making, such as brainstorming, addresses this issue by, introducing a greater sum total of knowledge in understanding the problem, the generation of a greater number of alternative viewpoints and better comprehension of the overall issue under consideration (Lunenberg, 2010). Due to its relative ease of implementation and collaborative nature, traditional brainstorming is thought to be one of the most popular idea generation methods in common use today (Chandra Sekhar & Lidiya, 2012; Gerber, 2009; Rietzschel et al., 2006). Despite its popularity, the traditional brainstorming method has been met with mixed success (Kerr & Tindale, 2004). Several issues such as cognitive demand, social loafing and production blocking have been posed to explain why group brainstorm methods may not attain the level of success that many believe them to be capable of (Kolfschoten & Brazier, 2013).

A viable alternative approach to traditional brainstorming is the use of co-creation CUbes. Co-creation CUbes are relatively small boxes with writable surfaces whereby co-creators can be asked to write, draw and connect ideas across the surface of the CUbe (see figure 4.1). Co-creation CUbes are a flexible brainstorming tool that gives co-creators the flexibility to move around and visit different locations whilst still taking their brainstorm with them (Magee et al., 2018). Having a portable brainstorming tool that facilitates walking has several advantages over more static approaches. Co-creators have been shown to be better at generating ideas whilst walking when compared to more traditional forms of sitting based idea generation (Oppezzo & Schwartz, 2014). Several studies have used variations of more physically active brainstorms, known as brainwalking, to enhance idea generation (Herschman et al., 2014; Napier & Wada, 2015). Brainwalking typically involves co-creators writing their thoughts at idea stations dotted around the room before rotating to the next idea station to build upon and add to the previous participant's thoughts (Mattimore, 2012). Whilst brainwalking can certainly be an effective tool, it is arguably limited by requiring co-creators to remain within the same room, particularly when asking co-creators to generate ideas based upon lived experience. A key component of idea generation is the ability to retrieve concepts from associative memory(Wang et al., 2010). Associative theorists argue that a person's concepts and ideas are stored in an interconnected network of cognitive nodes that is called a semantic network (Dugosh et al., 2000) and that the retrieval of a concept from memory may make other related concepts easier for co-creators to recall within the brainstorm (Wang et al., 2010)**.** Often, it is the exposure of ideas from others within the brainstorm group which acts as a cue to stimulate associative memory (Brown et al., 1998) leading to an associational chain of ideas (Brown & Paulus, 2002). However, this approach is highly dependent upon the ideas and experiences of the brainstorm members. Individuals may have a limited pool of associative memories to draw upon and once the associative reservoir is exhausted brainstorming productivity declines (Göpelt & Witte, 2016).

One approach that can potentially be taken to extend the number of associative memory triggers is to draw upon visual cues from the physical environment. Visual cues have been found to facilitate detailed memory recall of both mundane and important everyday experiences (Kalnikaite et al., 2010)**.** As such, encouraging the co-creators to walk around their environment with the co-creation CUbe may help to trigger associative memory resulting in more thoughts being written down than in a traditional brainstorm. Furthermore, the mobile nature of the co-creation CUbe aligned with the physical activity focus of the research that could have been undermined by asking co-creators to remain relatively stationary through more traditional brainstorming approaches.

4.2.2.2 Photovoice

Developed by Wang & Burris (1997), photovoice is a participatory action research method, epistemologically compatible with co-creation, that empowers participants to identify, represent and enhance their community through the use of photographic techniques (Wang, 1999). Photovoice was originally grounded in three key strands of theoretical literature: critical education, feminist theory and documentary photography (Wang & Burris, 1997). Influenced by the work on critical education by Freire (1970), photovoice outlines that, with the proper tools, every individual is capable of critically exploring their own personal and social realities and identifying and evaluating contradictions which may exist within them (Wang & Redwood-Jones, 2001). From feminist theory, photovoice emphasises that individuals from a diverse range of demographic groups have expertise and insight into their own communities and that dominant groups should not be allowed to bias participatory research findings (Wang & Burris, 1997). Finally, photovoice draws upon the principles of documentary photography and shifts the focus away from participants being passive subjects in other people's images to being actively involved in the production of the images themselves (Wang & Burris, 1997).

Whilst photovoice has been used successfully within workplace domains to explore a variety of topics including the identification of health and safety hazards (Flum et al., 2010), perspectives of employees with intellectual disabilities (Akkerman et al., 2014) and employee resilience (Wahab et al., 2017); a dearth of literature exists exploring perceptions of workplace physical activity and sedentary behaviour. Therefore, the inclusion of photovoice within the co-creation workshops was anticipated to bridge this gap. Furthermore, photovoice has been advocated as an appropriate method in identifying barriers and facilitators of behaviour within co-creation research (The Co-creating Welfare Project Partners., 2019).

Whilst a key aim of photovoice is to transition participants away from being passive subjects and towards active participants, it is important to note that photovoice-based research has been subject to critique for potentially underutilising participant contributions. Authors have challenged photovoice studies for lacking clarity as to whether the images produced have been analysed or have been simply used to illustrate a theme; meaning potentially meaningful data has been ignored (Brunsden & Goatcher, 2007). Indeed, many studies that have used photographic methods often exclude the images themselves from the data analysis and instead utilise them as elicitation prompts for wider interview discussions (Smetaniuk et al., 2017; Stadtlander et al., 2017). This can be problematic as it can bias qualitative research towards monomodal interpretations of human experience through the emphasis on verbal transcripts and language structures (Reavey & Johnson, 2017). It is well known that human communication is not monomodal and meaning is often expressed through a combination of modalities including verbal, gestural, pictoral and visual (Kress, 2009). Therefore, actively including visual images within the data analysis itself may help to provide more contextualised interpretations of participant data (Gleeson, 2020). Indeed, when analysed alongside textual data, photographs have the potential to enhance the communicative intention of participants and add depth beyond the dialogue itself (Edmondson, 2013). Whilst relatively novel to workplace physical activity, combining text-based and visual-based analytical methodologies to explore multimedia data has been effective in other research domains (Edmondson, 2013; Presi et al., 2016). Therefore, to directly address the under-examination of participant photographs within research, the researcher made a conscious decision to ensure that both textual and visual data would be analysed collectively.

4.2.3 Procedure

Prior to commencement, ethical approval for the co-creation study was gained from the ethics committee at Coventry University. Following this, co-creation workshops were scheduled for times and locations that were convenient to the greatest number of co-creators which resulted in the co-creators being distributed across five different co-creation groups. At the beginning of each co-creation workshop, the co-creators were verbally briefed about the nature and intention of the workshop as well as the importance of their contributions as co-creators. Managing expectations is an essential first step within co-creation projects as it helps to reduce the potential for misunderstandings and dissatisfaction whilst also ensuring the project remains focussed by minimising distractions (Nielsen & Yahya, 2013). The role of co-creator was also key to emphasise as it was important to develop a sense of investment in the research study and reduce perceptions of tokenistic contribution, which has been identified as a potential issue within more consultative practices (Ghaye et al., 2008). After the verbal introduction to the workshop, co-creators were given the opportunity to asks questions and seek further clarification for any areas of the study that had not been fully understood. Following this, co-creators were invited to read a participant information sheet and to sign an informed consent sheet indicating that they were happy to contribute to the research project and for any co-created artefacts produced to be published using pseudonyms. All co-creators then completed a demographic questionnaire which asked about their age, gender, current occupation, line managerial responsibilities and estimated time spent engaging in physical activity or sedentary behaviour on an average workday.

The first activity of the workshop was to brainstorm perceived barriers and facilitators of workplace physical activity using co-creation CUbes. Co-creators were given a blank co-creation CUbe (see figure 4.1) and one green and red marker pen per group. Co-creators were instructed to draw, write and label barriers of physical activity using a red marker pen and facilitators of physical activity using a green marker pen. The co-creators were encouraged to walk around the building in which the study was taking place (see section 4.3 for list of study locations) whilst carrying the co-creation CUbe and write down their key thoughts and ideas. The co-creators could walk into any room or location within the building as long as the co-creators would not disturb any other people, any meetings that were taking place or cause the co-creators to enter explicitly identified secure or private zones. The co-creators were also permitted to walk around the outside perimeter of the building in which the study was taking place in. To help give each co-creator the opportunity to contribute, co-creators were instructed to pass the CUbe to the person who was speaking which acted as a visual cue to the group for when one or more individuals had been speaking for an extended amount of time. During the activity, the researcher shadowed the co-creation group at a distance to ensure that they remained safe and to also be available should any questions about the process emerge. This semi-structured approach to CUbe completion was important so as not to stifle creativity and to open up additional possible uses of the CUbe which had not been previously considered by the researcher. The co-creators were given 30 minutes to complete the activity.

These instructions were in line with suggested use of CUbes in co-creation research (The Co-creating Welfare Project Partners., 2019).

Figure 4.1: Co-creation CUbe

The second activity of the workshop was a derivation of photovoice(Wang & Burris, 1997). The photovoice methodology used within the study was adapted from the process outlined by the Co-creating Welfare Project (The Co-creating Welfare Project Partners., 2019). Firstly, the co-creators were given one Fujifilm Instax Square SQ6 Instant Camera per group preloaded with film capable of taking up to a maximum of 10 photographs. Photographs were printed directly onto a 62mm x 62mm film, emerging from the camera immediately after the image is taken. The use of non-digital photography was a conscious choice by the author as traditional cameras have a limited number of exposures and features encouraging photographers to pause and think carefully about the images being taken (Belli, 2020). Furthermore, the Instax instant camera has been identified as a novel and fun way to engage groups in photovoice projects (Baker, 2016). The co-creators were briefed about how to use the camera and given guidance on ethical and responsible photograph taking outlining issues such as images that could violate privacy, disclose sensitive information or breach the Data Protection Act. Co-creators were given the opportunity to ask questions about the task and ethical photograph taking. Co-creators were given 20 minutes to walk around their immediate location and capture images of perceived barriers and facilitators of physical activity within the workplace. After 20 minutes had elapsed, each group was asked to select two facilitators and two barriers which best represented the most pertinent factors which influence physical activity and sedentary behaviour whilst at work. The co-creation groups were then asked to complete a worksheet grounded in the SHOWED framework. The SHOWED framework asks participants to reflect upon the photographs that have been taken by considering the following six questions:

- What do you see here?
- What is really happening here?
- How does this relate to our lives?
- Why does this concern, situation, strength exist?
- How can we become empowered through our new understanding?
- What can we do?

The combination of photovoice photographs with a SHOWED worksheet has been used successfully in physical activity research in non-workplace domains (Hamilton et al., 2017).

Upon completion of the two workshop activities, the co-creators were debriefed verbally and provided with a debrief sheet summarising the nature of the research. In line with the initial informed consent agreement, the co-creators were also invited to attend a second workshop which would focus on generating solutions to the barriers that had been identified.

4.2.4 Data Analysis Procedure

Following the pluralist approach to analysis, two analytical methods were performed on the data collected from the co-creation workshop. Co-creation CUbe data was initially analysed through quantitative content analysis and then co-creation CUbe and photovoice data were analysed simultaneously using integrated visual thematic analysis (figure 4.2). Adaptions from Ronzi, Pope, Orton, & Bruce (2016) included quantiative content analysis instead of thematic analysis due to the short texts produced in the CUbe activity, and visual analysis instead of content analysis of photograph data to develop a more robust exploration of the photographs.

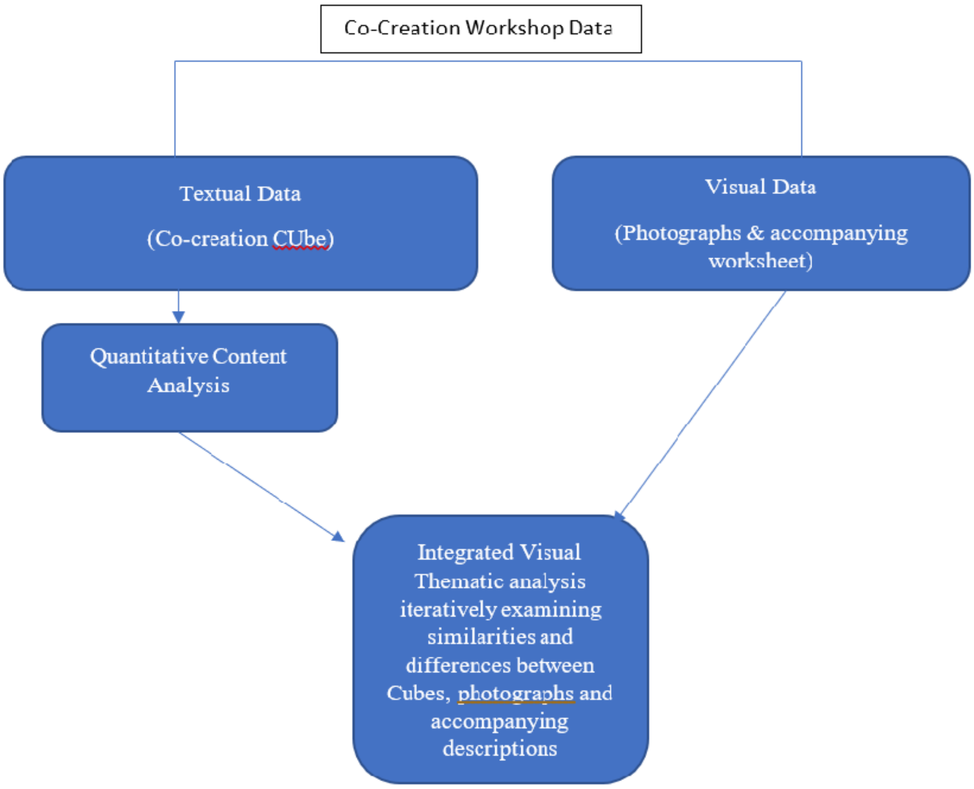


Figure 4.2: Workshop One Data Analysis Procedure- Adapted from (Ronzi, Pope, Orton, & Bruce, 2016)

4.2.4.1 Analysis 1: Quantitative Content Analysis Procedure

Quantitative content analysis is a research method whereby textual, visual or aural materials are recorded, coded and analysed in a systematic manner (Coe & Scacco, 2017). Despite originating within communication literature, content analysis has subsequently been adopted by a variety of disciplines including psychology (Gicevic et al., 2016; Yoon et al., 2011). A four-step process, as devised by Rose et al. (2014), was used comprising of sampling and unitising, coding scheme development, coding and reliability testing, and analysis. During the sampling and unitising stage, the sample comprised of the co-creation CUbes and the units analysis were the statements written on them. The next stage of the content analysis process was coding scheme development. Within the current study, the Theoretical Domains Framework (TDF) (Cane et al., 2012) was selected as the foundation of the coding scheme. The TDF is an integrative framework which streamlines multiple behaviour change theories into a singular framework with a view to assessing behavioural problems and informing subsequent intervention design and implementation (Cane et al., 2012). The TDF can help to provide understanding of the contextual factors that can act as barriers or facilitators to an individual's behaviour(Atkins et al., 2017). Garne-Dalgaard et al. (2019) developed a coding manual to code barriers and facilitators of workplace physical activity into TDF domains. This manual was adopted as the coding scheme for the current study. The next stage is the coding stage, where the coding scheme is used to place the units into appropriate categories; a process which can involve one or more researchers (Rose et al., 2014). The primary research extracted the comments from the co-creation CUbes and transcribed them into an Excel spreadsheet, as is consistent with previous research (Bussières et al., 2012). Statements from CUbes were transcribed into a single column, with each cell representing a single statement. Domain allocations were written into the column adjacent to each statement. Following an invitation to all of the co-creators**,** D1 volunteered to perform an independent review of the CUbe coding using the TDF coding manual by Garne-Dalgaard et al. (2019) for guidance. The primary researcher was available to help answer questions about the TDF definitions when requested. Disagreements were resolved via discussion.

The final step outlined by Rose et al. (2014) was reliability testing and analysis. During this stage, inter-rater reliability between different coders should be assessed to determine consistency and findings should be summarised in an appropriate manner, for instance through the use of frequency counts. Within the current study, inter-rater reliability between the lead researcher and co-creator D1 was established through Cohen's Kappa (Cohen, 1960). Cohen's Kappa is a measure of inter-rater reliability which has advantages over simple percentage agreement due to its ability to account for chance agreement between raters (McHugh, 2012). It has been argued that Cohen's Kappa is one of the most important and widely accepted measures for assessing inter-rater reliability on data sets which use nominal scales (Sun, 2011). Table 12 outlines the interpretation criteria of Cohen's Kappa.

Table 11: Interpretation of Cohen's Kappa Statistic (Source: McHugh, 2012)

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4.2.4.2 Analysis 2: Integrated Visual Thematic Analysis Procedure

To explore the artefacts produced by the co-creators simultaneously, an integrated visual thematic analysis was conducted. This approach combined Braun and Clarke's (2006) Thematic Analysis and Visual Analysis by Presi et al.(2016). By integrating textual and visual analytical methodologies it was possible to explore the multi-media data sets comprehensively as the photovoice methodology produced both textual and visual data (Chapman et al., 2017).

The photographs produced by the co-creators were first considered. The photographs were initially analysed using an adaptation of the visual analysis method proposed by Presi et al. (2016). Visual analysis involves descriptive analysis, emotive response analysis and compositional analysis of the target imagery which can then support subsequent polytextual analysis. The visual coding of the co-creator's photographs can be seen in appendix 6. During the descriptive analysis, each photograph was considered individually and the content of the image described. During this stage, no inferences were made about the meaning behind the photograph and the narrative description was restricted to the surface level items present within the image. Following this, emotional response analysis was conducted, where the researcher viewed each photograph individually and provided a written description of the emotions that the image evoked within them. Emotional response analysis enabled the researcher to consider the content of the photographs and the potential responses that each of the images could evoke from a viewer. The next step was compositional analysis where the rule of thirds was applied to each of the co-creation group's photographs (Presi et al., 2016). The rule of thirds is a common compositional rule which states that an image can be divided into nine equal parts by separating it with two equidistant vertical lines and two equidistant horizontal lines, providing a framework for assessing the arrangement, positioning and compositional structure of a photograph (Amirshahi et al., 2014). An example of a photograph taken from within the study with a rule of thirds grid overlayed can be seen in figure 4.3.

Figure 4.3: Photograph with Rule of Thirds Grid Overlayed

Within the visual arts, the rule of thirds has traditionally been used as a method to assess how aesthetically pleasing a photograph is (Bhattacharya et al., 2010; Brachmann & Redies, 2017). However, aesthetics was not the primary focus of the current study and as such the rule of thirds was instead applied to give a systematic, structured and replicable framework for analysing the positioning of elements within the co-creator's photographs. During compositional analysis, the researcher considered each photograph individually and used the rule of thirds to provide a narrative description of where items were placed and their relationship to other items within the frame. During compositional analysis the following features were considered:

- What objects are included within the photograph
- The positioning of items within the photograph
- What may be omitted from the photograph
- What has been emphasised within the photograph
- What has been subordinated within the photograph

By considering such factors, it can help the author to convey meaning beyond the superficial subject of the photograph (Harrison, 2003). During this stage, all of the photographs and their descriptive, emotional response and compositional analyses were considered simultaneously. Similarities, patterns and repetitive features across the co-creation group photographs were noted. Consistent with the approach taken by Presi et al. (2016) this stage was iterative; whereby photographs and identified patterns were reconsidered multiple times.

Once the initial analysis of the textual and visual data had been completed, integrated visual analysis was performed. This approach combined the Thematic Analysis process outlined by Braun & Clarke (2006) and Presi, Maehle, & Kleppe's (2016) Visual Analysis. Firstly, the CUbe statements and SHOWED photograph descriptions were semantically coded to give a "succinct summary of the explicit content of the data" (Braun & Clarke, 2006). Next, consistencies, patterns and similarities between the semantic codes were explored and grouped into preliminary themes describing the underling nature of the text-based data. The co-created photographs were then grouped into provisional themes based upon the similarity and consistency of the patterns identified during the visual analysis. Patterns and consistencies between the text and visual themes were then considered and compatible themes integrated, producing the final visual-textual themes.

4.3 Results

Five co-creation groups completed workshop one which resulted in the production of five co-creation CUbes and 20 photographs of perceived barriers and facilitators (see appendices 4 and 5). Co-creators (n=14) comprised of 9 females and 5 males with ages ranging from 23 to 58 years (M=36, SD=11.25), with females having a slightly higher average age (M=37.11, SD=12.48) than males (M=34, SD=8.25). The co-creators were employed in a variety of sectors including; retail (n=4), an auction house (n=4), higher education (n=3), entertainment (n=1), fashion (n=1) and accountancy (n=1). The amount of time in which co-creators had been employed within their current organisation ranged from 3 months to 117 months (M=40.36, SD=39.36). Five of the co-creators had line managerial responsibilities and were responsible for supervising between 1 to 16 employees (M=6.8, SD=5.93). Co-creators varied in the amount of time spent sat down during the workday ranging from 5% of the workday through to 95% of the workday. However, across co-creators the self-reported percentage of daily sitting time during work hours was high (M=70.14%, SD=29.63%). Individual participant demographic information can be found in table 13. The co-creators were split amongst five co-creation groups based upon their availability to attend workshops. Two co-creation workshops were held at the co-creator's worksite (groups A and E), whilst three co-creation workshops were held off-site at a local library (groups B, C and D). Within co-creation research, public libraries have served as a viable location for hosting workshops in instances where it is not feasible for them to be hosted in the employee's place of work (Rossitto & Lampinen, 2018).

Table 12: Barriers & Facilitators Workshop Participant Demographic Information

Participant	Age	Gender	Organisational sector	Job title	Length of time in current organisation (months)	Line manager (number of reportees)	Self-reported percentage of time spent sitting during average working hours
A1	58	Female	Higher Education	Lecturer	15	No	95%
A2	27	Female	Higher Education	Lecturer	14	No	90%
A3	27	Female	Higher Education	Lecturer	28	No	95%
B1	31	Female	Retail	Supermarket Customer Assistant	3	No	12%
B2	31	Male	Entertainment	Escape Room Games Master	32	No	90%
C1	56	Female	Retail	Personal Assistant	15	No	50%
C2	49	Female	Accountancy	Team Leader	8	Yes (9)	85%
D1	30	Male	Auction House	Senior Watch Specialist	105	Yes (3)	70%
D2	39	Male	Retail	Assistant Manager	117	Yes (16)	5%
D3	30	Female	Retail	Fashion Buyer	54	Yes (1)	90%
E1	47	Male	Auction House	Watch Specialist	106	No	65%
E2	23	Male	Auction House	Junior Cataloguer	21	No	85%
E3	26	Female	Auction House	Junior Cataloguer	23	No	90%
E4	30	Female	Auction House	Watch Manager	24	Yes (5)	60%

4.3.1 Co-Creation CUbe: Quantitative Content Analysis

4.3.1.1 Inter-rater Agreement

Within the current study, there was substantial agreement between the rater's categorisation of the barriers of physical activity (k=.73 (95% CI, .56 to .9), p<.05) and almost perfect agreement between the rater's categorisation of the facilitators of physical activity (k=.86 (95% CI, .76 to .96), p<.05). All disagreements between raters were resolved through discussion and an overview of the main discussion points can be seen in table 13.

Table 13: TDF Coding Disagreement Discussions

Barrier/Facilitator	Original TDF Code	Alternate TDF Code	Resolution
Desk-based work	*Social/Professional Role and Identity (Definition: A coherent set of behaviours and displayed personal qualities of an individual in a social or work setting)*	*Environmental Context and Resources (Definition: Any circumstance of a person's situation or environment that discourages or encourages the development of skills and abilities, independence, social competence and adaptive behaviour)*	Presence of desks and seats in the environment enable behaviour, it is not reflective of the professional role. Code as *Environmental Context and Resources*
High workload	*Social/Professional Role and Identity (Definition: A coherent set of behaviours and displayed personal qualities of an individual in a social or work setting)*	*Reinforcement (Definition: Increasing the probability of a response by arranging a dependent relationship, or contingency, between the response and a given stimulus)*	Organisations control employee workloads. By not reducing workloads the organisation is reinforcing sitting behaviour and creating a relationship between work and sitting. Code as *Reinforcement*

Note: TDF definitions derived from Atkins et al (2017).

4.3.1.2 TDF Domains Mapping

A total of 129 barriers and facilitators were extracted from the co-creation CUbes. Of these, 74 were categorised as facilitators of physical activity by the co-creators and 55 were categorised as barriers. *Social/Professional Role and Identity* and *Environmental Context and Resources* were the two most common allocated domains accounting for 76.37% of barriers and 74.32% of facilitators whilst no barriers or facilitators were categorised to the TDF domains of *Knowledge, Skills, Beliefs about Capabilities, Goals* or *Optimism*. This suggested that such facets were not immediately salient to employees when considering influences on workplace physical activity behaviour. The categorisation of CUbe statements into TDF domains can be seen in table 14.

Table 14: Categorisation of Co-Creation CUbe data mapped onto TDF Domains

TDF Barriers (*n* =55)			**TDF Facilitators (*n* =74)**		
Domain	**(n)**	**(%)**	**Domain**	**(n)**	**(%)**
Social/Professional Role and Identity *(Definition: A coherent set of behaviours and displayed personal qualities of an individual in a social or work setting)*	29	52.73%	Social/Professional Role and Identity *(Definition: A coherent set of behaviours and displayed personal qualities of an individual in a social or work setting)*	31	41.89%
Environmental Context and Resources *(Definition: Any circumstance of a person's situation or environment that discourages or encourages the development of skills and abilities, independence, social competence and adaptive behaviour)*	13	23.64%	Environmental Context and Resources *(Definition: Any circumstance of a person's situation or environment that discourages or encourages the development of skills and abilities, independence, social competence and adaptive behaviour)*	24	32.43%

TDF Barriers (*n* =55)			**TDF Facilitators (*n* =74)**		
Domain	**(n)**	**(%)**	**Domain**	**(n)**	**(%)**
Intentions *(Definition: A conscious decision to perform a behaviour or a resolve to act in a certain way)*	6	10.91%	Social Influences *(Definition: Those interpersonal processes that can cause individuals to change their thoughts, feelings, or behaviours)*	9	12.16%
Reinforcement *(Definition: Increasing the probability of a response by arranging a dependent relationship, or contingency, between the response and a given stimulus)*	3	5.45%	Reinforcement *(Definition: Increasing the probability of a response by arranging a dependent relationship, or contingency, between the response and a given stimulus)*	2	2.70%
Social Influences *(Definition: Those interpersonal processes that can cause individuals to change their thoughts, feelings, or behaviours)*	3	5.45%	Beliefs about Consequences *(Definition: Acceptance of the truth, reality, or validity about outcomes of a behaviour in a given situation)*	2	2.70%

TDF Barriers (*n* =55)			**TDF Facilitators (*n* =74)**		
Domain	**(n)**	**(%)**	**Domain**	**(n)**	**(%)**
Emotion *(Definition: A complex reaction pattern, involving experiential, behavioural, and physiological elements, by which the individual attempts to deal with a personally significant matter or event)*	1	1.82%	Memory, Attention, Decision Process *(Definition: The ability to retain information, focus selectively on aspects of the environment and choose between two or more alternatives)*	2	2.70%
Knowledge *(Definition: An awareness of the existence of something)*	0	0%	Behavioural Regulation (Definition: Anything aimed at managing or changing objectively observed or measured actions)	2	2.70%
Skills *(Definition: An ability or proficiency acquired through practice)*	0	0%	Intentions *(Definition: A conscious decision to perform a behaviour or a resolve to act in a certain way)*	1	1.35%

TDF Barriers (*n* =55)			**TDF Facilitators (*n* =74)**		
Domain	**(n)**	**(%)**	**Domain**	**(n)**	**(%)**
Beliefs about Capabilities *(Definition: Acceptance of the truth, reality or validity about an ability, talent or facility that a person can put to constructive use)*	0	0%	Emotion *(Definition: A complex reaction pattern, involving experiential, behavioural, and physiological elements, by which the individual attempts to deal with a personally significant matter or event)*	1	1.35%
Optimism *(Definition: The confidence that things will happen for the best or that desired goals will be attained)*	0	0%	Knowledge *(Definition: An awareness of the existence of something)*	0	0%
Beliefs about Consequences *(Definition: Acceptance of the truth, reality, or validity about outcomes of a behaviour in a given situation)*	0	0%	Skills *(Definition: An ability or proficiency acquired through practice)*	0	0%

TDF Barriers (*n* =55)			**TDF Facilitators (*n* =74)**		
Domain	**(n)**	**(%)**	**Domain**	**(n)**	**(%)**
Goals *(Definition: Mental representations of outcomes or end states that an individual wants to achieve)*	0	0%	Beliefs about Capabilities *(Definition: Acceptance of the truth, reality or validity about an ability, talent or facility that a person can put to constructive use)*	0	0%
Memory, Attention, Decision Process *(Definition: The ability to retain information, focus selectively on aspects of the environment and choose between two or more alternatives)*	0	0%	Optimism *(Definition: The confidence that things will happen for the best or that desired goals will be attained)*	0	0%
Behavioural Regulation (Definition: Anything aimed at managing or changing objectively observed or measured actions)	0	0%	Goals *(Definition: Mental representations of outcomes or end states that an individual wants to achieve)*	0	0%

Of the 55 barriers identified by the co-creators, 50.91% (n=28) were categorised under the domain of *Social/Professional Role and Identity.* As barriers, statements categorised under this domain were those that were believed to undermine or conflict with a person's social or professional role or identity. The most common workplace activity categorised within this domain was the business meeting. Nine of the statements within this domain reflected meetings of different iterations including formal trade meetings, job interviews and meeting 'chatty customers'. Following this, the next most common grouping of statements reflected dealing with and responding to emails and desk-based paperwork and administrative tasks. Two statements also considered the influence of professional workwear and uniforms. Combined, the current study suggests that business meetings, email communication and desk-based administrative tasks were common workplace activities that undermine an employee's capacity to engage with physical activity. Furthermore, professional workwear, and the sense of professional identity that this conveys, may also generate conflict between an employee's professional role, identity, and the adoption of physical activity.

The second-most categorised TDF domain was *Environmental Context and Resources*, representing 25.45% (n=14) of the barrier statements. Within the TDF, this domain reflects the resources and environment in which the target behaviour is to be performed and the influence that each can exert on an individual's propensity to perform them. In the current study, the general worksite building was considered by the co-creators including ergonomic factors such as heating and lighting. Three of the statements reflected the availability of comfortable seating, whilst the proximity of car parking facilities was referred to twice. The accessibility of technology within the worksite and factors such as poor Wi-Fi were also categorised under this domain. Extraneous environmental factors such as temperature or wet weather were categorised. Combined, statements within this domain suggest that the comfort of the worksite, the wider environment, and accessibility of sedentary promoting options, such as car park proximity, can act as common barriers to workplace physical activity.

The TDF domain *Intentions*, formed the third largest category capturing 10.92% (n=6) of the co-creation CUbe barriers. Within the TDF, this domain reflects conscious decisions or general resolve to act in a certain way. Statements within this domain broadly reflected feelings of laziness, procrastination, and a general lack of motivation. The relative consistency of these intentions across co-creation groups suggested that it is not only the worksite and the job role that were salient barriers but also more personal motivations and characteristics.

The TDF domains of *Reinforcement, Social Influences* and *Emotion* captured the remaining barrier statements articulated by the co-creators. Within these domains, perceptions of being judged or distracted by colleagues, high levels of stress and work patterns which sustain sedentary behaviours were identified. A full overview of physical activity barrier statements included under each domain can be found in appendix 7. Combined *Social/Professional Role and Identity*, *Environmental Context and Resources* and *Intentions* encapsulated 87.28% of the barrier statements produced by the co-creators. The domains spanned multiple levels from individual feelings and motivations through to the wider physical and social environments.

In contrast, the co-creators identified 40% more facilitators of physical activity in comparison to the number of barriers. There was also more diversity within the number of TDF domains in which statements were categorised, with nine TDF domains being utilised for facilitators of physical activity in comparison to six TDF domains for barriers of physical activity. The two most commonly utilized categories were however consistent between barriers and facilitators, *Social Professional Role and Identity* and *Environmental Context and Resources*.

Of the 74 facilitators identified by the co-creators 41.89% (n=31) were categorised under the domain *Social Professional Role and Identity.* Within this domain, statements broadly represented physically active work tasks such as moving items around the workplace, checking stock and receiving deliveries. The requirement to move between offices and locations to complete work tasks and customer interactions were also common facilitators categorised within this domain. Combined, this suggests that certain professional roles and responsibilities are compatible with performing physical activity whilst at work. Increasing the number of such activities, for instance moving between locations to complete work tasks, and interspersing them throughout the workday may be one way in which the barriers associated with *Social Professional Role and Identity* could be overcome.

The second-most utilised domain was *Environmental Context and Resources*, comprising of 32.43% (n=24) of all facilitator statements. Within this domain, the physical distances between work locations, offices and key facilities were represented. The presence and accessibility of stairs as well as uncomfortable seating and the availability of sit/stand desks were noted. Finally, the availability of breaktimes to move between floors or visit off-site locations were also common facilitators categorised under this domain. Combined, the statements within this domain suggested that increasing opportunities for physical activity, such as increasing the accessibility of stairs or positioning teams in different locations, can help employees to increase activity levels.. Furthermore, breaktimes appear to be a particularly salient resource within the workday which could be utilised to promote physical activity.

Social Influences represented the third biggest TDF domain, accounting for 12.16% (n=9) of the facilitator statements. Within the TDF, social influences represent interpersonal processes which can influence an individual’s thoughts, feelings or behaviours. Facilitators under this domain broadly comprised of participating in charity events, socialising with colleagues, and having colleagues who were a positive influence on performing physical activity. Combined, this suggests that providing opportunities for social interaction between employees may be a viable mechanism for promoting physical activity behaviours.

The remaining facilitators were dispersed across the domains of *Reinforcement (n=2), Beliefs About Consequences (n=2), Memory, Attention, Decision Processes (n=2), Behavioural Regulation (n=2), Intentions (n=1) and Emotion (n=1).* Facilitators within these domains included the use of

FitBits to track physical activity levels, company incentives, motivation and a general feeling of wellness. A full overview of physical activity barrier statements included under each domain can be found in appendix 7. The diversity in the number of TDF domains represented suggests that facilitators of physical activity may be more nuanced than barriers of the same behaviour. That is, there may be less consensus around what promotes physical activity when compared to what inhibits it. Combined, the domains of *Social/Professional Role and Identity, Environmental Context and Resources* and *Social Influences* represent 86.48% of the total facilitators identified by the co-creators. This suggests that, in contrast to perceived barriers, there are elements of an employee's professional role and worksite environment that were compatible with physical activity. That is, employee's roles and working environments neither inherently facilitate nor impede physical activity but rather the way in which they are structured may be influential. As a facilitator, opportunities for social interaction between employees appear to be particularly salient and could represent a viable target for intervention.

4.3.2 Integrated Visual Thematic Analysis

Following integrated visual thematic analysis of all of workshop one materials, eleven themes were identified; 'It's the nature of the job: activity reinforced through job design', 'The built environment and incidental activity', 'Workload', 'Meetings', 'Customer Service', 'These boots were/n't made for walking: The role of appropriate footwear', 'Technology – A double-edged sword', 'Social Influence: Colleagues standing up for and in the way of physical activity', 'Break Times', 'Organisationally Endorsed Physical Activity Campaigns' and 'Intrapersonal Factors: Mind & Body Being Ready for Physical Activity'. Each theme is considered in turn below.

4.3.2.1 It's the nature of the job: activity reinforced through job design

It was noted by participants that certain work tasks were inherently connected to physical activity or sedentary behaviour by virtue of needing to either sit or stand to complete them. Such tasks were often perceived to be barriers of physical activity, accounting for 70% (n=7) of the total CUbe statements associated with this theme. Whilst participants within the current study came from diverse occupational backgrounds, the presence of "*job tasks which require sitting"* (A) was a unifying pattern across co-creation groups. The nature of such job tasks was diverse ranging from; being *"on [a] sofa watching CCTV monitors" (B)* to *"working on tills"* (B) to doing *"paperwork [and] being sat down at [my] desk" (C),* suggesting that sedentary behaviour was a common feature embedded across many different occupational roles. Desk-based computer work was also a common image across multiple co-creation group's photographs with iterations being present within three of the co-creation group's barrier photographs (*see figure 4.4)***.** Compositionally, these photographs were often constructed in a manner that emphasised the sedentary nature of such work. In photographs where the co-creators were present, the desk-based work was always being performed whilst sat down. Even in images without human subjects, photographs were often constructed in a manner whereby office chairs were salient features of the frame, such as in the photograph produced by group C. Explaining their images, co-creators stated that they regularly felt *"tied to [their] workstation"* and that desk-based work *"forces you to sit down"*, emphasising the idea that sedentary behaviour was not a choice but something that was embedded in the way in which modern work tasks were designed.

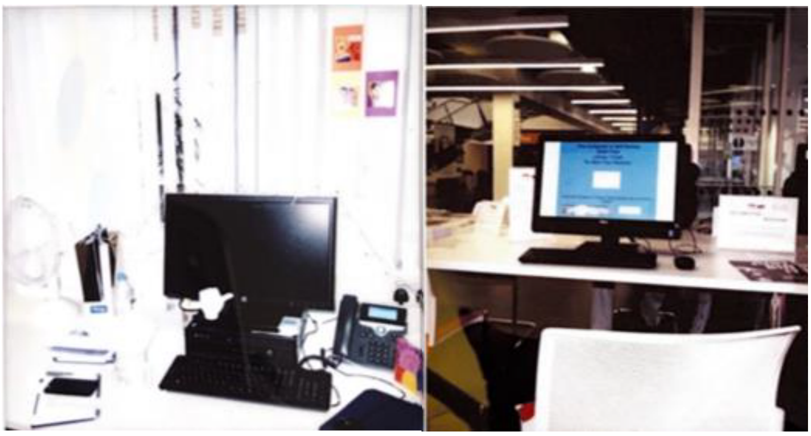

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Figure 4.4: Desk-Based Work (Barriers Left: Group A, Centre: Group C, Right: Group D)

However, it is important to note that job design was not exclusively perceived to be a barrier to physical activity. A smaller number (30%, n=3) of job tasks were identified as being inherently active by nature. Such tasks were most associated with delivering training as it required *"standing up" (A) and being "stood at the front (B).* Other active job tasks identified by the participants were "*stacking shelves and moving cages" (B)*. Job design, and the way in which work tasks are completed, may therefore play a key role in the level of employee physical activity during the workday. As both a potential barrier and facilitator of physical activity, job design and the balance of active and sedentary work tasks should be considered carefully.

4.3.2.2 The Built Environment & Incidental Activity

The built environment was acknowledged as an influential factor in both promoting and inhibiting workplace physical activity. The most commonly cited facilitator within this theme was the availability of stairs, accounting for half of the total number of facilitators. Staircases also featured heavily within the facilitator photographs generated across co-creation groups (see figure 4.5). Each of these photographs shared compositional similarities with the photograph being taken from the bottom of the staircase looking upwards. This positioning accentuated the length and height of the staircases and generated a perspective of climbing the stairs. Combined, these compositional consistencies emphasised the most active elements of staircases, suggesting that it is the ascension rather than descension of stairs that was most salient. Indeed, of the three co-creation groups who incorporated staircases within their photographs, each made some form of reference to being active and burning energy, supporting this interpretation. Group A explained that taking the stairs *"makes you active and walk"* and generated feelings of being *"energised"* whilst group C described how stairs *"make you feel good as you feel you have burnt some energy"* and group E explained that taking the stairs *"makes you burn energy*.

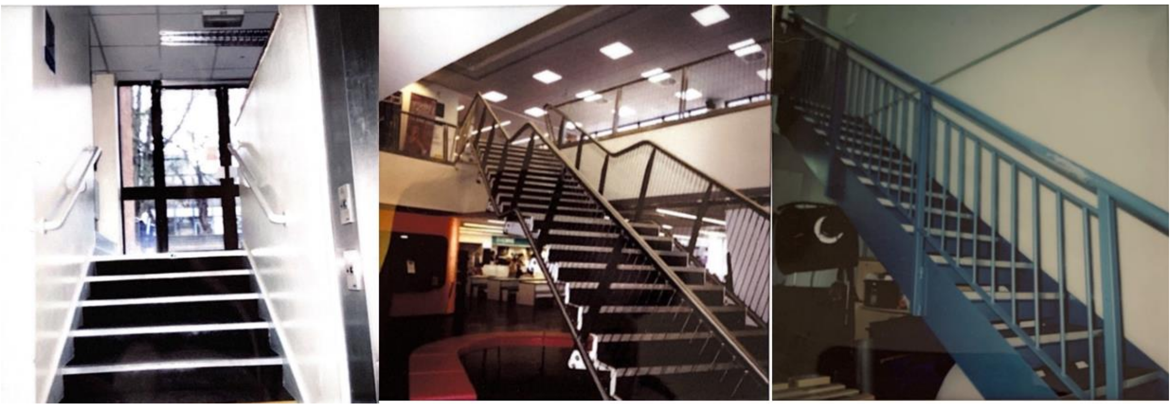

Figure 4.5: Staircases as Facilitators (Left: Group A, Centre: Group C, Right: Group E)

However, it was also recognised that the way in which the worksite was built played a role in stair usage. For group A, the location of their office in a basement led to staircases being viewed as an *"accidental facilitator"* as taking the stairs was *"essential to get to places"*. Indeed, moving between locations was perceived to be exclusively a facilitator of physical activity by all co-creation groups. The distances between locations varied dramatically ranging from travelling to different cities such as *"travelling to the London office"(C)* through to travelling between more localised buildings such as *"walking between offices for a delivery" (D).* Moving between localised offices was the most common expression of this facilitator being present in six of the twenty-one identified facilitators within this theme. However, travelling short distances within the same office, such as "*going to the equipment cupboard" (D) or "re-filling office supplies"(D),* were also perceived as being facilitators of physical activity. This suggested that it was not necessarily the length of the distance between two locations but rather the act of moving between locations that was the facilitator.

Whilst travelling between locations was one of the most identified facilitators of physical activity within the co-creation CUbes, no photographs of this facilitator were produced by any of the groups. The juxtaposition between its prevalence within CUbe and photovoice data could suggest that forms of incidental activity, such as moving between locations, may be overlooked in preference of more purposive and conscious forms of physical activity physical activity.

For group C it was acknowledged that the presence of staircases was *"a requirement in all workplaces, although [staircases] are not very obvious at times".* This suggested that whilst employees may perceive stair climbing to be a positive influence upon workplace physical activity, the impact could be indirectly influenced by the visibility and accessibility of staircases. Conversely, the availability and "*convenience of lifts*" (A) was identified as a barrier to physical activity. Group C stated that *"when the lift is broken…I have to take the stairs"* implying that lifts were the initial choice when moving between floors of a building. An elevator was also the primary focus of a barrier photographed by group C (see figure 4.6). The composition of this photograph, with the lift dominating the central portion of the frame whilst being flanked by two bright red columns, draws the viewer's eye directly towards it. Given that the co-creators within this group stated that staircases were not always obvious in worksites, the use of colour to frame the elevator during the composition of the image suggested that sedentary alternatives may sometimes be more immediately visible, detracting employees from using stairs. Indeed, the co-creators explained that organisations should strive to make elevators *"less attractive and accessible".*

Figure 4.6: Elevator as a Barrier (Group C)

However, the co-creators also acknowledged that elevators can be a source of *"relief when you are in a high rised building"* and that elevator usage was connected to physical exhaustion *"I use the lift when I am tired"*. Combined, this suggests that whilst predominantly perceived as a barrier to physical activity, elevators may still play an essential role in supporting employees who have physically exerted themselves throughout the workday or work in a building with multiple floors. Given that the aim of workplace physical activity interventions is to increase energy expenditure, elevators may eventually play a counter-intuitive role; preserving energy so that more may be used within the interventions themselves. Whilst speculative, a potential relationship between increased employee energy expenditure and elevator usage warrants further investigation.

The proximity of off-site locations was also viewed as both a barrier and facilitator, with the "*nearest car park being far away"(B)* promoting activity whilst the *"nearest car park being close" (A)* inhibited activity. The consideration of both off-site locations suggested that the co-creators used the workday rather than the workplace as the frame of reference for determining occupational physical activity. As such, researchers should adopt a holistic approach when designing interventions in this area. Finally, the co-creators identified that the perceived comfort of the environment can influence employee physical activity levels. For instance, *"uncomfortable chairs" (B)* were thought to promote activity whilst *"comfortable chairs" (B)* were thought to act as barriers. Furthermore, factors such as "*…poor heating & lighting" (B)* were also viewed as characteristics of the environment which inhibited physical activity. Such findings suggest that employees may be less inclined to engage with physical activity when the environment is designed to prioritise comfort. Practitioners may therefore need to carefully balance environmental comfort and discomfort when implementing physical activity interventions.

4.3.2.3 These Boots Were/n't Made For Walking: The role of appropriate footwear

Shoes were identified as a salient factor in discouraging physical activity for groups B and C. In particular, the comfort of footwear was perceived to be a key barrier to physical activity with certain shoe types making it *"uncomfortable walking around for too long" (C).* Uncomfortable footwear was also the subject of one of group B's barrier photographs (see figure 4.7). Within this image, a co-creator's foot can be seen with an area of redness below the hallux. The participants explain that "*This photo shows my foot after a day at work. There are red areas where skin is peeling.*

The safety shoes needed don't allow much freedom of movement when wearing them. During such a long shift, they rub and cause my toes to pinch together"(B). The construction of this photograph, being presented in the first-person perspective against a predominantly black background, created a sense of empathy from the viewer. By being placed in the point of view of the participant who is looking down at their injury, the viewer was given an awareness of what the individual was experiencing. The black background removes visual distractions for the viewer which further emphasised the embodied nature of discomfort that the photograph represents. Such a compositional structure afforded the co-creators a way of articulating feelings of discomfort in a manner that words alone may not have been able to fully convey. When explaining the impact of uncomfortable footwear, the co-creators stated that *"when working regularly, the discomfort and pain generated by wearing the necessary shoes for safety increases. It is accumulative so the more work I do, the more my feet hurt. The footwear discourages activity by making the activity painful or uncomfortable".* This further echoes the sentiment that the type of footwear which one wears during working hours can influence the amount of physical activity performed.

Figure 4.7: Uncomfortable Footwear as a Barrier (Group C)

Across co-creation CUbes, no group identified clothing as a facilitator to physical activity, instead clothing was associated with feelings of discomfort and pain. However, group E identified appropriate footwear as a facilitator of physical activity within one of the group's photographs (see figure 4.8). When describing the photograph, the co-creators explained that *"wearing comfortable* *shoes makes it easier to be active as your feet get less tired during the day"* and that *"when I'm wearing my boots to work I can go out for walks regardless of the weather"*. This sits in direct contrast to the barrier of uncomfortable footwear identified by group C. When footwear is comfortable employees may feel more capable of performing physical activity and overcoming other barriers such as tiredness or weather. This sentiment can also be seen within the construction of the image. In the photograph, a person can be seen sat down in an office setting wearing boots. The co-creator's boots are in the centre of the frame making them the primary focus for the viewer. However, the boots are surrounded by artefacts of work in all directions such as; the office chair to the left of the image, paperwork to the right of the image, paperwork to the top of the image and the leg of a desk to the bottom of the image. Despite being surrounded by elements, which were perceived to be barriers of physical activity across co-creation CUbes, the boots were framed as a tool which can be used to overcome these.

Figure 4.8: Comfortable Footwear as a Facilitator (Group D)

Given that many organisations require employees to wear a uniform, or meet more generalised professional dress codes, the role of clothing in the context of physical activity needs to be considered. Uniforms or dress codes that promote uncomfortable clothing, particularly in relation to footwear, may discourage employees from being physically active. However, those that permit more comfortable forms of clothing may facilitate more physically active behaviour.

4.3.2.4 Customer Interactions

Customer facing roles were identified as both promoting and inhibiting physical activity. In general, customer interactions were predominantly viewed as being a facilitator of physical activity, accounting for 71% of the CUbe comments within this theme. Customer interactions promoted activity in a variety of different ways. Firstly, the co-creators noted that *"customer facing roles need to be animated and engaging" (B)* and that upon seeing customers they would be *"moving to greet" (C)* them. The simple presence of customers therefore appeared to trigger a professional identify that was inherently physically active. In addition to psychologically reacting to the presence of customers, the co-creators also described how delivering customer service promoted physical activity. Fulfilling requests for customers, checking stock, showing merchandise, and putting merchandise back were interactions identified as facilitating physical activity. However, in certain circumstances customer interactions were also viewed as being a barrier of physical activity. The co-creators described situations where they were *"putting customer interactions above being away from [their] station" (B)* or engaging in prolonged sedentary behaviour by being *"held up by 'chatty' customers when on the phone or sat down during valuations" (D).* Whilst only accounting for two of the total CUbe statements categorised within this theme, the inclusion of customer interactions as a potential barrier suggests that it is the context in which customer interactions take place that may determine whether it is perceived to be a barrier or facilitator of physical activity.

4.3.2.5 Meetings

Meetings were largely perceived to be a barrier of physical activity and were often associated with sedentary behaviour. As the co-creators in group D expressed "*meetings involve sitting*". The timings of meetings were also indicated to be impactful. Group C referred to "*Monday trade meetings*" and stated that they are "*starting the week sat down*". The timing of these trade meetings appeared to set the tone for the remaining work week and so starting with sedentary behaviours was viewed as a barrier to physical activity which carried over across subsequent days. In addition to this, the proximity of meetings to one another was also perceived to be a barrier to physical activity. Participants within group C indicated that "*back-to-back meetings*" were also be problematic and variations of meetings, such as job interviews, could lead to a "*long period of time sat down*". Whilst the time spent in the meeting itself was viewed as being a barrier, travelling to and from a meeting was perceived to be a facilitator of physical activity.

Participants cited active modes of travelling to and from meetings such as "*I have to walk to other departments and desks"* (C). However, participants also referred to Skype meetings as being a barrier suggesting that technology may be reducing the need to actively travel between meetings and therefore negating opportunities for physical activity. Work meetings were also the subject of group D's barriers of physical activity (see figure 4.9). The image captured describes "*pointless and boring Zoom meetings".* In the photograph, three individuals can be seen sat around a desk looking towards a laptop. The laptop has been prioritised at the centre of the frame, making it a key focal point within the image. The human subjects of the picture are slightly offset to the left of the laptop, presenting them as almost secondary elements of the image. The individuals have been posed in the "hear no evil, see no evil, speak no evil" actions which evokes a feeling of censorship and restriction in the viewer. Combined, the compositional elements suggest that employees may feel trapped by computer mediated meetings and are unable to perform any behaviours other than the prescribed requirements of being sat down, facing a computer for the duration of the digital meeting.

Figure 4.9: Meetings as a Barrier (Group D)

Combined, business related meetings appear to be perceived as a barrier of physical activity. As such, the design of business meetings could represent a target for viable intervention. In particular, meetings which set the agenda for the working week could be of particular interest to target as these may set the tone for the days ahead. Converting such meetings into more physically active formats could encourage these behaviours to continue into the week so rather than "starting the week sat down" employees are starting the week being active.

4.3.2.6 Workload

Participants identified workload as predominantly being a barrier to physical activity, with references to high workloads being made by all groups. A consistent feature of high workloads was the timebound nature of many work tasks, meaning that the co-creators were unable to take time away to perform physical activity. Group D articulated that tight deadlines meant that they *'have to get work done quickly so can't afford to leave [their] desk'*. This was also captured with a barrier photograph produced by group E (see figure 4.10).

Figure 4.10: Workload as a Barrier (Group E)

Within the image, a co-creator can be seen working on a computer whilst simultaneously typing and talking on a phone. The subject is facing away from the camera and is focussed upon the screen rather than looking into the lens which further reinforces the idea that demanding workloads consume the attention of employees and provide fewer opportunities to engage in behaviours not related to the completion of work tasks. In explaining the photograph the co-creators stated; *"when you have a lot do, there's no chance to get away from the desk. You're having to balance phone calls, emails, invoices and they're all equally important. You can't step away from your desk otherwise the work won't get done and it starts to stack up. Our work is very desk-based, so there's no choice but to sit down whilst you do it"*. Whilst this statement partially reflects job design through its reference to desk-based work, the emphasis was firmly placed upon the volume of work tasks needing to be completed. This suggests that high workloads may be an overlapping, but distinct, barrier of physical activity when considered in combination with desk-based work.

Deadlines and to-do lists were referred to by groups B and C further compounding the idea that having a lot of work to complete within a specific timeframe could inhibit physically active behaviours. High workloads were also connected to longer working days by group A who mentioned that they were accustomed to *'staying late to get work done'*. This suggests that high workloads can potentially cause sedentary behaviour to spill over from the occupational domain into what would have otherwise been classified as leisure time. Further compounding its status as a potential barrier to physical activity, high workloads were also connected to broader feelings of stress and frustration. This was reflected in one of the barrier photographs produced by group A (see figure 4.11). Within the image, a person's fist is clenched tightly around a stress ball whilst resting upon a pile of paperwork. The composition of this image was particularly evocative. Rather than passively taking an image of paperwork, which could have sufficiently conveyed the idea of a high workload as a barrier, the co-creator's use of symbolism with a hand tightly squeezing a stress ball conveys not just what the barrier is but also how it may operate. That is, the stress and frustration generated by high workloads may be an important element to consider when seeking to understand what inhibits physical activity at work. When describing how workloads may impede physical activity the co-creators within this group stated *"[you] have to meet deadlines, [there's] a desire to get everything done on time"* and that this meant that there was *"no time or energy left for activity"*. The co-creators linked heavy workloads to physical feelings of exhaustion, tenseness, and stiffness as well as psychological outcomes such as demotivation, stress, frustration and a lack of concentration. It does therefore appear that heavy workloads may drain psychophysical resources, leaving little left to motivate physically active behaviours.

Figure 4.11: Workload Stress as a Barrier (Group A)

Outside of the actual workload, concern was also expressed about *'colleague perception'* by group C. This group indicated that taking time out of the workday to engage in physical activity could be viewed negatively by others who may believe that they are *'not working hard enough'*. This could lead to a counter-intuitive situation where employees, who are attempting to balance their workload with physical activity, may be given more work to complete due to perceptions of them not having enough work to do. This is important to note as such findings suggest that both the physical workload and the wider organisational culture around workload may need to be considered when attempting to address this salient barrier.

It is important to note however that high workloads were not universally perceived to be a barrier to physical activity. Groups B and C mentioned that *'busy times'* and *'time limits'* can promote activity. In these instances, the work tasks being completed were physically active such as *'rushing around dealing with customers'* (C) and needing to *'re-set puzzles in rooms'*(B). Therefore, having to complete these active tasks quickly and consecutively could promote physical activity behaviours rather than inhibit them. This contrasts with the desk-based work which was typically associated with high workload as being a barrier to physical activity. The diverse occupational backgrounds of the co-creators and the dual nature of workload as both barrier and facilitator of physical activity suggests that it is the nature of the work tasks and not just the volume of them which needs to be considered.

4.3.2.7 Technology: A double-edged sword

Technology was identified by the participants as an influential contributor to both physical activity and sedentary behaviour. As a barrier to physical activity, participants identified pieces of physical equipment such as *"computers"* (A) *and "hard connections at desk"*(C). However, the use of technology for communication purposes was the most consistent expression of this perceived barrier. Technology mediated communication took many forms for the participants including; *"replying to emails sat down at desk"*(C)*, "answering phone calls"* (D)*, using a "walkie talkie"* (B) *and "Zoom/Skype meetings"* (C)*.* Explaining how technology acted as a barrier to physical activity, participants in group C articulated that *"I can talk to people anywhere but always connected to my desk";* suggesting that technology has reduced the need for individuals to physically move to communicate. By having the ability to communicate with others at a distance via email, telephone and virtual meetings the requirement to move is diminished. Asynchronous forms of technology mediated communication, such as email, may compound this issue as "*having to respond to lots of emails"* (C) may generate further emails; in response creating a chain of sedentary communication.

Whilst technology was predominantly viewed by participants to be a barrier of physical activity there were forms of technology that were perceived to facilitate physical activity. For group C, the portability of having a work laptop meant that they could *"move around and work from anywhere"* whilst for groups A and D having health tracking monitors, such as a Fitbit, reminded them to move throughout the workday. Health tracking technology was also the subject of two of the co-creation group's facilitator photographs (see figure 4.12). The photograph taken by group E depicts an outstretched arm with a smartwatch visible on the wrist and health tracking information is displayed upon the screen. The first-person perspective of this image, in combination with the act of raising the arm to show the watch face, creates a sense of embodiment for the viewer who can vicariously experience how this piece of technology is used to track activity levels during the day. Within the description of the photograph the co-creators explained; "*Smart watches notify you when you've been sat down too long and buzz to remind you to move*". This suggests that the device itself acts as a physical reminder to move. The convenience of the device was also identified; *"It also makes tracking your steps easy as you don't have to really do anything extra"*. From a psychological perspective, the device also appeared to reduce feelings of stress associated with performing physical activity; "*It takes the pressure off. If you forget to move then you know there's always going to be a reminder*."

The photograph taken by group B depicts a similar, but differently composed, approach to using smart technology to track physical activity levels. In this image, the display of mobile phone health application can be seen. Within this image, various health statistics and trends can be seen. Contrasting with the photograph produced by group E, the emphasis within this image was not on the device itself but on the outcome measures of physical activity which include daily steps, distance walked, and calories burned. This suggested that smart technology may act as a facilitator in two ways. Firstly, the presence of the device can act as a visual cue to engage with physical activity when it is attached to the wrist or when the device prompts the behaviour. Secondly, smart devices can motivate and reinforce positive physical activity behaviours by presenting the user with outcome measures that allow individuals to self-monitor their behaviour.

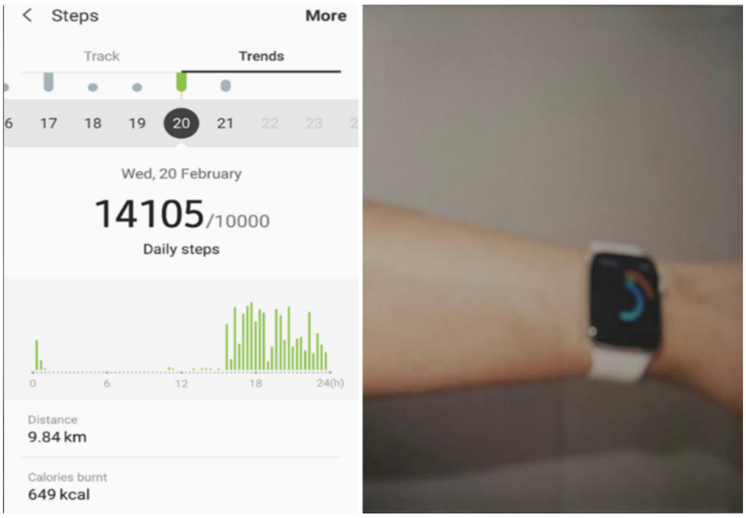

Figure 4.12: Technology as a Facilitator (Left: Group B, Right: Group E)

4.3.2.8 Social Influence: Colleagues standing up for and in the way of physical activity

Social interactions were perceived to be both *"positive and negative" (A)* influences on physical activity dependent upon the nature of the interaction. As a barrier, social influences were most associated with being sat down at a colleague's desk either when *"socialising"* (D) *or "assisting colleagues*" (B). However, the very same activities were also identified a facilitator of activity when desks were not present as expressed by group C "*socialising with colleagues and discussing the* *weekend"* and group B *"teamwork- moving to help others around store".* This suggested that physically active social interactions can be moderated by the environment.

Colleagues were also viewed as sources of motivation to perform physical activity through expressing *"supportive and encouraging"* (A) behaviours. Social support and influence were also depicted in the facilitator photographs produced by group A and group D (see figure 4.13). Co-creators in group A explained that *"peers and colleagues [act] as motivators to get active [and] leave the office for lunch and coffee"*. In describing how peers influence physical activity the co-creators referred to *"implicit motivation [through] influence from peers activity levels" and "want[ing] to spend more time with colleagues"*, with the perception that *"social activity is more enjoyable".* This suggests that colleagues and peers can play a powerful role in promoting physical activity within workplace through multiple mechanisms including modelling active behaviours and fulfilling social needs.

Figure 4.13: Social Influence as a Facilitator (Left-Group A, Right-Group D)

Group D also explored the concept of social support and endorsement within their photograph. However, the nature of this image was to capture the importance of *"support across the organisation".* The composition of this photograph clearly conveyed this sentiment. Whilst there are three individuals within the image, no person is positioned in the centre of the frame. This created more equity between the subjects and did not position any one individual as the dominating focal point. Instead, the centre of the image wass reserved for the action of hand clasping between two of the subjects. This action was representative of support. By positioning this in the centre of the frame, the concepts of support and connections between employees were emphasised for the viewer. The subjects within the image were also arranged in varying heights. The ascendency in height and the position of the subjects was reflective of an organisational hierarchy. As people ascend the hierarchy, they gain more power and influence to make large changes. As subjects ascend in the image they also gain more mobility moving from the most restrictive position, crouching, to the least restricted position, standing. This positioning anthropomorphises the sentiments expressed by the participants in this group when explaining the motivation behind the photograph. When explaining the image, the co-creators stated; "*when management supports [physical activity], it filters down and everyone gets involved. It becomes a shared responsibility, everyone helps each other. If you're not feeling motivated you can get support from others. Other times you're the one who is supporting your colleagues"*. This suggested that in organisations where physical activity is actively endorsed, employees may feel more supported and may also be more supportive in turn, leading to a collective increase in physical activity levels. However, social influence and the personal connections and interactions between employees can be a double-edged sword. If not managed effectively, socialising, and assisting colleagues can increase sedentary behaviour if these activities are performed around a desk.

4.3.2.9 Break Times & Going out for lunch

Break times were identified as a facilitator of physical activity across all groups with lunch breaks accounting for 6 out of the 11 facilitator statements within this theme. Lunch breaks were often connected with leaving the worksite to purchase food; the presence of food was also a common feature in shorter breaks such as *'making a cup of tea'* (D) and *'getting a biscuit'* (D). The fulfilment of physiological needs, such as satiating hunger, may therefore be an influential factor in encouraging movement away from desks. This is also echoed by the statement that lavatory breaks were viewed as being a facilitator of physical activity which once again reflects the need to satiate a physiological function. However, the fulfilment of physiological needs was not the only feature outlined in the use of break times. Several of the facilitator statements also referred to the socialisation aspects of *"meeting friends for lunch"* (B). Break times may therefore be multi-faceted and increase physical activity through the fulfilment of employee social as well as physiological needs. The duration of the breaks identified by the co-creators also varied from hour long lunch breaks through to more limited break times. Microbreaks were often associated with movement inside of the worksite such as *'getting a biscuit…on a different floor'* (D), whilst longer lunch breaks were most often associated with movement outside of the worksite such as *'walk[ing] into town'* (D) and visiting shops. Employee break times may therefore operate on different levels with microbreaks facilitating short bouts of movement within the worksite and macrobreaks facilitating more sustained bouts of movement out of the worksite.

However, it is important to note that the presence of on-site break facilities can potentially discourage employees from using break times to perform physical activity. This was captured in one of group B's barrier photographs (see figure 4.14). When explaining the break area, the co-creators stated *"As the job is so active, they make an effort to give a nice area to rest physically and mentally before going back to work. On the surface, this is a nice gesture, but they should be trying to encourage different types of activity*". This description encapsulates the balancing act often faced by employers who wish to provide spaces for rest and relaxation as well as promote physical activity.

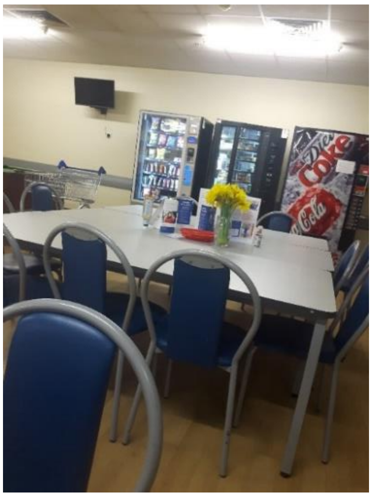

Figure 4.14: Comfortable Break Rooms as a Barrier (Group B)

The availability of outside spaces to use during breaktimes also formed the foundation of one of group C's facilitator photographs (see figure 4.15). The image has been taken from the inside of a building facing outwards and composed so that a bold exit sign is presented towards the centre of the frame. The staging of the photograph, taken from the inside of the building as opposed to capturing the outdoor space itself, suggests that the building may act as a boundary for physical activity. Within the building is where professional work is completed and outside of the building is where the co-creators felt freer to be physically active. The exit doors captured within the photograph may therefore represent the psychological boundary between the two worlds. There was also a stark contrast in illumination levels with the foreground being considerably darker than background. This compositional structure communicated a sense of freedom, as to leave the building the viewer would pass through the dark interior into the light exterior. In describing the photograph, the co-creators outlined; "*We often use our breaktimes to get out of the office and walk into town to get lunch or do some shopping. It's nice to just get out of the office for a while, get some fresh air and recharge* ". The co-creators also referred to using outside spaces as a stress reduction technique; "*Getting out of the office is really important to help you destress and come back relaxed, especially if it's a sunny day outside*". This explanation provided a clear distinction between how the co-creators experience the worksite and the wider external environment, further strengthening the position that the exit doors represented not only the physical boundary but also a psychological one.

Figure 4.15: Outside Space as a Facilitator (Group C)

Whilst having the ability to go outside during the workday was generally viewed as a positive influence on physical activity levels, extraneous conditions such as weather and temperature could interfere with this. The weather acted as a salient barrier towards leaving the worksite and was directly referred to in all of the CUbe barriers reported under this theme. Furthermore, it served as the subject for one group D's barrier photovoice images (see figure 4.16). Within the photograph a pictorial representation of a rain cloud is presented on the screen of a computer monitor. The use of a computer monitor, as opposed to an outdoor scene, indicated that weather can be unpredictable and difficult to capture on command. Unpredictability and lack of control may be factors that can make scheduling physical activity more difficult. The use of a computer monitor may also be referencing the perception that when it rains the co-creators were more likely to stay inside and sit at their desks. Indeed, in describing the image the co-creators stated "*When it's raining or cold outside you don't really want to go out unless you have to. People tend to take their lunchbreaks in the office or eat at their desk when there's bad weather. It makes you want to stay in the warm*".

Figure 4.16: Weather as a Barrier (Group D)

4.3.2.10 Intrapersonal Factors: Mind & Body Being Ready for Physical Activity

Alongside elements of their job roles and working environments, the co-creators also described their own psychological and physical well-being in relation to workplace physical activity. Psychological and physical well-being could act as either a barrier or facilitator of physical activity dependent upon how they were experienced. As a facilitator, *"feeling well"* (A) *and "general wellness" (A)* alongside motivation were perceived as conducive; whilst *"illness"*(A), "*work stress"* (A), *"laziness*"(C) and "*procrastination"* (A) were perceived as being inconducive. This suggested that a base level of wellness may be a pre-requisite for engagement with workplace physical activity and without this, engagement may be perceived as more challenging. Laziness was a relatively consistent factor indicated by the co-creators in groups A, C and D. Laziness was connected to a lack of motivation, the delegation of active work tasks and certain days of the week. The relative consistency of the co-creators perceiving themselves as being lazy provided somewhat of a paradox given that high workloads, staying late to complete work and supporting colleagues to complete work were also identified by the co-creators. Such behaviours were not indicative of a general propensity for laziness. Instead, when considered in the context of the theme *Workload*, one might tentatively suggest that the co-creators were expending their energy and mental resources prioritising the completion of work tasks above being physically active. That is, the completion of demanding work tasks may sap the energy and motivation that would have otherwise been channelled towards physical activity. Whilst tentative, the theme *Breaktimes* does lend support to this. When provided with restorative breaks, such as lunch breaks, the co-creators described performing more physically active behaviours. Therefore, it may not be the case that employees are lazy but rather that their energy and efforts are being channelled towards the completion of work tasks rather than physical activity.

4.3.2.11 Organisationally Endorsed Physical Activity Campaigns

For the co-creators, organisationally led initiatives were viewed exclusively as positive influences on employee physical activity levels. Such findings are promising as they suggest that employees are likely to perceive workplace interventions positively, especially if they are endorsed by their employer. The organisationally endorsed initiatives described by the co-creators ranged from *"raising awareness"* (A) through to organisations offering *"half-price gym membership and incentives"* (B). Physically active charity events were also referred to by the co-creators, one of which formed the subject of group B's facilitator photograph (see figure 4.17). Within the photograph, a 'Race for Life' advertisement can be seen displayed on a notice board. The image captured not only the logo of the event but also photographs of employees who had completed the race in previous years. The inclusion of these photographs within the image conveyed a sense of social reward and cohesion gained by completing the race. In combination, the composition suggests that the race facilitates physical activity but social elements may motivate engagement with it. This idea was conveyed by the co-creators who explained "*I am pleased that the company want to build such a pleasant team-based environment as to encourage so much activity during and outside of work. It feels like being a part of the team is an option for anyone and you can really make friends, keep active, and help good causes if you choose*."

There were no reported instances where organisationally led physical activity initiatives were perceived as barriers to, or negative influences on, physical activity. The positive perception of workplace initiatives suggests that employees are receptive to, and favourably view, interventions in this domain.

Figure 4.17: Organisationally Endorsed Events as a Facilitator (Group B)

4.4 Discussion

Whilst the workplace has been identified as a viable domain to target physical activity behaviours employee engagement with physical activity remains relatively low. To date, many workplace physical activity interventions have been developed using a top-down process which may be one potential explanation for the mixed success of interventions within this domain. Through the reliance on top-down processes, interventions may not have fully accommodated the opportunities and challenges faced by employees trying to incorporate more physical activity into their workday. The current study therefore sought to gain insight into the barriers and facilitators which can influence workplace physical activity from the perspective of employees themselves. Understanding these factors not only provides impetus for the co-creation of future interventions but also more nuanced information about which factors may contribute towards engagement with physical activity in the workplace. To ascertain which barriers and facilitators were salient to the co-creators two methodological approaches were drawn upon; co-creation CUbes and photovoice. Through these approaches, the co-creators were able to articulate their experiences and produce rich multi-media artefacts for analysis. A pluralistic approach to analysis was taken to promote a thorough exploration of the barriers and facilitators identified by the co-creators.

Firstly, quantitative content analysis was conducted on the co-creation CUbe data to map the identified barriers and facilitators into theoretical domains using the TDF. The application of the TDF was deemed important as a key critique within workplace physical activity literature is the underutilisation of theoretical frameworks to determine factors which facilitate or impede engagement with physical activity (Nilsen, 2020). The findings of the current study were broadly consistent with those of a scoping review conducted by Garne-Dalgaard et al. (2019), in that the most commonly categorised domains for both barriers and facilitators were; *social/professional role and identity*; *environmental context & equipment* and *social influences*. These commonly cited domains are diverse and suggest that barriers and facilitators of employee physical activity may operate on multiple levels. Ecological research views behaviour as a dynamic interaction between the individual and their work environment across four levels; intrapersonal, interpersonal, institutional and community (Henning et al., 2009). The presence of barriers and facilitators across these levels within the current study therefore lends strength to those who have called for an increase in ecological approaches to exploring workplace physical activity behaviour (Watanabe & Kawakami, 2018).

In addition to this, the dual nature of these domains, as both the most commonly categorised barriers and facilitators, suggests that they are neither inherently restrictive or permissive but rather influence physical activity in different ways depending upon how they are encountered by employees. It has previously been noted that barriers for some individuals may be facilitators for others and that the TDF can help to elucidate how domains may overlap and interact with one another (Power et al., 2017). This was seen within the current study where socialising with colleagues was identified as a facilitator of physical activity by co-creators in group C but a barrier for co-creators in group D. Therefore, particular attention needs to be paid towards the individuality of employees and the context in which workplace physical activity behaviour is promoted (Garne-Dalgaard et al., 2019; Power et al., 2017). Co-creational approaches, like the ones utilised within the current study, may therefore serve as viable tools for accommodating individual circumstances and contexts.

Within the current study, no barriers or facilitators were coded under the following domains; knowledge, skills, optimism, beliefs about capabilities or goals. This is somewhat surprising as optimism, self-efficacy and goal setting have been associated with increased employee physical activity (Iwasaki et al., 2017; Kavussanu & McAuley, 1995). Furthermore, building knowledge, skills and self-efficacy are common workplace physical interventions strategies which have been associated with positive behavioural change outcomes (Jirathananuwat & Pongpirul, 2017). Whilst clearly important from a research perspective, the current study suggests that these particular domains may not be as immediately salient to the co-creators when compared to other factors such as their professional identity. It may also serve to highlight the risks of relying upon top-down approaches as key perspectives and alternative solutions may be missed if stakeholders are not actively involved in the research process. However, it is also important to note that frequency does not necessarily equate to importance within content analysis (Weatherson et al., 2017). That is, the TDF domains which were less frequently used may still be of high importance to the co-creators. The analytically pluralistic approach adopted within the current study therefore provided the opportunity for the co-created artefacts to be explored in more detail and to build upon the TDF coding.

Through integrated visual thematic analysis, it was identified that factors influencing workplace physical activity were rarely comprised of barriers or facilitators exclusively. That is, the same factors could serve as either a facilitator or a barrier dependent upon how they were encountered. This echoes the results of the TDF content analysis. However, it is important to note that the theme *organisationally endorsed physical activity campaigns* was comprised exclusively of facilitators. Whilst employee receptivity to workplace physical activity interventions is often presumed, it is rarely explicitly acknowledged within the literature despite being identified as a key driver of intervention engagement (Spence, 2015). The findings of the current study therefore do suggest that employees are receptive to physical activity promoting interventions and that the workplace may indeed be a viable domain to target.

Within the study, break times were overwhelmingly viewed as a facilitator of physical activity with only poor weather acting as a barrier to leaving the worksite itself. This finding is consistent with wider literature which has demonstrated that employees often utilise lunch breaks to engage with physical activity and in organisations where unscheduled breaks are discouraged employees often report lower levels of physical activity (Croteau, 2004; Sawyer et al., 2017). Given that short breaks were considered as facilitating physical activity alongside more traditional lunch breaks, the inclusion of microbreaks into the workday may be a viable strategy for further enhancing employee physical activity levels. Indeed, early evidence suggests that both managers and employees view short 10-minute physical activity breaks as feasible and desirable (Bramante et al., 2018). However, the implementation of new breaks into the workday must be carefully considered. Employees often do not see the value in engaging with workplace physical activity interventions if a longer day is required in order to complete their workload (Ryde et al., 2020). Given that participants within the current study also referred to having to “stay late” to complete their workload as a barrier, it appears that this is a valid concern. Therefore, adding time to the length of the workday for employees to complete physical activity may actually compound workload as barrier rather than reduce it. Instead, intervention designers should consider investigating ways to integrate physical activity into the pre-existing working hours. Future research may also benefit from exploring the relative efficacy of promoting frequent short breaks against infrequent longer breaks. Within the current study breaks of one hour were linked to off-site visits which may promote longer bouts of physical activity. However, it remains unclear as to which time point employees begin to consider transitioning from staying on-site to walking to off-site locations. Researching break time length along a continuum may help to provide more contextual information around which types of physical activities are feasible for breaks of different lengths and reduce the need to increase the length of the overarching workday.

The themes *The Built Environment* and *Inactive by Design*, may provide insight into characteristics which influence how physically active employees are within their job roles. Staircases were commonly cited facilitators of physical activity across both CUbe and photovoice data. The visibility and availability of staircases were referred to as factors promoting stair usage alongside the removal of choice, for instance when elevators are broken. As a frequent facilitator, staircases may therefore be a viable target for intervention in workplace settings. Indeed, the encouragement of stair use is a relatively common intervention strategy(Bellicha et al., 2015); with point of choice prompts and incentives demonstrating small but positive effects (Eves et al., 2006; Schumacher et al., 2013). In contrast to the facilitator of staircases, the availability and visibility of sedentary alternatives, such as elevators and car parks were commonly perceived as barriers to physical activity. From an organisational perspective, this may be problematic as features such as elevators are often more visible that staircases in office settings (Weghorst, 2016). Given that visibility and availability were characteristics referred to in both the barriers and facilitators these features may represent viable targets for intervention. However, it is important to note that the way in which visibility is enhanced needs to be carefully considered. Interventions which have used footprint stickers leading to stairwells and highly visible banners have been associated with a reduction in stair usage (Åvitsland et al., 2017; Coleman & Gonzalez, 2001). Therefore, a strategic approach to intervention needs to be taken to help avoid unintentionally compounding physically inactive behaviours.

The way in which jobs are designed may also promote or inhibit physical activity. Under the theme *Inactive by Design*, examples of work tasks which necessitated standing and sitting were described. Work tasks were predominantly associated with being barriers of physical activity with desk-based work being the most common expression of this. Desk-based work is known to be a substantial contributor to sedentary behaviour in office environments (Parry & Straker, 2013). However, in comparison, a much smaller amount of literature exists exploring sedentary work tasks in non-office roles. The current study found that occupations within the entertainment industry and in retail also possess work tasks which are highly sedentary in nature. Specifically, co-creators in group B described the requirement to be sat down watching CCTV when hosting escape rooms and the requirement to be seated when working on tills in retail settings. Given the importance of physical activity to protecting the health and well-being of individuals and organisations alike, further research is required to support employees from non-office occupations. Business meetings were also identified as a barrier to physical activity; a finding consistent with wider literature (Hadgraft et al., 2016). Recently, efforts have been directed towards exploring the utility of standing and walking meetings (Ahtinen et al., 2017; Stray et al., 2016). Such meetings discourage the use of chairs and encourage employees to stand or walk whilst developing ideas or solving problems (Knight & Baer, 2014). Evidence for the efficacy of such meetings has been mixed. Standing meetings have been shown to reduce sitting time but walking meetings have not been significantly associated with reductions in sitting time with issues such as; the need to look at a computer, a lack of discretion, lack of suitable walking spaces and the weather contributing to their mixed efficacy (Danquah & Tolstrup, 2020). To a certain extent, these challenges have been echoed by the co-creators who identified outside spaces as a facilitator and poor weather as a barrier of physical activity. In light of this, different forms of physically active meetings may be suited to different kinds of conversations. Given the salience of workplace meetings as a barrier to physical activity, future research may benefit from further assessing the application of creative, participatory, methods to making business meetings more physically active.

Footwear was identified as a barrier of physical activity for three groups. Little is known within the literature about the influence of professional footwear on employee physical activity levels. When footwear has been considered, it is often as an explanation for adverse events associated with intervention participation rather than a variable in its own right (Neuhaus, Healy, et al., 2014). Whilst none of the co-creators listed footwear as a facilitator of physical activity on the co-creation CUbe, it did serve as a facilitator in one of group D's photographs. For these co-creators, appropriate footwear was perceived as a positive influence, enabling them to walk outside even during adverse weather conditions. Given that many workplaces have professional dress codes (Cardon & Okoro, 2009), consideration should be made around whether more casual forms of footwear are permissible if physical activity is to be viably promoted.

Technology was primarily cited as a barrier of physical activity by the co-creators, with a common feature being the use of technology for communication purposes. Electronic communication tools identified within the current study included; Zoom, Skype, telephones, walkie-talkies and emails. Emails in particular were frequently associated with being sat down and being kept at a desk by the co-creators. Despite this, the sending of health promotion emails has been a common technique used within many workplace physical activity interventions (Andersen et al., 2013; Fry & Neff, 2009) . However, email usage itself has rarely been explored as the target for interventions in this context. This is important as digital tools, such as email and Zoom, are crucial for many modern businesses. However, predicting and addressing issues associated with their use will remain challenging if employee interactions with them are poorly understood (Whitty & Carr, 2006). Future research may therefore benefit from exploring alternative, more physically active, strategies towards digital communication administration in workplace settings. For example, encouraging employees to physically meet colleagues rather than send emails appears to be a viable strategy to promote more active behaviours (Bennie et al., 2011). Such a strategy would also align with the concept of microbreaks discussed under the theme *Break Times*.

Whilst technology was predominantly associated with being a barrier of physical activity the co-creators also identified that certain pieces of technology may also act as a facilitator. More specifically, wearable technology. Across CUbes, FitBits were referred to and images of smartwatch health data formed the foundation of both group B and E’s facilitator photographs. Combined, this suggests that having easily accessible visualisations of health data may be a key component of such devices. That is, it may be the data more so than the device which is contributing to its status as a facilitator. Such conclusions are supported by wider research which has shown that wrist worn devices providing feedback result in higher levels physical activity and less sedentary behaviour than wrist worn devices that do not (Jauho et al., 2015). It is also important to note that whilst popular, there have been inconclusive results associated with Fitbit use and health outcomes in workplace settings. Some studies have shown no significant effect on employee daily step counts (Finkelstein et al., 2016) whilst others have demonstrated increases in physical activity but no significant effect on daily sitting time (Vandelanotte et al., 2018). One suggestion put forward to explain this is that participants who engage with FitBit studies may be those who are already physically active at baseline; leading authors to suggest that alternative strategies may be required to encourage participation from more diverse samples (Guitar et al., 2018). Given the salience of data visualisation within the current study, promoting the feedback capabilities of such devices may be one way in which this could be achieved.

Under the theme *Customer Service*, the interactions between the co-creators and customers were considered. Customer interactions were generally viewed as facilitators of physical activity due to the requirements of checking stock or showing customers around the worksite. This may be once explanation as to why service-based occupations tend to report higher levels of physical activity when compared against other occupational types(Takao et al., 2003). The co-creators also identified that when they were hosting customers, they felt the need to be animated and engaging. This suggests that the presence of customers may trigger a professional identity which inherently more physically active than when customers are not present. Indeed, recent evidence suggests that personality, body language and social competence are key elements of the professional identity within customer service roles (Echeverri & Åkesson, 2018). Increasing opportunities for face-to-face customer contact may therefore be one approach which could help facilitate physical activity within workplace settings. However, it is important that such interventions are carefully managed as the co-creators also identified instances where customer service acted as a barrier, such as when the interactions took place a desk or via telephone. This lends further strength to developing interventions which reduce technology assisted communication and restructuring meetings, in this instance with customers, to make then less sedentary.

Alongside interactions with customers, the co-creators also identified the role of social support and social interactions with colleagues as both a barrier and facilitator of workplace physical activity. Social interactions and support have previously been identified as positive reinforcers of employee physical activity(Jirathananuwat & Pongpirul, 2017) and are increasingly popular strategies utilised within the development of physical activity interventions (Ginis et al., 2013). However, the dual nature of social interactions as both a potential facilitator and barrier of physical activity within the current study suggests that its application needs to be carefully considered. As a facilitator, the co-creators identified examples such as colleagues encouraging stair use, socialising with colleagues and working as a team to help support the completion of physically active work tasks. Given that the co-creators identified social interactions and support as a facilitator of physical activity, social network mapping could be a viable strategy to identify key employees within an organisation's social structure who offer differing forms of social support; these individuals can then be targeted for training to develop them in the role of physical activity champions (Edmunds et al., 2020). However, it is important to note that the co-creators also identified instances where social interactions were viewed as a barrier of physical activity. These were predominantly associated with socialising whilst sat down at a colleague's desk. Therefore, the context in which social interactions take place needs to be considered as the presence of sedentary environments can encourage physically inactive interactions.

Workload was predominantly viewed as a barrier of physical activity across all the co-creation groups. High volumes of work, tight deadlines, and the requirement to stay late to complete tasks were all cited by the co-creators; with the completion of work tasks given priority over health protecting behaviours such as physical activity. High workloads have been identified as a significant barrier to engagement within physical activity, often reducing the perceived time available to engage with interventions(Edmunds et al., 2013; Phipps et al., 2010). Indeed, employees who report high workloads have been found to be three times less likely to engage with physical activity breaks embedded within the workday than those who report manageable workloads (Bale et al., 2015). This leads to somewhat of a counter-intuitive finding; employees who are physically active can potentially increase their productivity (Grimani et al., 2019; Lin et al., 2017) but employees may be less inclined to participate in physical activity because of perceptions that their workload will suffer. Consequently, workplace interventions are unlikely to be effective if employees perceive themselves as having a high workload. Compounding this issue, the co-creators also expressed concerns that engaging with physical activity may be perceived by colleagues that they were not working hard enough. Therefore, even if an employee's workload is manageable, the individual may still not engage which a physical activity intervention due to concerns about their professional reputation. Therefore, interventions around organisational culture and physical activity may be required to ensure that employees are both given manageable workloads and that engaging with physical activity is seen as a form of productivity enhancing behaviour.

Finally, the co-creators also considered a series of intrapersonal factors. As facilitators, motivation and being in generally good health were associated with engagement in physically active behaviours a finding consistent with wider literature that has frequently concluded that workplace physical activity interventions tend to attract employees who are already active and healthy (Bardus et al., 2014; Leslie et al., 2005). Indeed, the over-representation of healthy, active employees has been a significant critique directed towards intervention research in this area (Marshall, 2004). Therefore, through the consideration of the barriers identified by the co-creators, it may be possible to elucidate which aspects of reduced health and well-being discourage employees from engaging with physical activity. Within the co-creation CUbe data, of the eight barriers identified within the *intrapersonal factors* theme, seven were psychological in nature with only one representing physical ill health. This suggests that physical well-being may play a less salient role than psychological well-being for the co-creators. This viewpoint was further supported by the co-creators in group D who stated that physical pain was used as a prompt to move rather than a reason for not moving, suggesting that reduced physical well-being can potentially motivate physical activity behaviours rather than diminish them. Conversely, influences on psychological well-being, such as work stress, were identified by the co-creators as barriers of physical activity; a finding consistent with the bidirectional relationship between stress and physical activity identified within the literature (Schultchen et al., 2019). Stress may therefore play a significant role in the patterns of intervention engagement seen within physically active and inactive individuals.

Outside of stress, the co-creators also identified laziness as a common barrier to physical activity, a finding consistent with wider research (Jewson et al., 2008; Loch & Guerra, 2018; Rao et al., 2012). Whilst seemingly a common barrier it is important to also consider the domain in which physical activity is being performed. Within the current study, the co-creators articulated that high workloads were salient barriers of physical activity and reported working late in order to complete them. Such behaviours are not typically associated with laziness. Instead, employees may be expending their effort and energy in prioritising the completion of work tasks over engaging with physical activity which could result in an exhaustion of both physical and psychological resources once work tasks have been completed. As such, what the co-creators ascribe as laziness may be more akin to tiredness or exhaustion when taken in context of the wider barriers identified. Indeed, an inverse relationship between work-related fatigue and leisure time physical activity identified within the literature (Bláfoss et al., 2019); suggesting that the completion of work tasks can indeed influence physical activity levels. However, such conclusions are tentative at this stage and further research is required to explore the nuances of laziness in relation to workplace physical activity.

4.4.1 Strengths and Limitations

Existing workplace physical activity intervention research has been critiqued for the under-representation of employee perspectives (Spence, 2015). The current study helped to address this critique through the adoption of co-creation methods and the inclusion of stakeholders from diverse organisations. This led to the voices of 14 co-creators from 5 different industries being heard. Historically, workplace physical activity research has predominantly explored the experiences of office workers. Whilst office-based workers do have an increased risk of physical inactivity in comparison to other occupations (Lindberg et al., 2018), this is not exclusively so. Non-office workers have also been identified as being at risk for sub-optimal patterns of physical activity and sedentary behaviour (Gilson et al., 2019). The present study included five co-creators from non-traditional office environments including escape rooms, supermarkets and retail work. As such, the study was included a breadth of knowledge, perceptions and experiences from employees who are somewhat under-represented within the literature. The co-creators also represented a mix of genders, seniority and physical activity levels. Bringing together co-creators from diverse backgrounds can help to reveal both explicit and implicit needs through the articulation of diversified ideas (Dann, 2018). Given the mixed evidence surrounding the efficacy of workplace physical activity interventions, the barriers and facilitators identified by the diverse co-creators within the current study may help to provide additional context and understanding as to why certain interventions fail where others succeed.

The current study also demonstrated the viability of creative, arts-based methods in understanding employee physical activity. The use of co-creation CUbes and photovoice was well-received by the co-creators and was reflected by the total of 129 co-creation CUbe statements and 20 photographs produced. The arts-based methods were also highlighted as a positive physical activity experience on the CUbes of two of the co-creation groups, further suggesting that the approaches were viewed favourably. Whilst increasingly common in domains ranging from secondary schools (Corr & Murtagh, 2020) to care homes (Giné-Garriga et al., 2019), a dearth of literature has explored the application of arts-based techniques to the issue of workplace physical activity specifically. Instead, barriers and facilitators of physical activity within this domain have often been explored through more traditional methodologies such as questionnaires (Hunter et al., 2018) or interviews (Bailey et al., 2018). Whilst such methods certainly have their place, arts-based health research has the potential to engage stakeholders, enrich the communication of ideas and provide insights beyond the scope of more traditional research methodologies (Boydell et al., 2012). Furthermore, knowledge conceptualised through creative arts-based methods has been deemed to be more accessible to a wider variety of stakeholders than traditional approaches (Colantonio et al., 2008). Considering the increased demand for more democratic, participatory research within health domains, methods which produce engaging and accessible outputs are in a strong position to bridge the gap between researchers and stakeholders.

A critique which could be directed towards the current study is that the co-creation CUbe methodology used within the workshops generated bullet point data and therefore may have given a superficial overview of the barriers and facilitators identified. Whilst the co-creation CUbe data was supplemented with additional contextual information using photovoice methods, it must be acknowledged that more traditional forms of qualitative data collection, such as interviews, may have provided richer data. However, interviews generate large volumes of information in the form of interview transcripts (Brinkmann & Kvale, 2018). Whilst useful to researchers, such forms of dense information may be less conducive to accessible information sharing between stakeholders. Through their brevity co-creation CUbe provide clear, concise and accessible ideas that can be more readily shared between co-creators. As co-creators were to be given the opportunity to review materials at the end of the full co-creation process, this was a factor that needed to be taken into consideration. Furthermore, one could argue that interviews are generally a physically inactive form of data collection. Indeed, the co-creators themselves identified interviews as a barrier to physical activity, albeit in a business context. Given that the impetus for the overarching research study was the relative health risks of physical inactivity and sedentary behaviour, asking co-creators to engage with sedentary forms of data collection, such as interviews, would have been paradoxical from a philosophic stance. The use of physically active data collection methods, such as co-creation CUbes and photovoice, was therefore a strength of the study which aligned not only with the democratic philosophy of co-creation but also with the wider principles of promoting physical activity.

Finally, the study utilised a relatively small sample size. Low sample sizes are often a critique of co-creation research and viewed as a potential risk of bias (Smith et al., 2018). Participatory approaches often require a substantial level of co-ordination between members of different communities which can restrict sample sizes (Nykiforuk et al., 2011). Whilst the current study did contain relatively small co-creation groups, the sample itself possessed demographic variety including a mixture of genders, ages, industries, managerial responsibilities and physical activity levels. Low sample sizes have also been identified as a potential limitation in establishing the generalisability of the findings from co-creation research (Leask et al., 2017). Whilst certainly a valid critique when viewed through a positivist lens, the aim of many qualitative research studies is more interpretative (Carminati, 2018). That is, the aim of such research is often to gain an in-depth understanding of the narratives, experiences, meanings and social context of the participants rather than to generalise to the wider population (Groleau et al., 2009). Given the dearth of bottom-up research and participatory approaches in exploring workplace physical activity, the findings of the current study offer a unique perspective into the experiences of employees which may not have been fully captured through more traditional nomothetic approaches.

4.4.2 Conclusion

The current study has provided insight into factors which were perceived to be barriers and facilitators of physical activity from the perspective of employees across different organisations and industries. The identification of organisationally endorsed campaigns as facilitators of physical activity implied that employees are receptive to interventions delivered within the workplace; further strengthening the position that this is a viable domain to target. Furthermore, the barriers and facilitators identified across the workshops spanned multiple levels including intrapersonal characteristics, such as laziness, organisational characteristics, such as physical activity campaigns, and outdoor spaces external to the organisation. This therefore suggests that multi-level ecological approaches may hold promise in efforts to promote a complex behaviour such as physical activity; a finding which echoes the sentiments of wider research in this area (Watanabe & Kawakami, 2018). Finally, the co-creation approach utilised in the current study represented an important first step in democratising research exploring physical activity in workplace settings. To build upon this foundation, co-creators should be given the opportunity to develop interventions which tackle the barriers and facilitators that have been identified.

Chapter 5: *Co-designing the Solution: Intervention Design*

5.1 Introduction

Building upon the findings of chapter four, this chapter outlines the second series of co-creation workshops. The workshops transitioned the focus from co-defining the main barriers and facilitators of workplace physical activity towards co-designing potential solutions to address them. A direct connection between these two phases is important as co-creation projects should have a clear focus about what the desired targets for behaviour change are prior to intervention design (Bowie et al., 2020). To achieve this, the main problems and opportunities faced by stakeholders must first be identified, articulated and scoped (Maccani et al., 2014). This information can then serve as a foundation to inform the development of focused and targeted co-created interventions.

As noted in chapter 1, workplace physical activity intervention development has historically underutilised participatory methods (Parry et al., 2013). As such, employee's thoughts, perceptions and needs around what makes an effective workplace physical activity intervention may have been under-represented. Indeed, it has been argued that more research is required to understand the characteristics of workplace physical activity interventions that are associated with acceptance and adherence(Mulchandani et al., 2019). By virtue of actively involving stakeholders in the intervention design process, co-creational approaches are well placed to address this. As noted in chapter 2, a key approach to systematically identifying the 'active ingredients' of interventions is through the use of BCT coding. Whilst more research is required to understand the 'active ingredients' of existing interventions, the dearth of co-created workplace physical activity interventions means that even less is known about the BCTs desired by employees themselves. This therefore represented an important gap in the literature that the current study sought to fill.

Alongside the identification of 'active ingredients' within co-created interventions, appropriate implementation and evaluation strategies must also be identified; as the impact of interventions is not only determined by the intervention itself but also upon how many people within the target population it can reach and the extent to which it is implemented properly (Fernandez et al., 2019). Whilst the workplace has been identified as a viable domain for promoting physical activity, interventions have been critiqued for being poorly implemented, limiting their potential impact on employee health (Wolfenden et al., 2018). A greater understanding of viable implementation strategies developed by employees themselves may help to overcome this critique. Currently, workplace physical activity interventions are also evaluated against a myriad of outcome criteria including; primary outcomes, such as activity levels and fitness, secondary outcomes, such as motivation and self-efficacy, and through the use of objective and subjective measurement methods (Johnson et al., 2018). However, employees have rarely been actively involved in the selection of intervention efficacy criteria. As such, it may be the case that employees judge intervention success by standards different to those of researchers. Co-creation methods may therefore also play an important role in determining which outcome criteria are associated with success from the perspective of employees.

It is becoming increasingly acknowledged that workplace well-being interventions must take into consideration employee's thoughts, perceptions and needs alongside the wider organisational culture in which they are located (Lachman et al., 2018; Terry et al., 2013; Zula, 2014). By actively engaging stakeholders across both the problem defining and intervention designing phases, the current research project was well-placed to address the aforementioned limitations. As noted within chapter one, the aims of this research phase were to empower employees to produce a series of co-created interventions, to systematically identify the 'active ingredients' of the co-created interventions through BCT coding, to identify intervention implementation strategies embedded within the co-created interventions and to identify intervention evaluation strategies most salient to employees.

5.2 Method

5.2.1 Design

A series of co-creation workshops were run focussing upon co-designing and co-refining new interventions to promote physical activity and reduce sedentary behaviour within the workplace. Each workshop was facilitated by the lead researcher to ensure consistency and efficiency between each of the workshop sessions. The co-creation workshops were run between October and December 2019 lasting approximately 1 hour. Ethical approval was obtained through Coventry University. The workshops were structured around three main activities; a pre-activity, main activity and post-activity. During the pre-activity the co-creators were asked to review the barrier and facilitator artefacts produced from the first series of co-creation workshops (chapter four). As noted within the introduction, co-creation projects should have a clear focus about what the desired targets for behaviour change are (Bowie et al., 2020). The review of co-created barriers and facilitators therefore served as a creative stimulus for focussing the intervention design process. Within the main activity of the workshop the co-creators were asked to design a new workplace physical activity intervention and produce a poster visualising how the intervention worked. Posters have been cited as a viable approach within co-design intervention research enabling participants to structure and convey ideas in a more interactive manner (Jessen et al., 2018). The post-activity comprised of group discussion where the co-creators explained how the designed interventions worked in further detail. The group discussions were audio recorded and subsequently transcribed verbatim. The production of an artefact followed by a discussion is a common feature of participant design research projects (Visser et al., 2005).

5.2.2 Participants

5.2.2.1 Recruitment strategy

During the barriers and facilitators workshop (chapter 4), the co-creators were invited to participate in the next series of workshops which would focus upon intervention design. The co-creators were also informed that they were able to invite colleagues to join the workshops who they felt would be interested in participating. Therefore, additional co-creators would be recruited through snowball sampling. Inclusion criteria for participation was kept intentionally broad with the only requirement being that the co-creators should be in some form of employment whether paid or non-paid. This was to capture the voices and experiences of a diverse range of individuals from a variety of industries and levels of seniority. 13 co-creators, comprising of four groups, were recruited into the co-creation workshops. One workshop was held with each group, meaning a total of four workshops were held during this research phase.

5.2.3 Materials

5.2.3.1 Pre-Activity – Workshop One Material Review

The co-creators were presented with all of the co-creation CUbe and photovoice artefacts produced in workshop one (see appendices 4 and 5).

5.2.3.2 Main Activity- Intervention Design and Poster Creation

The main activity materials comprised of an A1 sheet of blank white poster paper, which served as the canvas for the co-creator's poster. To help enhance imagery, magazines related to health, fitness and lifestyle as well as newspapers were provided to participants. To construct and affix ideas onto the poster, participants were given glue sticks, scissors, post-it notes, coloured permanent markers (green, blue, red and black), pencils and rulers. The use of poster paper, stationary and pictures cut out from magazines have previously been used in co-creation poster production research (Salmi et al., 2011).

5.2.3.3 Post-Activity- Group Discussion

The co-creator's explanations of the co-designed interventions were audio-recorded on an Olympus V415121SE000 digital voice recorder. A list of broad discussion points was produced to help the co-creators explore different aspects of their intervention including; what the intervention was, how it would motivate behaviour change, who would be instrumental in delivering the intervention, what resources would be required to deliver it and how best to evaluate whether it had had an effect on employee physical activity or sedentary behaviour (see appendix 7).

5.2.4 Procedure

5.2.4.1 Pre-activity: Workshop One Material Review

Co-creators were initially provided with a participant information sheet outlining the nature of the study and given the opportunity to ask questions before deciding to participate. The co-creators were then invited to sign an informed consent sheet before being introduced to the first activity of the workshop. During the pre-activity, each co-creation group was gathered around a central desk which had the co-creation CUbes and photovoice artefacts produced by all of the groups within the barriers and facilitators workshop. Co-creators were asked to work as a group orientating themselves with the barriers and facilitators and to identify those which were most relevant to their occupational roles. The co-creators were informed that the barriers and facilitators identified during this stage would become the targets of the intervention that would be designed within the main activity. The co-creators were given fifteen minutes to work as a group and complete the initial familiarisation and salient problem identification process.

5.2.4.2 Main Activity: Intervention Design and Poster Creation

Once the co-creators had identified what the targets of the group's interventions would be the researcher introduced the intervention design and poster creation activity. The co-creation groups were informed that they had 30 minutes to discuss potential intervention ideas between themselves and to agree upon an intervention, or a series of interventions, which could help to overcome or enhance the barriers and facilitators that the group had identified during the pre-activity. The co-creators were invited to produce a poster which conveyed the essence of their intervention taking into consideration who would be involved, how the intervention would work and how its effectiveness should be evaluated. The co-creators were informed that the posters could be constructed on the A1 sheet of paper in any way they wished, whether they wanted to draw, write or cut and paste images from a selection of magazines and newspapers that had been provided. The co-creators were free to plan the use of the available time and allocate tasks between themselves. The researcher provided announcements when there were 15, 10 and 5 minutes remaining in the poster creation activity.

5.2.4.3 Post-Activity- Group Discussion

After the 30 minutes had elapsed, the co-creation groups were invited to gather around a central desk with the produced poster placed at the centre. The researcher also placed the list of broad discussion points onto the table; helping the co-creators to explore different aspects of their intervention during the conversation. The group was invited by the researcher to describe the intervention that had been developed and the conversation was audio recorded. Upon completion of the workshop activities the co-creators were thanked for their participation and debriefed about the nature of the research.

5.2.5 Data Analysis Procedure

The audio-recordings of the group discussions were transcribed verbatim into Microsoft Word; forming the primary data set of the study. In line with the pluralistic philosophy outlined within chapter 3, the transcriptions were analysed using two distinct approaches. Firstly, the BCTTv1 was used to facilitate the identification of BCTs present within the co-created interventions (for an overview of the BCTTv1 see chapter 2). Each of the transcripts were read and re-read by the researcher to promote familiarity with the data. Each transcript was then read in full and the comments function used to highlight specific BCTs that had been identified, using the BCTTv1 as a coding manual. A BCT was only coded where there was clear evidence for inclusion and a supporting quotation could be provided. The BCTs and supporting quotations were then collated into a table (see appendix 8).

Secondly, qualitative content analysis of the transcripts was conducted to identify commonalities within the intervention implementation and evaluation strategies developed by the co-creators. The aim of qualitative content analysis is “to systematically transform a large amount of text into a highly organised and concise summary of key results” (Erlingsson & Brysiewicz, 2017). Data is systematically coded and analysed through the identification of common themes or patterns (Cho & Lee, 2014). Bengtsson (2016) outlined four steps within qualitative content analysis; decontextualization, recontextualization, categorisation and compilation. During the decontextualization stage, the researcher reads and re-reads the transcribed text to familiarise themselves with the data. The data set is then broken down into smaller meaning units which represent the smallest unit of information relevant to the research question. Each meaning unit is then allocated a code, which represents the overarching context of the meaning unit. During the recontextualization stage the original text is re-read alongside the coded meaning units to check that all aspects of the content have been covered in relation to the study aim. During categorisation, commonalities between the meaning units are explored and grouped into related themes. Finally, in the compilation stage, the researcher beings the writing up process and carefully selects quotations from the text to elucidate the themes being presented.

5.3 Results

Four co-creation groups completed the intervention design workshops. 10 out of the 13 (77% retention rate) co-creators had previously been involved with workshop one which explored barriers and facilitators of workplace physical activity (chapter 4). The additional three co-creators were recommended into the study by existing co-creators and came from IT (n=1) and Higher Education (n=2) related organisations. Co-creators (n=13) comprised of 4 males and 9 females with ages ranging from 27 to 58 years (M=35.92, SD=11.25). The co-creators were employed in a variety of sectors including; higher education (n=5), retail (n=4), entertainment (n=2), accountancy (n=1) and IT (n=1). Four of the co-creators reported having line management responsibilities with the number of direct reports ranging from 1 to 16 (M=7.25, SD=6.75). Self-reported sitting time ranged from 5% to 95% of the workday with high levels of occupational sitting being reported across co-creation groups (M=74.23%, SD=26.76). Participant demographic information can be found in table 15.

Table 15: Participant Demographic Information; Workshop 2

Participant	Age	Gender	Organisational sector	Job title	Line manager Responsibility (number of reportees)	Self-reported percentage of time spent sitting during an average workday
A1	31	Female	Entertainment	Escape Room Games Master	No	90%
A2	30	Male	Entertainment	Escape Room Games Master	No	95%
B1	56	Female	Retail	Personal Assistant	No	50%
B2	49	Female	Accountancy	Team Leader	Yes (9)	85%

Participant	**Age**	**Gender**	**Organisational sector**	**Job title**	**Line manager Responsibility (number of reportees)**	**Self-reported percentage of time spent sitting during an average workday**
B3	27	Male	IT	Administrator	No	60%
C1	58	Female	Higher Education	Lecturer	No	95%
C2	27	Female	Higher Education	Lecturer	No	90%
C3	27	Female	Higher Education	Lecturer	No	95%
C4	27	Female	Higher Education	Assistant Lecturer	No	50%
C5	36	Female	Higher Education	Lecturer	No	90%
D1	30	Male	Retail	Senior Watch Specialist	Yes (3)	70%
D2	39	Male	Retail	Assistant Manager	Yes (16)	5%
D3	30	Female	Retail	Fashion Buyer	Yes (1)	90%

Each of the four co-creation groups produced a poster that visualised the nature of their interventions (see appendix 9). For the participants there did not appear to be a singular solution to the problem of workplace physical inactivity. As such, all of the co-created interventions were multi-componential. Indeed, the multi-componential nature of workplace physical activity interventions was highlighted directly by the co-creators:

"*It's not just one thing. It's a cascade of many things, so giving people the opportunity to do those things like bike rides, exercising in their break times, eating healthy foods. So it's a cascade of many things."* D2

"*It is not all pumping iron but it's lots of tiny little interventions that could actually just get the pulse moving*" C1

The co-created interventions also spanned socioecological levels with intervention strategies such as; the addition of active seating (individual level), group walks (social), the addition of an extra physical activity break (organisational) and the creation of dedicated physical activity spaces (environmental). A brief overview of each of the co-created interventions can be found in table 16.

Table 16: Brief Descriptions of the Co-Created Interventions

<table>
<tr><th>Group</th><th>Brief Intervention Description</th></tr>
<tr><td>A</td><td>Multi-componential intervention comprising of:

Employers encouraging group activities
Giving employees the same break times
Developing partnerships with external organisations to offer discounts and rewards to employees
Developing partnerships with external organisations who can provide resources that the employer cannot
Using classical conditioning to pair endorphins generated through exercise with being happy at work
Group activities including attending a local gym or walking outside
Physically active social interactions at pubs or coffee houses
Encouraging employees to communicate their own ideas about new interventions
Communicating how physical activity can be fun and reduce stress
</td></tr>
<tr><td>B</td><td>Multi-componential intervention comprising of:

Adding unstable seating to the work environment
Adding exercise equipment to the work environment
Offering exercise classes including; yoga and Boxfit
Bringing dogs to the workplace to take for walks
Hosting meetings at external locations such as pubs
Group activities including; bike riding, five-a-side football, volleyball and swimming
Adding an extra break to the work day at 3pm
Encouraging employees to communicate their own ideas about new interventions
Making formal commitment to attend exercise classes
Sending reminders about available exercise classes
Offering incentives such as free food or drink to encourage participation
Monitoring exercise class up-take and exercise equipment usage
</td></tr>
<tr><td>C</td><td>Multi-componential intervention comprising of:

Office Burn

Providing physical activity equipment such as; exercise machines, standing desks, exercise bikes, step machines, rubber stretch bands, Swedish balls

Workplace Zen

A quite space for meditation, destressing and focusing upon mental health
A space for Yoga

Outdoor Pursuits</td></tr>
</table>

	• Encouraging employees to use outside spaces by cycling, walking, swimming together Additional intervention components included: • Encouraging employees to communicate their own ideas about new interventions • Passively tracking intervention engagement by monitoring equipment use and use of physical activity spaces • Buddy systems • Encouraging employees with physically active hobbies to teach others • Employer subsidising interventions • Leaders role modelling behaviour • Tracking health outcomes • Tracking mental well-being
D	Multi-componential intervention comprising of: • Making tables in the workplace higher to promote standing • Turning elevators off to promote stair use • Encouraging employees to exercise during break times • Monitoring employee's mental health • Managers leading by example • Making a culture where not exercising is perceived as unusual • An employee health champion • Adding exercise equipment into the workplace including bikes & running machines • Employers providing uniforms and equipment to reduce cost to employee • Hiring more staff to cover workload • Communication of health benefits of being physically active • Monitoring weight, BMI, steps taken and employee mood • Linking exercise to charity • Promoting both physical activity and healthy eating

5.3.1 Behaviour Change Technique Coding of Co-Created Interventions

To address the second aim of the study, understanding the 'active ingredients' of co-created interventions, each intervention was coded for the presence of BCTs from the BCTTv.1. 21 out of a possible 93 BCTS (22.5%) were identified across the interventions developed by the four co-creation groups (see table 17). At least one BCT was identified from within 12 out of the 16 possible categories present within the BCTTv.1. No BCTs were identified from the categories; *comparison of outcome, regulation, scheduled consequences* or *self-belief.*

The most commonly utilised BCTs were *5.4 Monitoring emotional consequences, 12.2 Restructuring the social environment* and *12.5 Adding objects to the physical environment*, which were present in the interventions of all four groups. Within the co-created interventions *5.4 Monitoring emotional consequences* most often referred to the measurement of mental well-being or encouragement of employees to reflect on how physical activity would reduce stress levels. The BCT *12.2 Restructuring the social environment* often related to organisations changing, or adding, break times so that employees would be free at the same time which in turn would facilitate group physical activities. The addition of an online platform for employees to share ideas about potential physical activity interventions was also outlined by group C, indicating that both physical and digital social structures were considered by the co-creators. All of the co-creation groups' interventions involved the addition of physical activity related equipment into the workplace suggesting that *12.5 Adding objects to the physical environment* represented a core foundation of the interventions. The identified equipment included; unstable seating, exercise bikes, yoga mats, running machines and stretch bands. The addition of lockers and changing facilities was also suggested by the co-creators in group A.

The second most commonly utilised BCTs were *1.2 Problem solving*, *3.2 Social support (practical)*, *4.1 Instruction on how to perform the behaviour*, *6.1 Demonstration of the behaviour*, *8.1 Behaviour practice/rehearsal, 10.1 Material incentive (behaviour)* and *12.1 Restructuring the physical environment*, which were present in at least three of the co-created interventions. Within the co-created interventions, *1.2 Problem solving* centred around employees being encouraged to develop their own ideas about how physical activity levels could be increased within the constraints of their occupational roles *3.2 Social support (practical)* comprised of buddy systems or employee champions who would offer support and encouragement to other employees. Group and team-based physical activities, such as five-a-side football, were also coded under this BCT as performing the target behaviour was dependent upon the presence of other employees. *4.1 Instruction on how to perform the behaviour* was present within group A, B and C's interventions which involved structured exercise classes, such as yoga, or employees themselves training others in a physical activity related hobby. In line with the BCTTv.1 recommendation, classes were also coded as *6.1 Demonstration of the behaviour* and *8.1 Behaviour practice/rehearsal. 10.1 Material incentive (behaviour)* was associated with employers subsidising the costs of engaging in physical activity such as contributing to costs of clothing and equipment. Group A also considered building relationships with external organisations who could offer rewards or discounts for walking to them. Finally, *12.1 Restructuring the physical environment* typically involved creating physical activity spaces where interventions could be comfortably performed. The co-creator's within group A suggested the creation of gender specific spaces to support males and females who feel self-conscious about exercising in front of the opposite sex. Group B suggested that a quiet, meditative space should be created to support yoga and mindfulness-based interventions. Group D suggested that work tables should be increased in height to facilitate standing and elevators should be turned off to promote stair usage.

BCTs present within half of the co-created interventions were; *3.1 Social support (unspecified)*, *6.2 Social comparison*, *7.1 Prompts/cues*, *7.8 Associative learning* and *10.2 Material reward (behaviour).* Interventions that included socially orientated physical activity in non-specified context were coded as *3.1 Social support (unspecified). 6.2 Social comparison* involved interventions where aggregated statistics about the performance of other employees would be shared across the organisation and where seeing others engage with the interventions was described as motivating factor. *7.1 Prompts/cues* comprised of active prompts, such as sending notifications to employees about upcoming exercise classes, and passive cues such as encouraging employees to bring a change of clothing to work. The interventions of groups A and C drew upon classical conditioning to pair certain work tasks or interactions with colleagues with endorphins generated via exercise. This was therefore coded as *7.8 Associative learning*. *10.2 Material reward (behaviour)* involved the receipt of a badge or a discount after physical activity was performed.

The co-created interventions were more diverse in relation to feedback and monitoring. Four BCTs from this category were identified; *2.1 Monitoring of behaviour by others without feedback*, *2.3 Self-monitoring of behaviour*, *2.4 Self-monitoring of outcome(s) of behaviour* and *2.7 Feedback on outcome(s) of behaviour*. Each BCT was present in two out of the four co-creation group's interventions. *2.1 Monitoring of behaviour by others without feedback* incorporated passive approaches to monitoring intervention engagement such as tracking the number of people accessing physical activity rooms or attending exercise classes. *2.3 Self-monitoring of behaviour* within the interventions referred to employees tracking daily step counts or the amount of minutes of active work performed. Within the co-created interventions, *2.4 Self-monitoring of outcome(s) of behaviour* referred to the tracking of physiological outcomes including blood pressure, weight and BMI. The BCT *2.7 Feedback on outcome(s) of behaviour* also referred to the tracking of the same physiological outcomes however, employees could share these with their organisation to gain feedback on changes over time.

Table 17: BCTs Present Within the Co-created Interventions

BCT	Group A	Group B	Group C	Group D
1.2 Problem solving	✓	✓	✓	
1.9 Commitment		✓		
2.1 Monitoring of behaviour by others without feedback		✓	✓	
2.3 Self-monitoring of behaviour	✓			✓
2.4 Self-monitoring of outcome(s) of behaviour			✓	✓
2.7 Feedback on outcome(s) of behaviour			✓	✓
3.1 Social support (unspecified)	✓	✓		
3.2 Social support (practical)		✓	✓	✓
4.1 Instruction on how to perform the behaviour	✓	✓	✓	
5.4 Monitoring emotional consequences	✓	✓	✓	✓
6.1 Demonstration of the behaviour	✓	✓	✓	
6.2 Social comparison			✓	✓
6.3 Information about other's approval			✓	
7.1 Prompts/cues	✓	✓		
7.8 Associative learning	✓		✓	
8.1 Behaviour practice/rehearsal	✓	✓	✓	
10.1 Material incentive (behaviour)	✓		✓	✓
10.2 Material reward (behaviour)	✓			✓
12.1 Restructuring the physical environment	✓		✓	✓
12.2 Restructuring the social environment	✓	✓	✓	✓
12.5 Adding objects to the physical environment	✓	✓	✓	✓
13.1 Identification of self as role model			✓	
16.3 Vicarious consequences				✓

5.3.2 Qualitative Content Analysis: Implementation Strategies

Through qualitative content analysis the third aim of the study, to identify intervention implementation strategies, was assessed. Three mutually exclusive categories were identified; '*Guide, Don't Tell', 'Employers Cannot Do Everything', and 'Break Times: The Golden Hour'*.

5.3.2.1 Guide, Don't Tell

Across co-creation groups, a key concern relating to the implementation of the interventions was that they should not be forced upon employees. The co-creators predicted that should organisations remove freedom and choice in performing physical activity then there would likely be resistance. For example:

> *"If someone turned the lift off and someone said 'c'mon get up now' I'd be like no*." D3

Indeed, there was a general scepticism directed towards workplace physical activity interventions that had no involvement from employees:

> "*There's probably natural resistance as soon as you see that it is the organisation that's setting it up"* C1

Therefore, it was deemed important for employees to be actively involved in both the design and implementation of workplace physical activity interventions from the outset. One explanation for the need to actively involve employees was that the priorities of employers may be very different from those of employees:

> *"…people have very different ideas and if an organisation comes up with something then the employees might be completely against it and then it's not going to do anything.*" C2

Therefore, whilst organisations may have positive intentions when implementing workplace physical activity initiatives; if employee's thoughts and perceptions are by-passed the intervention may, at best, be ineffective or, at worst, damage the relationship between employee and employer. Concerns were also expressed about employer led interventions being overly rigid:

"*if you make it rigid and regimented then people who are very, they actively don't want to be active, then they're not going to have fun there*" A1

The co-created interventions were believed to be more effective when they allowed for spontaneity and that organisations should avoid stifling this through unnecessary '*regulation rubbish'* (A1). It was felt that employees who had good ideas may be discouraged from implementing them by having to go via management to get permission to run them; which could potentially hamper innovation and the further evolution of the interventions over time.

To overcome the resistance towards employer led interventions, open and honest communication was seen as a vital implementation strategy. As with the interventions themselves, a dictatorial approach to communicating why employees should engage with the interventions was anticipated to lead to resistance:

"*someone can't just tell you to do something. You have to be told in a way that's practical for you."* D3

Instead, a less direct storytelling approach was identified as being more persuasive:

"*I think it's about focus as well, so rather than say dictating to someone, you tell them the reasons why. You give them the narrative of what they're doing. So, you tell someone the reasons why you are doing this and what it benefits them for because you're not trying to make someone's working experience uncomfortable. You're trying to get the best out of them, get them moving. Basically, promoting a better lifestyle*." D2

Given the power dynamics within employment relationships, employers may be accustomed to giving instructions on work tasks, priorities and deadlines; controlling the scope and remit of employee activities. Whilst appropriate for the completion of work tasks, the same strategy is likely to be ineffective in supporting employee health. As such, when implementing workplace physical activity interventions employers may need to adopt the role of guide rather than enforcer and accept a more symbiotic relationship, that is *"It goes both ways"* (D1). One way in which employers could adopt the role of guide is to lead by example:

> "*…senior managers they have to lead by example*" D3
>
> "*Getting some physical leaders in the organisation on board to be doing the exercise at their desk or using the facilities that encourages others*" C5
>
> "*If leaders are setting the tone and show that it's valid then that will help with the perception*" D2

Leading by example may therefore help to address resistance by showing that, whilst interventions are not mandatory, they are endorsed by employer and can be successfully integrated into the working day. Leading by example may also help to develop a culture where physical activity becomes "*the norm rather than something odd*"(C1), a factor that the co-creators identified as being important to intervention adoption:

> "*It is the people and the culture so that it's not seen as an oddity…something that's acceptable within the workplace environment that nobody turns a head when you just get on and do it*." C1

5.3.2.2 Employers Cannot Do Everything

Whilst participants expected tangible commitments from employers to support the co-created interventions, there was also acknowledgement that employers may not be able to provide everything. It was recognised that "*individuals would still contribute a little bit*" (C1) and when employers did not have the resources available external partnerships, technology and freely accessible outside spaces could be leveraged to bridge the gap. The recognition that employers have limited resources suggests that there was no expectation that all of the co-created interventions had to be run by the host organisation. Instead, employers needed to reflect upon the interventions that they had the resources and experience to deliver and outsource those that they did not:

> "*We've put outsource relationships… so it's basically that if the employers can't really do anything themselves to encourage it, it's can you reach out to other aspects of the community to bring in that activity?"* A1

Alongside making the practicalities of delivering the interventions more manageable for employers, the outsourcing strategy described by the co-creators was also believed to produce mutually beneficial outcomes for all parties. This could be in terms of a commercial benefit such as:

> "*find businesses within walking distance of their premises and have offers or discounts or partnerships with them" A1*

Suggesting that local businesses may benefit from increased custom and employees benefit from reduced costs. External partnerships could also provide more altruistic benefits such as supporting local charities with employees being *"volunteers, at a trust*" B2. Combined, the co-creator's strategy suggested that developing 'win-win' partnerships with external organisations may be one way in which employers can deliver more variety for employees without accruing prohibitive costs.

Outside of external partnerships, the use of technology was also cited as a way in which employees could help themselves to become more physically active without overburdening employers. In lieu of formal exercise classes, employees could be encouraged to use freely accessible online materials such as YouTube videos:

> *"you could even take your laptop quietly in the corner, put on your headphones and put on a YouTube yoga session*." C1

Alongside cost savings, the use of online exercise videos would also align with a non-dictatorial implementation strategy as employees would be able to choose which types of classes to engage with and when. The co-creators also suggested that interventions could be housed within an "*online platform*" (C2) that could serve as an information hub. An online platform could be used to host "*group forums*" (C2) and "*get the initial ideas of what employees want*" (C2). This would serve as an accessible way for employers reach a greater number of employees and to actively engage employees with the intervention implementation process in a cost-effective manner.

Finally, the co-creators identified that freely accessible outside spaces could be drawn upon to promote physical activity and that the interventions did not necessarily have to take place on-site:

> "*it includes things like outdoor pursuits, so getting people to go outdoors in the environment together" C2*
>
> *"encouraging employees to take up more physical activity outside of the workplace" C5*

As organisations do not have to host or contribute financially to the use of external locations it represented another implementation strategy that could reduce the burden on employers.

5.3.2.3 Break Times: The Golden Hour

Breaks times were identified as a common time point during the workday that could be used to anchor the co-created interventions around:

> "*allow the employees to have the same break time to encourage them to go out and do things together*" A1
>
> "*You can have someone external come in and does the classes during lunchtime*" B3
>
> "*go for a walk at lunchtime*" B2
>
> *"exercising in their break times*" D2

However, for break times to be effective it was felt that employees should be given "*at least an hour break*" (A1), as this would allow employees to have both lunch and engage with physical activity. The block approach to break times was favoured over spreading break times across the day, for instance "*rather than 15 minutes here and 15 minutes there*" (A1). Whilst lunch breaks were identified as a convenient point in the workday to engage with physical activity interventions, there were perceptions that this alone may not be enough. An additional 40-minute physical activity break was also suggested by the co-creators to provide more time to engage with the interventions. Indeed, emphasis was placed upon employers to invest not only money but also time to enable employees to become more physically active:

> "*I think you should be prepared to spend some extra money or to give them some spare time"* D1

As such, one strategy to maximise potential intervention engagement, and to reach a greater number of people, may be to restructure the length and durations of free time available to employees across the working day.

5.3.3 Qualitative Content Analysis: Determining Intervention Effectiveness

Through qualitative content analysis the fourth aim of the study, to identify how intervention effectiveness should be determined, was assessed. Whilst the co-creators acknowledged the importance of tracking and monitoring employee's physical activity, it was felt that this needed to be managed carefully to avoid damaging the relationship between employee and employer:

> "It's just tracking people subtly so that they don't feel suspicious as if they feel the organisation is watching over them which tends to have negative connotations" C1

Indeed, a key concern of the participants was that they didn't want employee physical activity levels to be scrutinised by their employers. The participants also alluded to the idea that they may be inclined to give socially desirable responses if their responses to intervention evaluations were identifiable:

"*A number of surveys over email…but just anonymous so people can be truthful*." D3

Therefore, intervention evaluation strategies need to be carefully considered by organisations. Alongside anonymity the co-creators also identified that making the sharing of physical activity data voluntary and using passive approaches to tracking physical activity may be effective strategies for reducing concerns about health data being monitored by employers. Under the caveat that data was monitored ethically, three key methods for tracking intervention effectiveness were identified; *'Direct Objective Measures', 'Indirect Objective Measures' and 'Indirect Self-Report Measures'.*

5.3.3.1 Direct Objective Measures

It was acknowledged that direct objective measures would be needed in order to make a scientific judgement as to whether the co-created interventions had had a positive impact upon employee physical activity levels:

"So, we're obviously going to need the objective side of things because we're going to need to see if there has been a difference in a sense. Scientifically almost." C2

The association made by the co-creators between objective measures and science suggested that such approaches may be a more formal method of determining intervention efficacy. Both behaviours and outcomes of behaviours were considered for objective measurement. In terms of physical activity behaviours, the co-creators suggested using an Apple watch to track "How many steps they've taken" D2. For the outcomes of physical activity behaviour, it was identified that different employees may value different outcomes:

"It would depend upon the individual really. So for some individuals it could be that they wanted to lose weight and therefore for them, if they're having weigh ins and they've lost weight then that's success for them…it really would be dependent upon the individuals." C2

However, the co-creators did identify that blood pressure, BMI and weight may be common outcomes that could be measured. Consistent with not mandating intervention content, it also appears that mandating outcomes of intervention effectiveness should also be avoided by organisations. Instead, employees may benefit most when able to choose the measures of effectiveness most salient to themselves.

5.3.3.2 Indirect Objective Measures

Outside of direct measures of physical activity, the co-creators also outlined indirect strategies for determining the effectiveness of the co-created interventions. The most commonly cited indirect measure was to track employee sickness absence levels:

> “Employees won't have as much time off sick” A1

> “Lower sickness levels across the company” B2

> “if they’re [employees] having less sick days” C1

> “Sickness days, you could measure every sick period, how many people who are off sick with stress” D2

For the co-creators, engaging with physical activity interventions was believed to improve general health and well-being. As such, it was anticipated that there would be an inverse relationship between intervention engagement and employee sickness levels. Therefore, organisations would be able to indirectly monitor the impact of the implemented interventions by tracking trends in employee sickness absence. Outside of employee sickness levels, the co-creators also identified that the uptake and usage of classes and equipment could serve as a broad indicator as to whether the interventions were having an impact on employee physical activity levels:

> “How many people are using the classes or equipment” B2

"tracking employees in terms of them going in and out of a gym room or into the zen room. So just scanning their workplace card, their staff card, to know how long they've been in there." C1

Such indicators may serve as a useful, but broad, gauge of intervention effectiveness particularly in instances where employees do not wish to share specific health data.

5.3.3.3 Indirect Self-Report Measures

Whilst direct objective measurements were perceived to be the most scientific approach to determining intervention effectiveness, the co-creators also acknowledged that more subjective outcomes, such as emotional states, were also valuable:

"perceptions of positivity, although unscientific, are as valid and as important as measured changes such as body weight and fat mass." C1

Indeed, a consistent outcome of intervention success expressed by the co-creators was improvements to mental health and positive affect:

"…another scale to see if it's a happy workplace. So, maybe a question along the lines of how well do you get along with your teammates? So it is all about the feeling happy at work." A1

"It could be in terms of mental health, how positive they feel coming into work, maybe they didn't feel so happy or motivated before" C2

"[measure] people's mood" D2

The consideration of mental health as a key outcome measure of intervention effectiveness indicated that employees may engage with workplace physical activity interventions for reasons other than protecting physical health or to lose weight. Indeed, good mental health was seen almost as a precursor to physical activity:

> "*Checking on people's mental health, seeing if they're in the right mental fitness to do it*." D2

As such, organisations may need to consider a more holistic approach to evaluating intervention efficacy and consider both mental and physical health outcomes as being equally valuable. Outside of mental health, changes to self-efficacy were also identified as a proxy for intervention effectiveness:

> "Measure how comfortable they feel using them [interventions] to see if it changes over time as well. How has it changed for them both physically and mentally." B2

Once again, this suggests that for some individuals intervention success may not be determined by increases in physical activity per se but rather in the confidence to perform physical activity whilst at work. Reflections upon the general experience of engaging with the interventions was also identified as a potential strategy for measuring intervention impact:

> "Some sort of feedback system after a period of time. Have you used it? What have you got out of it?" C2

The use of open-ended reflective questions suggests that intervention effectiveness can also be determined qualitatively, complimenting the more traditional quantitative objective measures previously outlined.

5.4 Discussion

The overarching aim of this research phase was to empower the co-creators to design a selection of interventions that would enhance or overcome the facilitators and barriers identified within chapter 4. Through the use of poster creation methods, four multi-componential interventions were designed and described by the co-creators. The co-created interventions were then analysed pluralistically, drawing upon BCT coding and qualitative content analysis to identify the 'active ingredients' of the interventions, alongside implementation and evaluation strategies favoured by employees.

Through BCT coding 21 BCTs were identified across the co-created interventions. The most commonly utilised BCTs were; *5.4 Monitoring emotional consequences, 12.2 Restructuring the social environment* and *12.5 Adding objects to the physical environment,* which were present within all of the co-created interventions. Within the meta-analysis conducted in chapter 2, the BCT *12.5 Adding objects to the physical environment* was also one of the most commonly utilised intervention components. As such, adding objects to the physical working environment, such as exercise machines, may represent a core foundation of workplace physical activity interventions; providing an initial starting point for intervention development. However, the BTCs *5.4 Monitoring emotional consequences* and *12.2 Restructuring the social environment* were not present in any of the included studies within the meta-analysis; suggesting a potential divergence between the components deemed effective by researchers and those deemed effective by employees. Within national workplace health promotion policies, it has been identified that the explicit consideration of emotions is relatively rare despite known associations with health behaviour (Seppälä et al., 2018). Whilst emotions may not be the primary target of workplace physical activity interventions, the consistent connections made between physical activity, reduced stress and improved mood by the co-creators suggests that emotions play a particularly salient role in enhancing intervention engagement. Furthermore, the measurement of emotional states was a consistent outcome identified by the co-creators used to determine intervention effectiveness. As such, intervention designers and policy makers may benefit from placing a stronger emphasis on less tangible outcomes, such as emotions, to more fully align with what employees perceive to be a key benefit of engaging with physical activity in the workplace. Finally, there was a discrepancy between the presence of the BCT *12.2 Restructuring the social environment* within the co-created interventions and the absence of the same BCT within the studies included in the meta-analysis conducted in chapter 2. One of the key rationales for targeting physical activity within the workplace is that interventions can capitalise upon pre-existing social networks (Plotnikoff et al., 2005; Robroek et al., 2009). Therefore, researchers may be hesitant to make changes to the social environment to avoid undermining one of the key strengths of the domain. However, restructuring the working day to provide more opportunities for employees to be free at the same time, and encouraging employees to perform physical activity together at locations other than the worksite, were salient intervention strategies for the co-creators. Consequently, the underutilisation of the BCT *12.2 Restructuring the social environment* within workplace physical activity interventions may mean that the full potential of the social environment has not yet been fully explored.

The BCTs *1.2 Problem solving*, *3.2 Social support (practical)* and *12.1 Restructuring the physical environment* were also common across the co-created interventions. The majority of the interventions described by the co-creators emphasised the need for employees to contribute their own ideas around how physical activity could be increased within the constraints of their occupational role, reflecting the BCT *1.2 Problem solving.* This finding diverges somewhat with the BCTs identified within the meta-analysis conducted in chapter 2. Whilst problem solving was identified in three out of the fourteen included studies, action planning was a much more prevalent intervention strategy being present in eight of the included studies. The BCT 1.4 *Action Planning* requires detailed planning of the target behaviour including specific information such as; context, frequency, duration or intensity (Michie et al., 2013). Within the co-created interventions, employees were not encouraged to think of detailed plans but rather more generalised solutions to the problem of physical inactivity. This suggests that employees may not view physical activity in terms as rigid as context, frequency, intensity or duration. Indeed, making interventions rigid and regimented was identified as a barrier to engagement with the co-created interventions. Whilst action planning has been identified as an effective intervention technique within the wider physical activity literature (S. L. Williams & French, 2011), caution should be taken when applying it to workplace settings to avoid interventions being perceived as being overly rigid and therefore less engaging.

Within the co-created interventions buddy systems and interdependent physical activities, such as five-a-side football, were outlined representing the BCT *3.2 Social support (practical).* Social interactions have been cited as an important component of workplace physical activity interventions, helping to improve not only motivation for the activity but also positively enhancing social relationships (Scherrer et al., 2010). In particular, having a friend or buddy who shares similar goals and motivations is a key facilitator of physical activity engagement(Dharod et al., 2011). As such, buddy systems are frequently implemented in workplace physical activity interventions (van Berkel et al., 2011). There therefore appears to be alignment between the literature and employee's in terms of the acceptability of buddy systems. Together with adding objects to the physical environment, the implementation of buddy systems may represent another key component of engaging workplace physical activity interventions. Alongside buddy systems, workplace team sports have also been identified as affording benefits to not only individual health but also wider organisational outcomes such as team cohesion and increased work performance (Brinkley, McDermott, & Munir, 2017). Therefore, the inclusion of the BCT 3.2 Social support (practical) may not only increase employee physical activity levels but may also strengthen employee relationships and important work outcomes. This is of particular importance when one considers that the perceptions of colleagues and concerns about the completion of workload were identified as barriers of physical activity (see chapter 4).

The BCT *12.1 Restructuring the physical environment* was also a common intervention component typically involving the creation of physical activity spaces. The co-creator's within group A suggested the creation of gender specific spaces to support males and females who feel self-conscious about exercising in front of the opposite sex. There is a dearth of literature exploring the impact of mixed gender physical activity spaces within workplace settings. However, evidence from educational domains does indicate that single gender physical activity spaces promote more moderate to vigorous physical activity than mixed-gender physical activity spaces (Wallace et al., 2020); suggesting that interventions may result in greater energy expenditure when the utilisation of the space is considered. Furthermore, it has been noted that males and females may have different psychological and social mediators of physical activity participation (Segar et al., 2002) and therefore a 'one size fits all' space may not be able to accommodate for this. Alongside gender specific activity areas, quiet spaces were also identified as being required to facilitate calmer forms of physical activity such as yoga. For the co-creators it was important to protect the underlying ethos of the intervention by matching the energy levels of the space to the intended physical activity that would be performed there. This idea is consistent with wider literature that has identified that employees often differ in their motivations for engaging with workplace physical activity interventions; for some it may be the opportunity to develop a muscular aesthetic whilst for others this could be a source of resistance (Verdonk et al., 2010). Consequently, aligning the use of space to specific types of physical activity may represent a viable strategy for increasing engagement in future workplace physical activity intervention studies. Another intervention strategy which comprised of restructuring the physical environment was to increase the height of tables and to turn off elevators. Whilst previous studies have identified that environmental changes, such as making stair well access easier and moving printers away from desks, are considered as effective strategies by employees (Gilson et al., 2011), the inclusion within the co-created interventions was somewhat counterintuitive. In relation to implementation strategies, it was identified that the co-creators did not want the interventions to be enforced or dictated to employees. However, making unilateral decisions to increase table heights and limit elevator use would remove the freedom of choice for employees. The co-creators did however acknowledge that transparent communication and telling the story behind why interventions were being implemented would reduce potential resistance. Whilst in its infancy in relation to workplace physical activity promotion, storytelling has been identified as a powerful and innovative tool in wider health behaviour change research (Bertera, 2014). Given that the co-creators identified storytelling as an important tool in decreasing employee resistance, and the success of the approach within wider health behaviour research, storytelling may represent a fruitful line of enquiry in enhancing workplace physical activity engagement.

Alongside BCT coding of the co-created interventions, the study also identified consistencies between co-creation groups in how the interventions should be implemented and evaluated. Three common implementation strategies were identified. As noted, a key feature of intervention delivery was that interventions should not be enforced upon or dictated to employees. This concern also appears to be shared by employers who have identified challenges balancing physical activity initiatives with employee personal choice (Mellor & Webster, 2013). A commonly cited strategy by the co-creators for overcoming this was for managers to lead by example. Indeed, Employer and managerial support is often recognised as being an important factor in enhancing participation rates with workplace physical activity programmes (DeJoy et al., 2009). However, it must be noted that engaging with workplace physical activity can be potentially stressful for managers. Rossing & Jones (2015) highlight a potential juxtaposition where one can be successful and highly experienced within in one's own job but less experienced and confident in exercising; meaning that engaging with workplace physical activity interventions can be perceived as embarrassing and risky towards one's professional credibility when exercising in front of colleagues. In light of this, managers may benefit from initial intervention training prior to interventions being implemented fully within an organisation. Building confidence and experience in using the new interventions may help to reduce feelings of anxiety for managers who play an important, and highly visible, role in promoting physical activity to the wider workforce.

The co-creators also emphasised that employers would not be able to deliver all of the co-created interventions as they make lack sufficient resources to implement them. Within the academic literature, considerations of the cost-effectiveness and economic impact of workplace interventions have been key concerns (Proper & van Mechelen, 2008). Indeed, guidelines designed to support the implementation of workplace health programmes often encourage organisations to manage the expectations of their employees and set realistic expectations of what is affordable (NICE, 2015). In the context of the current study, such guidelines may be doing employees a disservice. As the co-creators within the current study have shown, employees are acutely aware of the costs and resources involved in delivering workplace physical activity interventions and show flexibility and creativity in producing cost-effective solutions. Therefore, rather than managing the expectations of employees, an approach akin to the top-down processes often seen within the literature, the findings of the current study imply working with employees to co-create and co-refine interventions to find the most cost-effective and appropriate solutions for their specific organisation.

Another common implementation strategy identified by the co-creators was to anchor more substantial physical activity interventions around break times. Lunch breaks play an important role in fatigue recovery (Trougakos et al., 2014) and employees are known to self-select the strategy of using lunch break to increase physical activity whilst at work (Croteau, 2004). The participants of the current study further lend strength to the importance of lunch breaks in employee physical activity interventions. However, whilst lunch breaks were identified as a convenient point in the workday anchor physical activity interventions around, there were perceptions that this alone would not be enough. An additional physical activity break was suggested by the co-creators to provide more opportunities for employees to engage with physical activity during the workday. The suggestion of employers providing additional time during working hours mirrors evidence that encouraging participation during paid working rather than unpaid working hours results in high intervention recruitment rates (Ryde et al., 2013).

Finally, the co-created interventions were analysed to identify how intervention effectiveness should be determined and which outcomes were most salient to employees. Three overarching approaches were identified: direct objective measures, indirect objective measures and indirect self-report measures. Direct objective measures were perceived by the co-creators as providing a scientific foundation for determining intervention effectiveness. As noted in chapter 2, objective measures of physical activity can provide more accurate representations of individual physical activity levels in comparison to self-report measures. The emphasis on objective measurement by the co-creators suggests that employees also view objective measures as reliable indicators of intervention effectiveness. However, the co-creators also identified that the specific outcomes to be measured would depend upon the individual employee. It was recognised that different employees would have different reasons for engaging with workplace physical activity and so generalised objective outcomes, such as weight and BMI, might not be relevant to all employees. Therefore, when evaluating intervention effectiveness, researchers and organisations may need to adopt a more tailored approach to determine which outcomes employees are using to evaluate overall intervention success.

Whilst the direct objective measurement of health outcomes was perceived to be important for determining intervention effectiveness, the co-creators also expressed concerns about employers having access to individual physical activity data. This sentiment has been echoed within the wider literature where privacy and ethical concerns around the 'quantified self' and tracking individual health data have been expressed (Marcengo & Rapp, 2014). Within the current study, the co-creators suggested that direct objective measures should be voluntary, and employees given the choice about who this information is shared with. As an alternative approach to direct objective measures, the co-creators also suggested that indirect objective aggregated data could be used to determine intervention effectiveness. Such approaches included the number of employees attending exercise classes, the number of employees using physical activity spaces and the amount of time being spent by employees within dedicated physical activity spaces. As such information is more generalised it may help to alleviate concerns about employers monitoring individual health information. Complimenting objective measures of intervention effectiveness, the co-creators also emphasised that self-reported mood and happiness were important outcomes. The extant literature does support a dose-response relationship between physical activity and self-reported happiness; where higher levels of physical activity are associated with higher levels of happiness (Richards et al., 2015). Despite this, emotions and positive affect are rarely reported within workplace physical activity intervention research. Whilst important, focussing purely upon tangible, observable behaviours, such as step counts and number of stairs climbed, may miss the full impact that workplace interventions have upon employees. That is, the goal for some individuals might not be to increase physical activity levels but rather to use physical activity as a tool for feeling happier whilst at work. This may be a subtle, but important, distinction for researchers and organisations to make when evaluating intervention effectiveness.

Combined, the findings have helped to address the three overarching aims of this research phase. Firstly, through BCT coding it was identified that the co-created interventions did share some similarities with the behaviour change strategies used by researchers within the meta-analysis conducted in chapter 2. For example, the BCT *12.5 Adding objects to the physical environment* was common across both employee and researcher generated interventions. However, disparities also existed. For example, the BCT *5.4 Monitoring emotional consequences* was a common feature of employee generated interventions but was not present within any of the studies included in the meta-analysis. As such, this research phase has highlighted a potential disconnect between how researchers tackle employee physical activity behaviour change and what employees want in practice. Such findings further strengthen the pragmatic position taken by the author and highlight the importance of actively involving employees in workplace physical activity research.

Through qualitative content analysis the aims of understanding how interventions should be implemented and evaluated were also met. Again, commonalities and disparities between research and practice were identified. For example, anchoring interventions around break times was a common implementation strategy across both researcher and employer generated interventions. However, guidelines on promoting physical activity in the workplace suggest that employee expectations must be actively managed (NICE, 2015). Yet within the current study the co-creators were acutely aware that employers would not be able to do everything and viewed building external partnerships as an important strategy. This lends strength to the view that rather than managing employee expectations, organisations should actively involve employees in the development of new initiatives; helping to set realistic expectations from the outset whist also offering innovative ideas as to how costs and resources can be kept manageable. Finally, the co-creators identified that both objective and subjective measures of physical activity and sedentary behaviour were viable intervention evaluation strategies. However, the co-creators also emphasised the importance of measuring mental well-being as a key outcome. Historically, research within this domain has determined intervention efficacy via direct measures of physical activity, eschewing the role that mental well-being plays in determining intervention success. As such, this research phase as highlighted an important gap between how researchers and employees determine intervention success.

5.4.1 Strengths & Limitations

As noted in chapter 1, workplace physical activity intervention research has historically under-utilised co-creational approaches. As such, employees have had limited opportunities to directly contribute to the direction and scope of the research agenda within workplace physical activity studies. Through its co-creational approach to intervention design, the current study has added important information about what employees expect and want from workplace physical activity interventions. Furthermore, given the dearth of co-created interventions within the workplace physical activity literature, little is known about which BCTs are important to employees in promoting positive behaviour change. By coding the BCTs present within the co-created interventions the study has contributed to a more precise and nuanced understanding of which intervention design components are likely to be effective. The specific BCTs identified within the current study can be used to both inform future intervention development and strengthen existing interventions by tailoring the 'active ingredients' to meet the needs of employees more directly. Alongside contributing a list of specific BCTs, the study has also identified the importance of emotions and positive affect to employees as an outcome of physical activity; a factor that is often overlooked in workplace health behaviour policy (Seppälä et al., 2018). The findings of the current study suggest that interventions may need to be evaluated more holistically and employees may choose to engage with physical activity interventions for reasons other than physical health.

A key challenge within the current study was that the co-created interventions could not be directly evaluated. From the outset the researcher made clear that due to funding and resource constraints, the co-created interventions could not be implemented but rather would be compiled as a toolkit which could be used by those wishing the add more physical activity into their workday. The availability of funding and resources can be a substantial challenge within co-creation research where the priorities of the stakeholders must be balanced against the financial constraints of the project (D. Beran et al., 2018). This is further compounded by research impact frameworks which often prioritise outcomes that may be incompatible with those of the stakeholders; but still necessary to secure future grants (Greenhalgh et al., 2016). Alongside financial constraints, another potential limitation within the current study was the loss of three co-creators from workshop one. Participant attrition is a relatively common issue encountered in multi-wave research and studies can vary dramatically in retention rates (Teague et al., 2018). Whilst the 77% retention rate within the current study is relatively high, it is important to acknowledge that even small levels of attrition can lead to incomplete data for those who withdraw (Stouthamer-Loeber & Bok van Kammen, 1995). Given the emphasis of participatory methods on actively hearing stakeholder voices, the current research may have only partially heard the full experiences of those three co-creators. Whilst little can be done once participants choose not to continue in multi-wave research, the inclusion of replenishment samples can help to minimise issues associated with participant attrition (Zethof et al., 2016). This was the approach adopted within the current study, whereby the co-creators were invited to bring new participants into the study for the second workshop. This approach led to the inclusion of three new co-creators who were able to build upon the foundations laid out by the co-creators who participated in workshop one.

5.4.2 Conclusion

Through the use of a co-creational approach the current study has provided key contextual information around what employees want and expect from workplace physical activity interventions. Interventions that emphasise the monitoring of emotional consequences, the restructuring of the social environment and the addition of objects to the physical environment are likely to be well received by employees, as these were the most common intervention design components utilised within the co-created interventions. Counter to some workplace physical activity guidelines, the current study has also shown that employees are acutely aware of intervention costs and may be more flexible and amenable to cost-effective solutions that previously thought. Employees may be prepared to engage with other organisations, technology, and freely accessible outdoor spaces if appropriate support has been put into place. Therefore, future intervention research may benefit from greater exploration of tools which can promote physical activity both within and outside of the physical workspace itself. Finally, the study has identified that employees may not be completely motivated by the perceived physical health benefits of workplace physical activity interventions but rather the emotional benefits. Thus, future intervention research may wish to explore the viability of interventions which primarily target emotional well-being through the medium of physical activity rather than making physical activity the primary outcome in and of itself. Overall, the co-creation workshops have established that participatory methods are viable approaches in supporting the development of tailored workplace physical activity interventions and that such can play a key role in democratising workplace physical activity research.

Chapter 6- Co-refine: The Development of Wellness@Work

Through the co-define and co-design workshops in chapters 4 and 5, the co-creators identified barriers and facilitators to workplace physical activity levels and developed a series of interventions to enhance them. Each artefact produced and described by the co-creators has added depth and nuance to the understanding of workplace physical activity and provided localised insight into the knowledge and experiences of employees. The next step within the co-creation process was to consider the scalability of the co-created solutions (Leask et al., 2019). Scalability is an essential component of the co-creation process as it ensures that the interventions reach their intended population and ensures that interventions avoid only meeting the needs of those who participated (Dollinger, 2018). To achieve scalability, a mechanism for synthesising and disseminating the co-created content was required. Given the dearth of co-created interventions within the workplace physical activity literature, and the starting position the current co-creation project, scalability was considered in terms of developing an initial intervention concept and assessing the acceptability and behaviour intention to use it by employees. During the scalability stage, the researcher plays a critical role in giving form to ideas developed via co-creation (Sanders & Stappers, 2008). Whilst co-created solutions have several strengths over those generated purely by subject experts, feasibility is often a hurdle which limits their implementation (Magnusson et al., 2003; Poetz & Schreier, 2012). As such, domain specialists can draw upon their knowledge to help translate co-created solutions into ones that both preserve the co-created content whilst remaining feasible (Bowie et al., 2020; O'Brien et al., 2016; Trischler et al., 2018).

The first step in identifying a viable scaling strategy was to consider the mode of delivery for the co-created intervention. Within the extant literature, two key modes of delivery have been predominantly utilised; face-to-face and website-based interventions (Richards et al., 2013). Traditionally, physical activity interventions have adopted face-to-face modes of delivery (van den Berg et al., 2007). It has been suggested that face-to-face interventions are both effective and can enhance the perceived importance of physical activity related health messages (Conn et al., 2011). Furthermore, such interventions can increase interaction between participants and help to develop greater empathy and understanding between researchers and participants (Richards et al., 2013). However, barriers to the delivery of face-to-face physical activity interventions include; time, cost, dependence upon the geographical location of the intervention and potential clashes with other work commitments (Steele et al., 2009); which can limit their utility. Conversely, website-based interventions have tangible advantages over those delivered face-to-face such as; the capacity to reach a large number of individuals at a relatively low cost (Maher et al., 2016), the ability for interventions to be accessed at times and paces convenient to the users (Sciamanna, 2002) and content which can be more easily tailored to individual user’s needs (Alley et al., 2016). Systematic reviews have also established that website-based physical activity interventions, can be effective at increasing physical activity levels (Vandelanotte et al., 2007). However, it is important to note that a key challenge often faced by electronically delivered physical activity interventions is the maintenance of user engagement over time, as online interventions tend to report high levels of initial engagement followed by a period of steady decline (Maher et al., 2014; Vandelanotte et al., 2007).

In deciding the most viable intervention delivery method, the findings of the co-creation workshops within chapters 4 and 5 were considered alongside the wider socioecological context of the research project. Within the co-creation workshops, the co-creators identified that there was not a singular intervention that would likely work for every employee. Instead, multiple interventions would be required and would need to be implemented simultaneously. Workload was also identified as a salient barrier with the co-creators expressing concerns about finding time to engage with physical activity alongside their existing commitments. Outside of the co-creation workshops, the nature of work has also changed significantly over the past two decades with an increased shift towards remote working practices (CIPD, 2020). A trend which sharply increased following the outbreak of COVID-19 with half of U.K. employees reportedly working from home

(ONS, 2020). Industry experts project that the number of employees working remotely is likely to increase and that the pandemic may have resulted in a permanent increase in the number of employees working remotely (Deloitte, 2021). Given that face-to-face interventions have been identified as being more time consuming, costly and challenging to fit around existing work commitments, alongside an increased number of employees working away from the physical office, website-based delivery of the co-created interventions was deemed to be the more effective delivery strategy.

As noted, a key challenge of website-based interventions is sustaining intervention engagement over time. One explanation for the sharp declines seen within digital intervention engagement is that websites often rely upon static content leading users to become bored after the initial novelty wears off (Kuru & Forlizzi, 2015; Vandelanotte et al., 2007). To overcome this, physical activity interventions are increasingly turning to social media platforms to deliver intervention content (Cavallo et al., 2012). Social media has been defined as any internet-based application which allows for the creation and sharing of user-generated content (Williams et al., 2014). As such, there are substantial parallels between functions of social media and the philosophy of co-creation. Indeed, social media has been referred to as the participative internet (Pew Research Centre, 2009). Social media has been identified as a potentially powerful tool for addressing complex health behaviours (Maher et al., 2016) and utilises techniques such as likes, shares and comments to promote sustained engagement with the platform and interaction between users and groups (Barger et al., 2016). Exchanges of user generated content have been identified as a powerful tool leveraged by social media platforms to sustain high levels of engagement over time (Weiksner et al., 2008). Given that social interaction was identified as a key facilitator of physical activity within the co-creation workshops described in chapters 4 and 5, synthesising and integrating the co-created interventions into a social media-based website would both align with the ideas developed by the co-creators and help to overcome the challenge of engagement often experienced within digital interventions; as users could continue to add content over time, ensuring that the intervention remains dynamic. This would providing users with both variety and choice in how they could interact with the synthesised intervention, both of which help to sustain engagement (Carlsson et al., 2020).

Given the importance of domain experts in managing the feasibility of co-created interventions, the transition towards remote based working practices and the relative success of social networks in conveying information in a participatory manner, the author proposed to the co-creators that a workplace physical activity social network could be a viable approach for expanding the reach of the interventions that had been designed. This approach was approved by the co-creators and the researcher developed an initial overview of what the workplace physical activity social network could contain and how it related to the content produced by the co-creators (see table 18). As noted, domain experts play an important role in the translation of co-created ideas into feasible interventions (Sanders & Stappers, 2008) and so it was deemed appropriate for the researcher to develop the initial overview for the co-creators to consider.

Eight weeks after co-creation workshop two, the co-creators were invited to a Microsoft Teams meeting to discuss the initial overview of the workplace physical activity social network. Seven of the co-creators from co-creation workshop two (B1, B2, B3, C2, C3, D1, D2) attended the meeting. The co-creators agreed that all of the proposed webpages were appropriate and that there was a clear link between the materials that the co-creators had produced and the content of the proposed social network. Whilst the co-creators were supportive of the proposed content, two sections were added in by the co-creators. Firstly, on the webpage 'Helpers and hinderers', the co-creators felt that users should have the option to add their own barriers and facilitators of physical activity alongside viewing those created by the co-creators. This led to the addition of a form onto the webpage where users could upload photographs and descriptions of barriers and facilitators of physical activity that had been encountered within the user's own role. Secondly, the co-creators also wished to see the inclusion of a suggestion button on the webpage 'Track your progress'. Whilst the co-creators felt that having pre-existing questionnaires would be helpful, there might be other data that users would like to track and so there needed to be a mechanism for users to communicate this.

Based upon the feedback received by the co-creators, the researcher built a prototype version of the workplace physical activity social network with the place holder name of Fit4Fun (see appendix 10). Two weeks after the initial Microsoft Teams meeting, the co-creators were invited to a second Microsoft Teams meeting to review the prototype website and to decide upon a name for the platform. The same seven co-creators (B1, B2, B3, C2, C3, D1, D2) attended the meeting. The co-creators approved of the design of the platform and felt that it conveyed key information well. Five potential names for the platform were generated by the co-creators; iFit, Workercise, ActiviMe, Stepmate and Wellness@Work. After discussion, the co-creators eliminated iFit and Workercise. It was felt that these two names implied the employees would need to complete vigorous exercise, which was not the intention of the platform. Similarly, stepmate was eliminated as it implied that employees would only be focussing on step counts, which was only one component of the platform. Both ActiviMe and Wellness@Work were identified by the co-creators as potentially good names for the platform. However, ActiviMe was eventually eliminated as it focussed upon the individual, by its inclusion of the word me, and did not fully reflect the social nature of the platform. It was therefore agreed that the name of the platform should be Wellness@Work. It was felt by the co-creators that this captured the multifaceted nature of the platform, without being overly limiting.

Table 18: Proposed website content and rationale

Webpage	Brief description	Rationale
Homepage	Section one: A menu where users can click through to the individual sections of platform	Navigation to the different areas of the platform
	Section two: A photo-gallery for users to share photographs of themselves engaging with physical activity	Within the theme 'Guide, Don't Tell' the importance of visibility and seeing others engage with interventions was discussed by groups C and D (see pg x). Sharing photographs in this manner could also help to build the culture of physical activity referred to within this theme (see pg x)
	Section three: A list of upcoming events that users could book directly on to	When explaining how to measure intervention effectiveness, it was identified by the co-creators in group C that the number of activities booked on the platform could be used as an indirect measure of engagement (see pg x)
	Section four: A voting system where users could decide on which activities/resources the organisational budget is spent	Within the theme 'Guide, Don't Tell' it was identified by the co-creators in group D that employees should be actively involved in choosing which interventions are implemented (see pg X)

Webpage	Brief description	Rationale
Homepage	Section five: A link to a forum to facilitate communication between users	Under the theme 'Employer's Can't Do Everything', co-creators in group C specifically referred to online forums as a way in which employees could communicate and share ideas (see pg x)
Latest research	Section one: Brief summaries of published research relating to workplace physical activity and sedentary behaviour. Links to publicly accessible versions of the full-text would be provided for users who wished to read more about the study.	Under the theme 'Guide, Don't Tell' co-creators in group D stated that it was important to be told the story behind why physical activity was being promoted and how it benefits employees (see pg X). It was also identified by group C that there may be resistance if such information comes from employers directly (see pg X). By sharing published research, employees can read around why being physically active is important without the information coming directly from their employer
Helpers & hinderers	Section one: A menu where users could choose to view a list of potential helpers, hinderers	Navigation to the helpers or hinderers section.

Webpage	**Brief description**	**Rationale**
Helpers & hinderers	Section two: A gallery providing a list and brief explanation of hinderers of physical activity.	Content for this page came from the barriers of physical activity identified by all of the co-creators during the first co-creation workshop. Users would be able to access this information to reflect upon aspects of their role that might be hindering them from being physically active
	Section three: A gallery providing a list and brief explanation of helpers of physical activity	Content for this page came from the facilitators of physical activity identified by all of the co-creators during the first co-creation workshop. Users would be able to access this information to reflect upon aspects of their role that might be helping them to be physically active.
	Section four: A form where users can upload photographs and brief descriptions of helpers or hinderers of physical activity from within their own role	Added following a Microsoft Teams meeting with co-creators to review the proposed platform.

Webpage	Brief description	Rationale
Intervention library	Section one: A list of interventions that users could engage with to add more physical activity, or disrupt sedentary behaviour, during the workday.	Content for this page came from the interventions developed by all of the co-creators during the second co-creation workshop. Users would be able to access this information and start engaging with the interventions that resonated with them the most.
Design your own intervention	Section one: Links to external videos relating to physical activity and yoga	Co-creators within group C specifically identified the use of external fitness videos, such as those hosted on YouTube (see pg X), as a way for employees to exercise independently
	Section two: Links to royalty free music both energetic and relaxing	Co-creators in group C specified two types of activities; energetic and relaxation based (see pg X). Access to energetic and relaxing music could help to create an appropriate ambiance for activity
	Section three: Maps of the local area where users could plot walking/running routes.	Co-creators in groups A and B identified that employees should have the option to walk outside and visit external locations (see pg x). Through providing maps of the local area, it would be possible for employees to plan and share walking routes

Webpage	Brief description	Rationale
Design your own intervention	Section four: List of commercial partnerships available to users and the reward that will be received for being physically active.	Co-creators in group A identified that organisations could make partnerships with other companies to give their employees discounts or incentives (see pg x). This section would provide a space for any partnerships to be visible to users of the platform
Could you teach?	Section one: An online registration form where users could sign up to teach a physical activity related class based upon one of their hobbies.	Co-creators in group C identified that employees may already have physically active hobbies outside of work and could potentially deliver classes related to their hobby (see pg X). This section of the platform would allow employees to register to teach their hobby to others.
Track your progress	Section one: A series of questionnaires that users could input either their physical activity, sedentary behaviour or mental well-being levels. The questionnaires and forms would include a mixture of self-report and objective measures	Information for this section of the website was derived from the outcome measures identified by all co-creation groups (see pg: X-X). The co-creators identified the role of objective and self-report measures, as well as the importance of measuring mental well-being alongside physical activity.

Webpage	Brief description	Rationale
Track your progress	Section two: A suggestions function where users can suggest other ways in which progress could be measured	Added following Microsoft Teams meeting with co-creators

Chapter 7 –Exploring the Behavioural Intention to use Wellness@Work

7.1 Introduction

Prior to implementing a new intervention, it is important to first assess factors which may influence intervention efficacy during the scaling process. The pre-implementation stage is a preparatory phase in which interventions can be proactively adapted, appropriate implementation strategies identified and potential barriers to effectiveness addressed prior to full-scale implementation (Eliacin et al., 2021; Goodrich et al., 2020). Failure to sufficiently consider the pre-implementation stage can have important consequences on how interventions are eventually run and, in turn, on the outcomes measured (Jafni et al., 2017). Within website-based research, it has been strongly encouraged that factors such as usability should be assessed prior to implementation so that interventions are optimised before being disseminated on a larger scale (Moreau et al., 2015). Given the relative novelty of an internal social media physical activity intervention and the importance of pre-implementation assessments, the current study sought to explore not just whether a co-created physical activity website would be viable but also which aspects of the intervention might influence employee’s intention to use and engage with the system. To achieve this, an established theoretical model of technology usage was adopted.

7.1.1 Unified Technology Acceptance and Use Theory

One of the most widely adopted theories of technology use is the Unified Technology Acceptance and Use Theory (UTAUT) (Venkatesh et al., 2003). The UTAUT extends and integrates eight different theoretical perspectives related to behaviour adoption including; the Theory of Planned Behaviour (TPB) (Ajzen, 1991) and Technology Acceptance Model (TAM) (Davis, 1986). It represents an empirically validated model which can account for approximately 70% of the variance in behavioural intention to use a specified technology; a significant increase over the estimated 40% of variance explained by the pre-existing theories upon which it was founded (Venkatesh et al., 2003). The UTAUT posits that the behavioural intention to use a technological system is influenced by three key factors; performance expectancy, effort expectancy and social influence. Performance expectancy refers to the degree to which an individual believes that using a system will enhance performance of a specified behaviour; effort expectancy represents the individual's perception of the ease of use of the system and social influence reflects the extent to which an individual perceives that important others believe the system should be used. The UTAUT also posits that facilitating conditions can influence subsequent system usage. Facilitating conditions represent the degree to which an individual believes sufficient organisational support and infrastructure exist to use the system. However, since its inception, the UTAUT has subsequently been expanded into the UTAUT2 in order to incorporate an affective component, hedonic motivation, alongside two additional factors; price value and habit (Venkatesh et al., 2012). Hedonic motivations refers to the degree to which the system is perceived as enjoyable whilst price value represents the balance between cost and benefit and habit reflects sustained use of the system over time. Alongside the aforementioned variables, the UTAUT2 also posits that age, gender and experience moderates both behavioural intention to use and subsequent usage behaviour (Venkatesh et al., 2003). An overview of the UTAUT2 can be found in figure 7.1:

Figure 7.1: UTAUT2 (Source: Venkatesh & Thong, 2012)

A strength of the UTAUT2 in comparison to alternative models of technology acceptance is the theory's accommodation of pre-intervention context (Venkatesh et al., 2003; Venkatesh & Davis, 2000). Alternative models, such as the TAM, have been critiqued for not sufficiently considering the pre-implementation stage of technology acceptance and subsequent use; instead focusing upon technology which the user is already familiar with (Hwang et al., 2017; Mohadis & Ali, 2018). As this chapter considers a novel intervention at the pre-implementation stage of development, the UTAUT2 represented a viable theoretical lens through which behavioural intention to use could be explored. Furthermore, the adoption of the UTAUT2 to explore determinants of behavioural intention to use a system, prior to its actual implementation, has been cited as an important strategy for maximising eventual intervention impact (Liu et al., 2019). Complimenting the theoretical relevancy of the UTAUT2, the theory has also been used successfully to explore behavioural intention to use physical activity related; mobile health applications (Nunes et al., 2019), exergames (Chen et al., 2018) and so further represents a viable lens through which to explore a new digital health based intervention. The aim of this research phase was therefore to use the UTAUT2 to determine employee's behavioural intention to use the Wellness@Work website prior to its implementation.

7.1.2 Hypotheses Development

As the current study focused upon exploring behavioural intention to use a co-created workplace physical activity website prior to implementation, the UTAUT2 constructs were adapted to include only those relevant to this stage of development. As the proposed intervention was intended to be free for employees, considerations of price value would not be relevant to the end user and so were excluded. The variable of habit was also not considered as this refers to the continued and sustained use of a live system and not one at the pre-implementation stage. Experience was also included as Wellness@Work was a novel intervention and so employees may not have sufficient experience with similar interventions. The remaining variables of performance expectancy, effort expectancy, facilitating conditions, social influence and hedonic motivation were included into the proposed model of behavioural intention to use the co-created physical activity website. Consistent with the theoretical relationships outlined by the UTAUT2 the following initial hypotheses were developed:

H1- Performance expectancy has a significant positive relationship with the behavioural intention to use the co-created physical activity website

H2- Effort expectancy has a significant negative relationship with the behavioural intention to use the co-created physical activity website

H3- Social influence has a significant positive relationship with the behavioural intention to use the co-created physical activity website

H4- Hedonic motivation has a significant positive relationship with the behavioural intention to use the co-created physical activity website

H5- Facilitating conditions have a significant positive relationship with the behavioural intention to use the co-created physical activity website

7.1.2.1 Moderating Effects of Age and Gender

Within the UTAUT2, age and gender are theorised to moderate the relationships between performance expectancy, effort expectancy, social influence, facilitating conditions and hedonic motivation (Venkatesh et al., 2012). In line with this, the moderating effects of these demographic variables will be assessed. Furthermore, age and gender will also be assessed to determine whether these factors also moderate the relationship between UTAUT constructs and intention to recommend the intervention.

H6- Age moderates the relationship between performance expectancy and the behavioural intention to use co-created physical activity website

H7- Age moderates the relationship between effort expectancy and the behavioural intention to use co-created physical activity website

H8- Age moderates the relationship between social influence and the behavioural intention to use co-created physical activity website

H9- Age moderates the relationship between hedonic motivation and the behavioural intention to use the co-created physical activity website

H10- Age moderates the relationship between facilitating conditions and the behavioural intention to use the co-created physical activity website

H11- Gender moderates the relationship between performance expectancy and the behavioural intention to use the co-created physical activity website

H12- Gender moderates the relationship between effort expectancy and the behavioural intention to use the co-created physical activity website

H13- Gender moderates the relationship between social influence and the behavioural intention to use the co-created physical activity website

H14- Gender moderates the relationship between hedonic motivation and the behavioural intention to use the co-created physical activity website

H15- Gender moderates the relationship between facilitating conditions and the behavioural intention to use the co-created physical activity website

7.1.2.2 Influence of Current Occupational Physical Activity Levels

Historically, workplace physical activity interventions have been critiqued for only attracting those who are already physically active (Bardus et al., 2014; Marshall, 2004; Ryde et al., 2013). Therefore, in addition to the UTAUT2 constructs, the study aimed to assess whether current occupational physical activity levels, as measured by the Occupational Sitting and Physical Activity Questionnaire (Maes et al., 2020), were related to the behavioural intention to use the new intervention. Considering the aforementioned critique of workplace physical activity interventions the following hypotheses were generated:

H21- Occupational sitting time (OST) has a significant negative relationship with the behavioural intention to use the co-created physical activity website

H22- Occupational standing time (OStT) has a positive relationship with the behavioural intention to use the co-created physical activity website

H23- Occupational walking time (OWT) has a significant positive relationship with behavioural intention to use the co-created physical activity website

H24- Occupational moderate physical activity time (OMPAT) has a significant positive relationship with behavioural intention to use the co-created physical activity website

H25- Occupational vigorous physical activity time (OVPAT) has a significant positive relationship with behavioural intention to use the co-created physical activity website

7.1.3 Proposed Model

Based upon the aforementioned hypotheses, the structural model outlined in figure 7.2 will be explored.

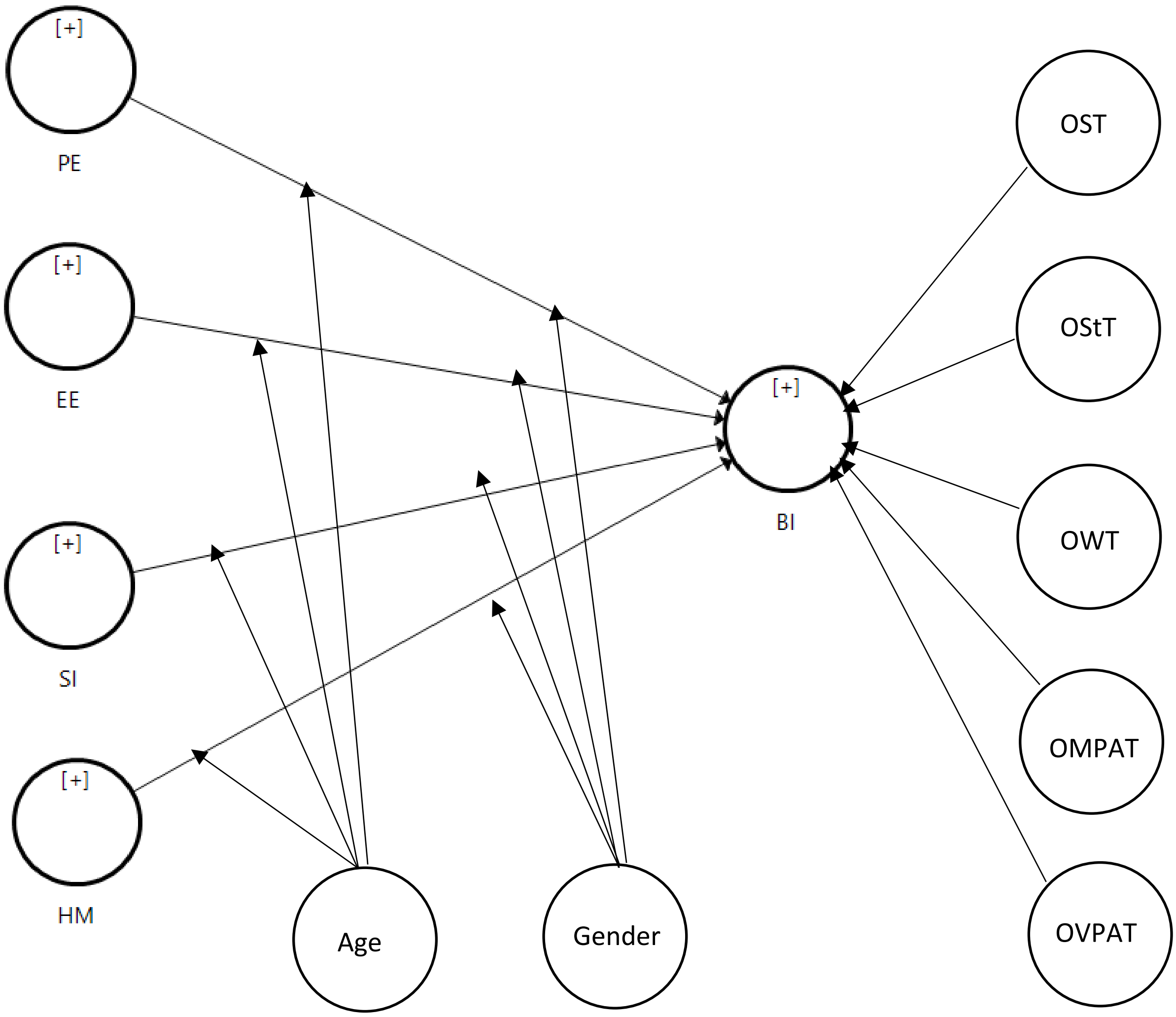

Figure 7.2: Proposed Structural Model – PE (Performance Expectancy), EE (Effort Expectancy), SI (Social Influence), HM (Hedonic Motivation), BI (Behavioural Intention to Use), OST (Occupational Sitting Time), OStT (Occupational Standing Time), OWT (Occupational Walking Time), OMPAT (Occupational Moderate Physical Activity Time), OVPAT (Occupational Vigorous Activity Time)

7.2 Method

7.2.1 Design

The study used a cross-sectional survey design to explore factors which determine employee's behavioural intention to use a novel co-created website-based intervention.

7.2.2 Participants

Following institutional ethics approval, participants were recruited through study advertisements placed on LinkedIn, Facebook and Instagram alongside the researcher's professional network. Snowball sampling was also utilised to encourage participants to share the link to the study with others. Participants were eligible for the study if they were currently employed in either paid or unpaid positions, had access to an internet connected computer and could understand English.

7.2.3 Materials

7.2.3.1 Demographic Questionnaire

To assess the potential moderators of age and gender a demographic questionnaire was developed. Age was assessed on a continuous scale whereby participants were asked to report their current age in years. Gender was assessed categorically through the options of male, female, other and prefer not to say. Additional contextual information about the participants was also collected comprising of; the occupational sector in which the participant worked, whether the participant's work role was predominantly desk-based, whether the participant had any line management responsibilities and whether the role involved remote working. This information was collected to provide context around the representativeness of the sample utilised within the research study.

7.2.3.2 Wellness@Work Video Demonstration

A 10-minute video demonstration exploring the functionality of the Wellness@Work website was produced. Each page of the Wellness@Work website was discussed in turn describing the aim of the webpage, the content of the webpage and the social media elements which users could draw upon to add to and engage with the content of the webpage. A link to the video demonstration can be found at: http://bop.coventry.domains/exploring-the-effectiveness-and-acceptability-of-a-new-workplace-physical-activity-and-sedentary-behaviour-website/

7.2.3.3 Occupational Sitting and Physical Activity Questionnaire (OSPAQ)

To measure the participant's typical occupational physical activity and sedentary behaviour levels, the OSPAQ (Maes et al., 2020) was used. The OSPAQ is a short, self-report, questionnaire in which test takers are asked to recall the number of hours worked over the prior seven days and determine the percentage of time spent sitting, standing, walking and performing physically demanding tasks whilst at work (Chau et al., 2012). The OSPAQ has been demonstrated to possess acceptable psychometric properties including moderate to strong criterion validity and test-retest reliability (Jancey et al., 2014). Examinations of the concurrent validity of the OSPAQ also suggest that the OSPAQ is an acceptable self-report measure for assessing occupational sitting and standing time when compared to objective accelerometer data (Maes et al., 2020). The brevity of the OSPAQ has also been cited as an advantage over longer measures of workplace physical activity due to its lower participant burden and faster completion times (Chau, van der Ploeg, Dunn, et al., 2012). As the current study included multiple questionnaires and a ten-minute video demonstration, the OSPAQ represented a viable measure of employee physical activity and sedentary behaviour.

7.2.3.4 Unified Theory of Acceptance and Use of Technology Scale (UTAUT)

UTAUT constructs were assessed via a 21 item scale. Items were adapted from existing UTAUT scales (Park et al., 2020; Rubin & Ophoff, 2018; Venkatesh et al., 2012) and tailored to reflect the Wellness@Work website. The adapted items and associated UTAUT constructs are outlined in table 19. Given the diversity of technology, the adaptation of existing UTAUT scales to align with research aims is a common strategy utilised within the literature (Perez-Aranda et al., 2021; Rubin & Ophoff, 2018; Yoganathan & Kajanan, 2014). Items were measured on a five-point Likert scale with response options ranging from *"Strongly Disagree"* to *"Strongly Agree"*. A five-point Likert scale was selected as, when compared to seven-point Likert scales, participant burden is reduced whilst reliability is preserved (Dawes, 2008). The UTAUT has been used successfully to assess determinants of physical activity related technology usage including; physical activity mobile phone applications (Liu et al., 2019), exergames (Chen et al., 2018) and wearable devices (Rubin & Ophoff, 2018) and was therefore deemed an appropriate measure for assessing usability of the newly designed intervention.

Table 19: UTAUT2 Construct Indicators

Indicator	Item
PE1	Using Wellness@Work would inspire me to do physical activity during my workday
PE2	Using Wellness@Work would contribute to maintaining my physical fitness during my workday.
PE3	Using Wellness@Work would contribute to maintaining good mental health during my workday
PE4	Using Wellness@Work would enhance my productivity during my workday.
EE1	I would find Wellness@Work easy to use
EE2	I am confident that I would be able to use Wellness@Work
EE3	Learning to use Wellness@Work would be easy for me
EE4	My interactions with Wellness@Work would be clear and easy to understand
SI1	Colleagues who are important to me would approve of using Wellness@Work
SI2	In general, my organisation would approve of using Wellness@Work
SI3	Employees whose opinions I value would approve of using Wellness@Work
SI4	Senior management in my organisation would approve of using Wellness@Work
FC1	Wellness@Work would be compatible with my work role
FC2	My organisation would provide time for me to use Wellness@Work
FC3	I could get help from my colleagues if I were having difficulty using Wellness@Work
FC4	I have the resources necessary to use Wellness@Work
HM1	Using Wellness@Work would be enjoyable
HM2	Using Wellness@Work would be fun
HM3	Using Wellness@Work would be entertaining
BI1	Assuming that I had access to Wellness@Work, I predict that I would use it in the future
BI2	If Wellness@Work became permanently available at work, I would plan to use it
BI3	If a demonstration version was available, I predict I would use it during my workday

Indicator Wordings (PE=Performance Expectancy, EE=Effort Expectancy, SI=Social Influence, HM= Hedonic Motivation, BI= Behavioural Intention to Use)

7.2.4 Procedure

Interested participants were able to click a link embedded within the research advert to access the study. The first two pages of the survey contained a detailed participant information sheet and informed consent questions. After consenting, the participants were provided with the brief demographic questionnaire that were designed for anonymous participation. Participants then completed the OSPAQ and were directed to a video demonstration of the Wellness@Work website. The video demonstration lasted 12 minutes and covered all pages of the website. The feasibility of the website was then assessed through the modified UTAUT2 questionnaire to explore perceptions and behavioural intention to use the Wellness@Work website. Upon completion of the UTAUT2 questionnaire, participants were provided with the opportunity to provide short text open-ended qualitative feedback about the elements of the website that were strong and the elements that could be improved further. Participants were then provided with a debrief sheet and the contact details of the researcher.

7.2.5 Data Analysis

7.2.5.1 UTAUT2 Data

Descriptive statistical analysis was performed within IBM SPSS version 26 through frequency tables, means and standard deviations. The proposed model of relationships between constructs was assessed using Partial Least Square Structural Equation Modelling (PLS-SEM) within SMARTPLS version 3.3.3. Structural Equation Modelling (SEM) is second-generation multivariate data analysis method which extends upon first-generation analytical techniques such as regression and discriminant analysis. Whilst undeniably important, first-generation statistical techniques have been critiqued for their reliance on simple model structures and the assumption that all variables can be considered as observable (Haenlein & Kaplan, 2004). SEM can help to overcome these limitations through its ability to explore complex model structures and latent variables (Beran & Violato, 2010). SEM is comprised of two sub-models; the inner structural model which outlines the relationships between independent and dependent variables and the outer measurement model which outlines the relationships between observed indicators and their latent variables (Wong, 2013). Two key approaches to SEM are most commonly found within the academic literature; co-variance based SEM (CB-SEM) and PLS-SEM (Hair et al., 2012). Both techniques share similar foundations but differ in their analytical approach. CB-SEM seeks to reduce discrepancies between the estimated co-variance matrix and the sample co-variance matrix to calculate relationships between observed and latent variables (Hair et al., 2012; Schmalbach & Avila, 2018).

CB-SEM can be regarded as a parametric test with strict data distribution and sample size assumptions which need to be met (Astrachan et al., 2014). Conversely, PLS-SEM is a non-parametric test which seeks to maximise the explained variance of the dependent variables through a series of iterative Ordinary Least Squares analyses (Hair et al., 2012; Schmalbach & Avila, 2018). Both techniques are able to explore complex model structures and relationships between variables. However, researchers often struggle to meet the challenging parametric assumptions of CB-SEM (Astrachan et al., 2014). In light of the modest sample size within the current study, PLS-SEM was selected as the most appropriate analytical approach. PLS-SEM has been deemed more robust than co-variance based structural equation modelling when handling smaller sample sizes (Hair et al., 2011). In particular, PLS-SEM is a viable approach for investigating measurement models with sample sizes between 100-150 participants (Reinartz et al., 2009). Contemporary PLS-SEM techniques have also been demonstrated to perform comparibly with CB-SEM (Dijkstra & Henseler, 2015) and have been deemed more appropriate than CB-SEM for studies seeking to identify key drivers of behaviour as opposed to theory development (Hair et al., 2011).

7.2.5.2 Qualitative Feedback

The analysis of short free-text open-ended responses to survey items has historically been an under-reported area of data analysis (Decorte et al., 2019). Whilst text-based responses to open-ended questions have been typically viewed as qualitative data, and therefore analysed through techniques such as qualitative content analysis, the utility of such approaches to short-text responses has been questioned (Rohrer et al., 2017). The authors note that free-text survey responses often produce high volumes of short-text answers, as opposed to more comprehensive narratives, making qualitative content analysis an untenable analytical method when the number of respondents is high. In light of the number of short-text responses generated by participants within the current study, manifest content analysis was instead conducted. Manifest content analysis explores surface level data, which is readily observable from within the text, and can be used to quantify textual data by counting the frequency with which it appears in the text (Kleinheksel et al., 2020). Bengtsson (2016) outlines that within content analysis data is initially reduced into meaning units; which represent the smallest comprehensible units of text relevant to the topic under consideration. Then, when analysed at the manifest level, meaning units are placed into categories based upon their degree of similarity to one another. Within the current study, an inductive approach to categorisation was utilised. Within inductive content analysis, categories are derived from the data in a bottom-up process and are closely related to the participant's actual words (Elo & Kyngäs, 2008).

7.3 Results

7.3.1 Participant Characteristics

148 participants completed the questionnaire survey. The sample was comprised predominantly of females (62%) and employees with no line management responsibilities (83.1%). Participant's ages ranged from 19 to 64 years with a mean age of 32.13 years (SD=10.22). The majority of participants reported having desk-based roles (81.1%) and there was approximately an even split between the number of remote workers (58.1%) and non-remote workers (48.9%). Occupations were categorised using the International Standard Classification of Occupations criteria (International Labour Office, 2012). Participant's predominantly comprised of business and administration professionals (22.9%) and teaching professionals (20.9%). Full participant demographic characteristics have been summarised in table 20.

Table 20: Wellness@Work Participant Demographics

Variable	**Mean**	**Standard Deviation**
Age	32.13	10.22
Male	30.96	9.68
Female	*33.45*	10.79
Variable	**Number (*n*)**	**Percentage (%)**
Gender		
Male	53	35.81
Female	92	62.16
Other	2	1.35
Prefer not to say	1	0.68
Line manager		
Yes	25	16.9
No	123	83.1
Predominantly desk-based role	120	81.1
Yes	28	18.9
No		

Variable	**Number (*n*)**	**Percentage (%)**
Occupational sector		
	34	22.97
Business & Administration Professional	31	20.95
Teaching Professional	17	11.49
Administrative & Commercial Manager	14	9.46
Health Associate Professional	10	6.76
Clerical Support Worker	8	5.41
Services & Sales Worker	7	4.73
Technicians & Associate Professionals	7	4.73
Information & Communications Technology	5	3.38
Personal Services Worker	4	2.70
Legal, Social & Cultural Professions	3	2.03
Production & Specialised Service Manager	3	2.03
Science & Engineering Professional	2	1.35
Protective Services Worker	1	0.68
Armed Forces Occupations	2	1.35
Not given		

7.3.1.1 Occupational Sitting and Physical Activity

The majority of participants reported high levels of sedentary behaviour within the workplace with an average of 67% of working hours being spent sat down. Modest amounts of the working day were spent standing, walking and performing moderate physical activity. These percentages are consistent with the high levels of sedentary time reported by employees in wider research studies (Headley et al., 2018).   An overview of participant's occupational sitting and physical activity levels can be found in table 21.

Table 21: Participant's Occupational Sitting and Physical Activity Time

OSPAQ	Range	Mean (SD)	Median
Percentage of workday spent sitting (including driving)***	0-100	67.63 (28.17)	80
Males	5-100	63 (28.25)	63
Females	0-100	70.14 (27.96)	80
Percentage of workday spent standing	0-60	12.83 (13.31)	10
Males	0-50	15.63 (13.71)	10
Females	0-60	11.31 (12.91)	10
Percentage of workday spent walking	0-50	10.44 (10.21)	8
Males	0-40	12 (9.81)	10
Females	0-50	9.59 (10.38)	5
Percentage of workday spent performing moderate physical activity	0-45	5.63 (8.14)	4
Males	0-35	6.67 (7.27)	5
Females	0-45	5.07 (8.56)	0
Percentage of workday spent performing vigorous physical activity	0-50	3.14 (8.14)	0
Males			
Females	0-35	2.76 (7.14)	0
	0-50	3.36 (8.66)	0

7.3.1.2 PLS-SEM

PLS-SEM draws upon two models to assess latent constructs; the measurement model and the structural model (Santi-Huaranca et al., 2018). PLS-SEM requires that each indicator must only be associated with a single latent construct; the measurement model therefore calculates predictive relationships between observed indicators and latent variables to help determine this (Hair et al., 2011). The structural model represents the stable and conceptual relationships between latent variables which make up the proposed model (Janadari et al., 2018). Within the current study, the measurement model was assessed by first establishing convergent validity, discriminant validity, multicollinearity, model fit and predictive relevance. Once an acceptable measurement model was confirmed, the structural model was assessed though path coefficients, t-statistics, p values and effect size calculations. Finally, the moderating effects of age and gender on the structural model were explored.

7.3.1.3 Convergent Validity

To assess whether items within each of the UTAUT variables were measuring the same underlying construct, the convergent validity of each UTAUT variable was assessed. Convergent validity refers to the extent to which items that supposedly measure the same underlying construct correlate with one another (Carlson & Herdman, 2012). If items are measuring a common underlying construct then responses should correlate highly with one another (Kline, 2015). To assess the convergent validity of the items within the proposed model the following measures were used; Cronbach's alpha (α), composite reliability and Average Variance Explained (AVE). For sufficient convergent validity to be established, Cronbach's alpha values should be above 0.7, composite reliability values should be above 0.7 and AVE values should be above 0.5 (Hair et al., 2011). An initial analysis revealed that the construct *Facilitating Conditions* did not meet the appropriate criteria (see table 22). Removal of individual items did not result in a significant increase to the Cronbach's alpha, composite reliability or AVE. In light of this, the construct was removed from the proposed model.

Table 22: Convergent Validity of the Facilitating Conditions Construct

Construct	**Item**	**Indicator Reliability**	**Cronbach's alpha (α)**	**Composite Reliability**	**Average Variance Explained (AVE)**
Facilitating Conditions	FC1	0.69	0.64	0.63	0.31
	FC2	0.57			
	FC3	0.45			
	FC4	0.47			

Alongside facilitating conditions, the lowest performing indicator, SI2, from the latent variable *social influence* was removed. SI had an indicator reliability of 0.40 which falls below the acceptable level of 0.7 (Hair et al., 2011). Removing this item substantially improved the goodness of fit for the proposed model, reducing SRMR from 0.06 to 0.04 and increasing Normed Fit Index (NFI) from 0.78 to 0.91. Whilst the item SI3 also had relatively low indicator reliability (see table 23), removal of this item did not substantially increase the average variance explained or improve the goodness of fit of the predicted model. Therefore, this item was retained. Little et al. (1999) support the retention of weaker items in SEM in cases where the strength of the model is not substantially weakened. All of the remaining items met the acceptable criteria for Cronbach's alpha, composite reliability and AVE (see table 23).

Table 23: Construct Validity of Constructs Included Within the Research Model

Construct	**Item**	**Mean (SD)**	**Indicator Reliability**	**Cronbach's alpha (α)**	**Composite Reliability**	**Average Variance Explained (AVE)**
Performance Expectancy	PE1	3.38 (0.99)	0.83	0.89	0.89	0.66
	PE2	3.64 (0.93)	0.80			
	PE3	3.62 (0.94)	0.83			
	PE4	3.28 (0.96)	0.78			
Effort Expectancy	EE1	3.70 (0.88)	0.72	0.88	0.88	0.64
	EE2	3.93 (0.91)	0.78			
	EE3	3.90 (0.86)	0.81			
	EE4	3.85 (0.79)	0.89			
Social Influence	SI1	3.59 (0.90)	0.87	0.78	0.80	0.59
	SI3	3.35 (0.97)	0.43			
	SI4	3.62 (0.81)	0.92			
Hedonic Motivation	HM1	3.66 (0.94)	0.97	0.94	0.94	0.84
	HM2	3.57 (0.95)	0.92			
	HM3	3.53 (0.96)	0.86			
Behavioural Intention to Use	BI1	3.39 (1.06)	0.88	0.92	0.92	0.80
	BI2	3.68 (1.02)	0.95			
	BI3	3.49 (1.06)	0.86			

Scale: 1=Strongly Disagree – 5=Strongly Agree

7.3.1.4 Discriminant Validity

To assess whether items between each of the UTAUT variables were distinct from one another, the discriminant validity of each UTAUT variable was assessed. To assess discriminant validity, the hetero-trait mono-trait method (HTMT) was used. Within HTMT, scores below one indicate that each item is correlated with its own construct more than any of the other constructs within the model (Gudergan et al., 2017). All of the included constructs were below this threshold and so discriminant validity was confirmed. Table 24 shows the HTMT values for each construct.

Table 24: HTMT Intercorrelation Matrix

	BI	**EE**	**HM**	**PE**	**SI**
BI					
EE	0.48				
HM	0.82	0.60			
PE	0.83	0.60	0.77		
SI	0.60	0.67	0.63	0.63	

7.3.1.5 Multicollinearity

Multicollinearity was assessed via the Variance Inflation Factor (VIF). The VIF statistic measures the inflation of variance in parameter estimates caused by correlations between predictor variables (Vatcheva & Lee, 2016). With PLS-SEM, VIF scores for latent variables below 3.3 are considered acceptable and reflective of no common method bias being present within the research model (Kock, 2015). All of the constructs within the model had VIF scores below the threshold of 3.3 (see table 25)

Table 25: VIF of UTAUT2 Constructs Included Within the Research Model

Construct	**VIF**
EE	2.04
HM	2.70
PE	2.71
SI	2.22

7.3.1.6 Goodness-of-Fit

With PLS-SEM, it is important to assess the approximate model fit. Measures of approximated fit assess discrepancies between the model-implied and the observed correlation matrices (Henseler et al., 2016). Two key statistical tests to assess the approximated model fit are the standardised root mean square residual (SRMR) and the normed fit index (NFI) (Schuberth, 2021). Within the literature, an SRMR value less than 0.08 is deemed as acceptable level of fit (Hu & Bentler, 1999), whilst values below 0.05 are regarded as good(Kline, 2015). The structural model within the current study had a SRMR value of 0.04 therefore suggesting that the model represented a good fit. In relation to NFI, values above 0.9 are interpreted as representing good model fit (Bollen, 1989). The structural model within the current study had an NFI value of 0.91 further suggesting a good model fit.

7.3.1.7 Predictive Relevance

To assess the predictive relevance of the structural model on predicting a target endogenous variable the Q2 statistic should be calculated (Ringle et al., 2012). To determine whether the model has predictive relevance Q2 should be above 0 (Hair et al., 2011). The structural model within the current study had a Q2 value of 0.58, suggested that the model had sufficient predictive capability.

7.3.1.8 Structural Model

Figure 7.3 provides a visual representation of the research model. Combined, 79% of the variance in the behavioural intention to use Wellness@Work can be explained by the UTAUT2 constructs included within the structural model.

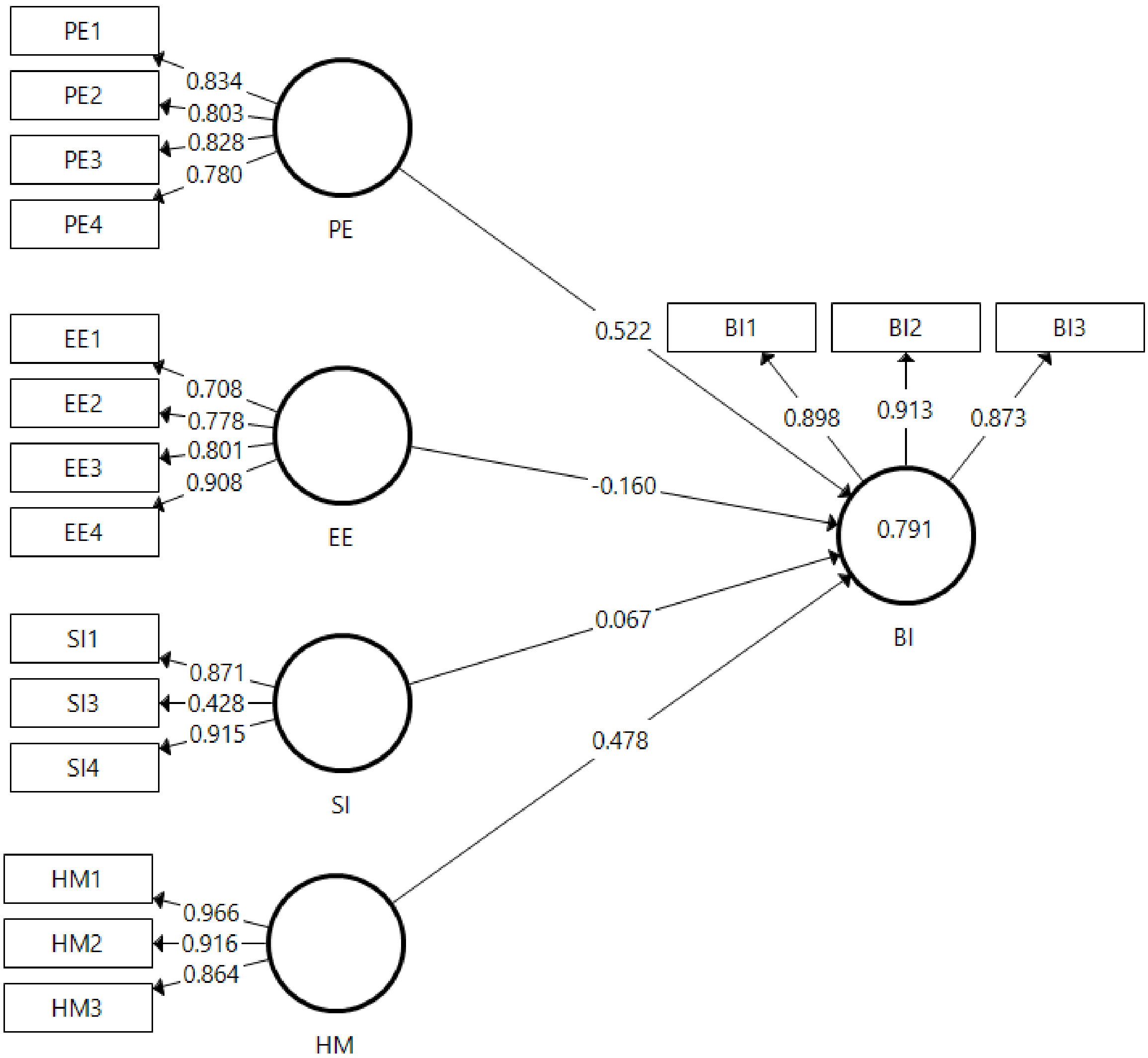

Figure 7.3: Structural Model

Table 26: Structural Model Path Co-efficients & Statistical Significance

	Path Co-efficient (β)	T-statistic	P-Value	Hypothesis Supported
Performance Expectancy -> Behavioural Intention to Use	0.52	4.58	<.05	H1: Supported
Effort Expectancy -> Behavioural Intention to Use	-0.16	1.58	>.05	H2: Not supported
Social Influence -> Behavioural Intention to Use	0.07	0.80	>.05	H3: Not supported
Hedonic Motivation -> Behavioural Intention to Use	0.48	4.44	<.05	H4: Supported
Facilitating Conditions -> Behavioural Intention to Use	N/A	N/A	N/A	H5: N/A

7.3.1.9 Effect Size Calculations

To interpret the magnitude of the calculated effect sizes, Cohen’s (1988) interpretation criteria were used. Table 27 displays the results of the effect size calculations.

Table 27: Effect Sizes of UTAUT2 Constructs Included Within the Research Model

	BI ($R2=0.79$)		
	Path Co-efficient (β)	Effect Size (f2)	Effect Size Interpretation
PE	0.52	0.48	Large
EE	-0.16	0.06	Small
SI	0.07	0.01	No effect
HM	0.48	0.40	Large

Based upon the values reported in table 27, Performance Expectancy and Hedonic Motivation exert a large effect on the outcome variable Behavioural Intention to Use. Effort Expectancy exerts a small effect and Social Influence exerts no effect upon Behavioural Intention to Use the Wellness@Work system.

7.3.1.10 Moderator Variables

In line with the theoretical model of the UTAUT2, age was explored as a moderator between the included UTAUT2 constructs and the behavioural intention to use the Wellness@Work system. Results indicated that age did not significantly moderate the relationships between any of the UTAUT2 constructs and the behavioural intention to use the intervention (see table 28).

Table 28: Moderating Effect of Age on Behavioural Intention to Use Wellness@Work

	Path Co-efficient (β)	**T-statistic**	**P-Value**	**Hypothesis Supported**
Age*Performance Expectancy -> Behavioural Intention to Use	0.10	0.59	>.05	H6: Not supported
Age*Effort Expectancy -> Behavioural Intention to Use	-0.12	0.88	>.05	H7: Not supported
Age*Social Influence -> Behavioural Intention to Use	0.05	0.66	>.05	H8: Not supported
Age*Hedonic Motivation -> Behavioural Intention to Use	-0.07	0.59	>.05	H9: Not supported
Age*Facilitating Conditions -> Behavioural Intention to Use	N/A	N/A	N/A	N/A

To explore gender differences in the behavioural intention to use Wellness@Work, multigroup analysis was conducted. No significant differences were identified between males and females on the latent variables of performance expectancy, effort expectancy and hedonic motivation. A significant difference was identified between males and females on the latent variable of social influence (see table 29). Bootstrapping was subsequently performed to assess the differences between each gender's path co-efficients (see table 30). Social influence exerted a significant weak positive effect on behavioural intention to use Wellness@Work for females. However, no significant effect for this variable was detected for males. Results also indicated that for both males and females, performance expectancy and hedonic motivation were significant predictors of the behavioural intention to use the system. Finally, effort expectancy was not a significant predictor of the behavioural intention to use the system for either gender.

Table 29: Multigroup Analysis- Moderating Effects of Gender on Behavioural Intention to Use Wellness@Work

Path	**Path Co-efficient (β)**	**T-statistic**	**P-Value**	**Hypothesis Supported**
Gender*Performance Expectancy -> Behavioural Intention to Use	0.06	0.39	>.05	H11: Not Supported
Gender*Effort Expectancy -> Behavioural Intention to Use	-0.13	0.84	>.05	H12: Not Supported
Gender*Social Influence -> Behavioural Intention to Use	-0.36	2.74	<.05	H13: Supported
Gender* Hedonic Motivation -> Behavioural Intention to Use	0.26	1.63	>.05	H14: Not Supported
Gender* Facilitating Conditions -> Behavioural Intention to Use	N/A	N/A	N/A	N/A

Table 30: Bootstrap Analysis of Path Coefficients for Male’s and Female's Behavioural Intention to Use Wellness@Work

Path	**Gender**	**Path Co-efficient (β)**	**T-statistic**	**P-Value**
Performance Expectancy -> Behavioural Intention to Use	**Male**	0.47	3.98	<.05
	Female	0.40	3.91	<.05
Effort Expectancy -> Behavioural Intention to Use	**Male**	-0.18	1.71	>.05
	Female	-0.05	0.53	>.05
Social Influence -> Behavioural Intention to Use	**Male**	-0.17	1.53	>.05
	Female	0.19	2.55	<.05
Hedonic Motivation -> Behavioural Intention to Use	**Male**	0.68	5.21	<.05
	Female	0.41	4.00	<.05

Finally, the effects of occupational physical activity levels on the behavioural intention to use Wellness@Work were explored (see table 31). Results indicated a significant, weak negative relationship between the amount of time spent sitting at work and the behavioural intention to use the system. Both the amount of occupational standing time and occupational walking time had a significant weak positive effect on the behavioural intention to use Wellness@Work. Neither occupational moderate or vigorous physical activity levels were significant predictors of the behavioural intention to use the system.

Table 181: Effects of Occupational Physical Activity Levels on Behavioural Intention to Use Wellness@Work

Path	**Path Co-efficient (β)**	**T-statistic**	**P-Value**	**Hypothesis Supported**
Occupational Sitting Time - > Behavioural Intention to Use	-0.16	2.99	<.05	H21: Supported
Occupational Standing Time - > Behavioural Intention to Use	0.17	3	<.05	H22: Supported
Occupational Walking Time - > Behavioural Intention to Use	0.10	2.41	<.05	H23: Supported
Occupational Moderate Activity - > Behavioural Intention to Use	0.03	0.52	>.05	H24: Not Supported
Occupational Vigorous Activity - > Behavioural Intention to Use	0.13	0.03	>.05	H25: Not Supported

7.3.2.1 Content Analysis: Qualitative Feedback

Tables 32 and 33 provide an overview of the strengths and areas for development categories identified from the short-text responses alongside the number of comments within each category.

In relation to the perceived strengths of Wellness@Work, the most commonly cited factor was its co-creative nature and that employees were able to add to the website themselves. Participants also indicated that the content of the website was a key strength with interactive content, the number of resources and motivating content representing the second, third and fourth most commonly cited strengths respectively. Combined, this information suggests that not only are co-creation-based interventions desired by employees, but such interventions also produce content that is favoured by them too. The social interactivity of the intervention was also consistently cited by the participants as a strength, reflecting the point of view expressed by the co-creators about the importance of social interaction within workplace physical activity interventions. Alongside this, the presentation and structure of the website itself was positively received. The website's aesthetics, ease of use and the availability of information in one place were specifically highlighted as strengths by the participants.

Table 192: Strengths of Wellness@Work

Category	***Percentage of total statements (n)***
Employee co-creation	14.52% (18)
Interactive content	11.29% (14)
Number of resources	9.68% (12)
Motivating content	9.68% (12)
Social interaction	8.87% (11)
Aesthetic website	7.26% (9)
Coaching	7.26% (9)
Easy to use	6.45% (8)
Something for everyone	5.65 % (7)
Website prompts behaviour	4.03% (5)
Progress tracking	4.03% (5)
Barriers and facilitators identified	4.03% (5)
Everything in one place	3.23% (4)
Creates a culture of physical activity	2.42% (3)
Pure physical activity focus	1.61% (2)
Total	**100% (124)**

In relation to areas of development, the most commonly cited request was to streamline the available content. A second concern expressed by the participants was that intervention use would require organisational endorsement. Participants also suggested that the website should integrate with pre-existing tools that employees may already be using to monitor their health and that a mobile application may be an alternate effective delivery method.

Table 33: Areas of Development for Wellness@Work

Category	***Percentage of total statements (n)***
Streamline content	14.47% (11)
Organisational endorsement required	13.16% (10)
Integration with other tools	9.21% (7)
Practical routines	9.21% (7)
Easier navigation	7.89% (6)
Make a mobile app	7.89% (6)
Wider demographic representation	6.58% (5)
Reward system needed	6.58% (5)
Website aesthetics	5.26% (4)
Wider lifestyle content	5.26% (4)
Gamification	3.95% (3)
Privacy	3.95% (3)
Create own groups	3.95% (3)
Notifications from website	2.63% (2)
Total	**100% (76)**

7.3.3.1 Recommending Wellness@Work

Alongside providing qualitative feedback regarding Wellness@Work, participants also indicated whether they would be inclined to recommend the intervention to other colleagues. The majority of participants (61.5%) indicated that they would indeed recommend Wellness@Work to others. Only a small number of participants (7.5%) indicated that they would not recommend the intervention to colleagues.

Table 34: Responses to the question 'I would recommend Wellness@Work to colleagues'

Strongly Agree % (n)	Agree % (n)	Neutral % (n)	Disagree % (n)	Strongly Disagree % (n)
16.2% (24)	45.3% (67)	31.1% (46)	4.1% (6)	3.4% (5)

7.4 Discussion

The current study aimed to assess psychodemographic factors which could influence the behavioural intention to use a new workplace physical activity website. The website, grounded in the results of co-creation workshops, was assessed during its pre-implementation phase. Based upon the UTAUT2, the current study proposed a model for explaining behavioural intention to use the intervention website by incorporating the variables; performance expectancy, effort expectancy, social influence, facilitating conditions and hedonic motivation. However, due to weak psychometric properties, the variable of facilitating conditions was subsequently removed. Alongside the aforementioned variables, the moderating effects of age and gender were also explored. The research model was robust, explaining 79% of the variance in behavioural intention to use the new website and its predictive relevance was established through Q2 and goodness-of-fit statistics.

Through PLS-SEM analysis, the research model indicated that both performance expectancy and hedonic motivation play an important positive role in influencing the behavioural intention to use the intervention website. That is, as perceptions around the usefulness and enjoyability of the website increase, so too does the behavioural intention to use the website. Conversely, effort expectancy and social influence were found to not be statistically significant predictors of behavioural intention to use Wellness@Work. These findings echo the work of Carlsson et al. (2020) who established that performance expectancy and hedonic motivation were significant predictors of intention to use physical activity logging applications whilst effort expectancy and social influence were not. Hedonic motivation and performance expectancy therefore appear to be particularly salient predictors of intention to use physical activity related technology. Such findings are not surprising as across populations, perceptions of enjoyment and fun have been identified as key motivators of physical activity intervention engagement (van der Wardt et al., 2020). Furthermore, in the context of mobile health applications, perceptions that technology would be useful in supporting physical activity have been associated with higher behavioural intention to use them (Ndayizigamiye et al., 2020). However, within the model the variable of effort expectancy had a weak, non-significant negative effect on behavioural intention to use the intervention website. This finding is somewhat counter-intuitive as, in non-workplace settings, studies have indicated that the perceived ease of use of physical activity related technology is associated with higher levels of behavioural intention to use (Liu et al., 2019; Wang et al., 2020). One explanation that has been put forward to explain such effects is that users may already be familiar with similar pieces of technology and so draw upon their pre-existing experience when judging how easy the technology is to use; negating the relevancy of the effort expectancy variable (Mensah, 2019).

Given the ubiquity of social media websites and the increased use of technology within the workplace, it may be the case that participants were already familiar with similar pieces of technology and so perceptions of effort expectancy were not an influential factor in predicting behavioural intention to use the website. Alongside effort expectancy, the non-significant relationship between social influence and behavioural intention to use Wellness@Work was somewhat counterintuitive. Given that the Wellness@Work website was intended to draw up social connections between users to promote and sustain physical activity, one would expect that the positive perceptions of others would strengthen the behavioural intention to use the website. This was not the case in the research model. However, it has been posited that as experience and familiarity with a system increase the role of social influence on behavioural intention to use it decreases, particularly when the system is not mandatory (Al-Qeisi, 2009). Combined, the weak effects of effort expectancy and social influence on the behavioural intention to use Wellness@Work may share a root cause; experience. With high levels of experience using related websites, participants may have already felt confident in their ability to use Wellness@Work and so the effort required to use the website, as well as the influence of others in encouraging use of the website, was perceived to be negligible.

Alongside the UTAUT constructs, the moderating effects of age, gender and experience were also explored. Within the UTAUT model, older individuals were theorised to be less likely to engage with and adopt new technology (Venkatesh et al., 2003). Therefore, one would expect age to moderate the behavioural intention to use Wellness@Work. However, this was not the case in the current study as analyses revealed that age did not significantly moderate the relationships between any of the UTAUT constructs and behavioural intention to use Wellness@Work. One explanation for these findings may be the ubiquity of technology in modern workplaces. In workplace settings, employees are likely to be familiar with a range of technologies which are used to complete job-related tasks and activities. As such, employees across the range of working ages are likely to be comfortable engaging with technology and so age may be a less pertinent factor when exploring technology adoption in workplace settings than in other domains. Indeed, experience was not a significant moderator of the behavioural intention to use Wellness@Work. Furthermore, whilst the moderating effects of age within the current study were not consistent with the UTAUT model, the findings do appear to support the view of Olson et al. (2011) who argue that it is a common misperception that older adults do not want to use new technology. Combined, the current study suggests that age does not appear to be an influential factor in moderating employee's behavioural intention to use Wellness@Work and that employees across the working age range may be receptive to engaging with the intervention.

For both male and female groups, performance expectancy and hedonic motivation were significant predictors of behavioural intention to use Wellness@Work. However, gender differences were identified in the role of social influence. For males, social influence was not a statistically significant predictor of the behavioural intention to use the intervention website. However, for females, social influence had a small, positive significant effect. Such findings are consistent with the UTAUT model as the original authors established that the effect of social influence on behavioural intention to use appeared to be stronger for females than males (Venkatesh et al., 2003). Subsequently, wider research has also documented stronger effects on this specific variable for females (Nunes et al., 2019).

Outside of the UTAUT constructs assessed within the research model, participants were also very likely to recommend the intervention website to others; with 61.5% of respondents indicating that they would indeed recommend the website to colleagues. Such findings are particularly important given that the Wellness@Work website encourages social interaction between users. The success of the intervention may therefore hinge upon the number of people who actively engage with the website. User recommendations play a critical role in the diffusion of technology to a wider audience (Naranjo-Zolotov et al., 2019) and users are often initially attracted to use social platforms through the recommendation of close contacts (Chen et al., 2018). Therefore, the high rates of initial recommendation are an encouraging sign that the intervention would potentially reach a sufficient number of employees and justifies the continued development and exploration of the intervention. However, it is important to note that workplace physical activity interventions have been critiqued for attracting those who are already physically active (Bardus et al., 2014; Leslie et al., 2005). In the current study, there was no significant relationship between current levels of moderate and vigorous occupational physical activity and the behavioural intention to use Wellness@Work. However, there was a weak but significant effect of occupational sitting time on the behavioural intention to use the system suggesting that Wellness@Work may need further adjustments to promote engagement in employees with high levels of occupational sitting time.

Complimenting the research model, the study also considered short-answer feedback about the perceived strengths and areas for development for Wellness@Work. The most frequently cited strength of Wellness@Work was its participatory nature and that users were able to co-create content. As the most frequently cited strength the co-creation of content could, in and of itself, be a powerful motivator of sustained intervention engagement. This is particularly salient, given that many health-based websites often suffer from high attrition rates (Vandelanotte et al., 2007). Furthermore, such feedback strengthens the underlying philosophy behind Wellness@Work's development process. That is, employees want to, and should, be involved in the co-creation of interventions targeting workplace physical activity. Alongside the co-creative nature of the website, participants also indicated that the content itself was a strength of the intervention with responses including; the number of resources available, there being something for everyone and having a list of barriers and facilitators available. As the content for the website was generated by employees within co-creation workshops, such positive perceptions further strengthen the position that co-created content may be more relevant and tailored to employee's needs and expectations.

Alongside the areas of strength, participants also outlined areas for further development. The most commonly cited area for development was the need to streamline content and participant's felt that a lot of information was presented. Such feedback indicated that there may be a potential issue with choice overload in the current iteration of the website. Choice overload refers to the counter-intuitive finding that when individuals are given too many options to choose from there is often decreased motivation to choose and commit to an option; furthermore, when a choice is made lower levels of satisfaction are often reported with it (Iyengar & Lepper, 2000; Scheibehenne et al., 2010). One way to minimise choice overload in future iterations of Wellness@Work would be to simply reduce the amount of content and options available on the website. However, the arbitrary reduction of content has been criticised for its paternalistic philosophy and the potential to reduce an individual's access to content most relevant to their needs (Besedeš et al., 2015). Furthermore, removing content would run counter to the co-created ethos of the website. Therefore, a mechanism for tailoring which content is displayed may be more appropriate. One approach which has been suggested is to use self-report questionnaires in combination with 'if this, then that' algorithms to display content that is more personally relevant (Vandelanotte et al., 2015). Tailoring content in this way would allow for personally meaningful information to become more visible without preventing the user from visiting other pages if they wished to do so.

Outside of reducing content, other key areas for development largely centred around the structure and aesthetics of the website alongside the ability to integrate with existing platforms and mobile devices. Issues such as design and structure are challenging to perfect during early stage development. Indeed, the design process within participatory research is often cyclical in nature, going through repeated iterations until the best version is achieved (Glen et al., 2014). From participant feedback, additional input from co-creators around the structure of the website may be beneficial during the next stage of development. Finally, participants articulated that Wellness@Work may need organisational endorsement and dedicated time in order to be used. These findings echo the sentiments expressed by the co-creators within the co-creation workshops. That is, employees may be motivated to alter physical activity levels but can be blocked by a lack of managerial support or high workloads which preclude activity. As such, organisational support appears to be a salient factor which needs to be considered during the implementation phase. As Wellness@Work moves from pre-implementation to implementation, co-creators from senior managerial levels should be actively sought to ensure the website meets both employee and managerial needs.

7.4.1 Strengths

As with all research studies, there were a variety of strengths and limitations that should be highlighted. A key strength of the current study was that it demonstrated the viability and acceptance of co-created digital interventions in workplace settings. The Wellness@Work website was well received and participants expressed both high levels of intention to use and recommend the platform. Historically, physical activity interventions have been predominantly developed through top-down processes (Gell & Wadsworth, 2015; Krans et al., 2019; Mansi et al., 2015; Speake et al., 2016). Whilst some interventions have certainly been successful in increasing employee physical activity levels, overarching evidence for workplace physical activity interventions remains mixed (Malik et al., 2014). By demonstrating that co-created interventions are well-received and favourably viewed, the current study strengthened the rationale for more bottom-up approaches to be adopted in this domain. Furthermore, the participatory nature of the study aligned with wider calls for the democratisation of research and the inclusion of stakeholders to ensure that their needs are appropriately addressed (Reynolds & Sariola, 2018). Alongside the co-created nature of Wellness@Work, the current study also demonstrated the viability of incorporating social media elements into workplace physical activity websites. The inclusion of social media elements such as; likes, comments and shares facilitate user generated content, enabling users to continuously add new content and interact with others. Such interaction may help to keep websites dynamic and encourage continued co-creation once embedded within an organisation. Indeed, participants within the current study consistently highlighted that the ability to co-create content was a key strength of the platform. Therefore, the current study strengthened the position that including social media functionality may help to overcome known limitations of pre-existing physical activity websites such as disengagement due to static content (Marshall et al., 2003). Finally, through the use of the UTAUT model, the current study was also able to determine specific factors which influenced the behavioural intention to use Wellness@Work. Combined, the UTAUT constructs explained a substantial proportion of the variance in the behavioural intention to use Wellness@Work.

Specifically, performance expectancy and hedonic motivation emerged as significant predictors of intention to use the system. Such findings may be beneficial to those who develop and implement digital workplace physical activity interventions as it highlights specific aspects of the interventions which can be targeted to potentially increase engagement.

7.4.2 Limitations

The current study could be regarded as having three key limitations. Firstly, the current study utilised a video demonstration of the intervention rather than a live, interactive version of the website. This approach was taken as a pragmatic alternative to the high costs, technical skill and timescales associated with developing a fully functional prototype website. Therefore, participant's responses may only reflect the imagined use of the intervention and it cannot be ruled out that participant's perceptions may differ following a more interactive demonstration. However, in a direct comparison of participant evaluation feedback**,** Zinderman et al. (2013) found no significant differences in UTAUT scores between participants who used a new prototype technology and those who were shown a video demonstration of it. Qualitative feedback was also comparable between the two groups leading the authors to conclude that video prototype demonstrations are a useful and cost-effective technique for evaluating early stage prototypes. Furthermore, with complex digital health interventions video demonstrations have been cited as a viable way of communicating early-stage intervention content in a clear and consistent manner (Aria & Archer, 2019). Therefore, a video demonstration was appropriate to the intervention's stage of development. However, as the Wellness@Work website moves through its development process, interactive prototypes will become increasingly important for assessing areas of strength and development.

The second key limitation was that the research model considered only the behavioural intention to use the website rather than actual usage behaviour. Whilst appropriate for the context of a pre-implementation prototype, it does mean that no firm conclusions can be drawn regarding whether employees would consistently use the system after it has been implemented. However, the behavioural intention to use a new system has been theorised to predict actual use across a variety of models including; the UTAUT (Venkatesh et al., 2003), UTAUT2 (Venkatesh et al., 2012) and the Technology Acceptance Model (Davis, 1986). Therefore, the strong levels of behavioural intention to use Wellness@Work within the current study offer a promising sign that the intervention would indeed be used by employees; further justifying the continued development and eventual implementation of the platform.

Finally, the exclusion of the facilitating conditions variable from the research model meant that the influence of this factor on the behavioural intention to use the new website could not be assessed. Whilst the inclusion of this variable could potentially have furthered the amount of variance explained by the model, its omission during the pre-implementation stage may have had limited impact. Within the original UTAUT, facilitating conditions were theorised to influence only actual usage behaviour and not behavioural intention to use (Venkatesh et al., 2003). Furthermore, wider research has indicated that facilitating conditions may not be the best predictor for behavioural intention to use systems (Rana et al., 2012; Saprikis et al., 2020). In light of this, facilitating conditions may be more influential during the post-implementation phase and so should be reassessed once the new website has been embedded within workplace settings.

7.4.3 Conclusion

The current study has identified that a physical activity website developed around co-created materials is a viable intervention strategy in workplace settings. Participants expressed high levels of behavioural intention to use and recommend such as website, indicating that it may reach, and be used by, a wide pool of employees. Qualitative feedback from employees was also positive and strengthened the rationale for co-creating workplace physical activity interventions. Continued development of the Wellness@Work platform therefore appears warranted. As Wellness@Work moves from pre-implementation to implementation it will be important to run further co-creation workshops to refine the design of the website and gain the insight of senior managerial staff. Elements of performance expectancy and hedonic motivation could also be emphasised to further increase engagement with the intervention website.

Chapter 8 – Discussion

8.1 Introduction

The overarching aim of this thesis was to take a pragmatic stance towards workplace physical activity promotion and to develop a novel intervention that would both contribute new knowledge and be of relevance to researchers, practitioners and employees alike. This was achieved through the use of co-creation methods, leading to a more democratised approach to knowledge generation in a research area where this has often been overlooked. Each of the studies included within the thesis have contributed to a more nuanced understanding of the drivers of employee physical activity, sedentary behaviour and workplace intervention efficacy. By actively involving employees across the research process, from problem formulation to solution development, the thesis has not only given voice to employees but has also highlighted disparities between how researchers and employees address the problem of workplace physical inactivity. This chapter provides a critical discussion of the research that was conducted and highlights the contributions made to both research and practice.

8.1.1 Summary of key findings

As noted within chapter one, the first step taken by the researcher was to review the extant literature relating to workplace physical activity and sedentary behaviour intervention efficacy. This was achieved through the meta-analysis conducted within chapter two. Historically, previous meta-analyses have produced mixed results in determining whether interventions in this domain are indeed effective (Malik et al., 2014; Martin et al., 2015; Taylor et al., 2012). Conflicting findings can be particularly problematic for practitioners who need to make informed, evidence-based decisions when implementing interventions (Sylvester et al., 2017). Previous reviews have been potentially limited by focussing upon short-term outcomes and an over-reliance on self-report measures; as physical activity interventions are vulnerable to novelty effects (Hall et al., 2019; Shin et al., 2019) and individuals tend to over-estimate physical activity levels when self-reporting (Prince et al., 2020). To address these potential limitations research questions one and two were devised.

Research questions one and two sought to identify whether workplace interventions were effective after six months at increasing objectively measured step counts and decreasing objectively measured sitting time respectively. Through random-effects meta-analysis it was identified that interventions did indeed increase step counts and reduce sitting time after six months. By focussing upon intervention effectiveness after six months and only including studies that had objectively measured physical activity and sedentary behaviours, the meta-analysis has reduced the potential impact of novelty effects and over-estimation of the target behaviours. As such, the meta-analysis has provided a more accurate representation of workplace physical activity and sedentary behaviour intervention effectiveness.

Given the pragmatic stance of the author, determining intervention efficacy alone was deemed insufficient in supporting practitioners to translate research into practice; as the findings would only indicate what worked but not how or why. This led to the development of research questions three, four, five and six. Research questions three and four considered whether the number of BCTs used, a proxy for intervention complexity, was associated with intervention effectiveness for physical activity and sedentary behaviour focussed interventions respectively. Through meta-regression, it was identified that there was a significant negative correlation between the number of BCTs used and intervention effect sizes. This indicated that for interventions that aimed to increase physical activity behaviours less complex interventions were more likely to be effective. As such, researchers may benefit from designing physical activity interventions with fewer BCTs and evidence has been provided for practitioners to justify streamlining interventions when seeking to enhance their efficacy. It is important to note however, that no statistically significant relationship was identified between the number of BCTs used and intervention effect sizes for sedentary behaviour focussed interventions. This lends support to researchers who have argued that physical activity and sedentary behaviour are related but distinct constructs (Gibbs et al., 2015). Therefore, researchers and practitioners should take caution when designing and implementing interventions directed at both physical activity and sedentary behaviour.

Research questions five and six used sub-group moderator analysis to identify whether the presence or absence of individual BCTs influenced intervention effect sizes for physical activity and sedentary behaviour focussed interventions respectively. Two BCTs (information about health consequences and adding objects to the physical environment) were identified as enhancing intervention effect sizes where they were present within interventions. Five BCTs, (commitment, self-monitoring of behaviour, instruction on how to perform the behaviour, credible source and material reward) were identified as enhancing intervention effect sizes when there were not present within interventions. Through exploring the influence of individual BCTs on intervention effect sizes, the study has contributed to a more nuanced understanding of not only how published interventions work but also which aspects of interventions can be adapted without unduly compromising efficacy. As noted within chapter 1, whilst published interventions may work in the specific organisational context in which they were studied, such effectiveness does not necessarily translate into the diverse settings in which many practitioners operate (Rasmussen et al., 2018).Therefore, through the identification of specific BCTs that could be amended from within published interventions the sub-group moderator analysis has contributed to bridging a potential gap between research and practice.

In light of the pragmatic position of the author, and to address the critique that workplace physical activity intervention research has underutilised participatory approaches (Parry & Straker, 2013), a co-creational approach was taken to identify the challenges, opportunities and potential solutions to workplace physical inactivity. This led to the development of research questions seven, eight, nine and ten. Research question seven sought to understand what employees perceived to be important barriers and facilitators of physical activity and sedentary behaviour. This research question was addressed in chapter four via co-creation workshops that utilised photovoice and co-creation CUbe methods to empower participants to document perceived barriers and facilitators of physical activity. Through integrated visual thematic analysis of the co-created artefacts 13 themes were identified. The themes spanned the intrapersonal, interpersonal, organisational and environmental levels. For example the themes of; *'Self-awareness and emotional management'* considered intrapersonal aspects such as laziness, *'Social Influence: Colleagues standing up for and in the way of physical activity'* considered the role of interpersonal relationships with colleagues, *'Organisationally endorsed physical activity campaigns'* considered the active promotion of physical activity at an organisational level and *'The built environment and accessibility of equipment'* considered the influence of the wider physical environment. As such, there did not appear to be a singular, unifying component of the workplace that was responsible for influencing employee physical activity levels. Instead, there was a complex interaction of socioecological components. These findings lend support to authors who have called for a greater application of socioecological approaches to strengthen the success rates of workplace physical activity and sedentary behaviour interventions (Pronk, 2021; Sahranavard Gargari et al., 2018). As such, both researchers and practitioners should take a multi-level approach when designing and implementing interventions within this domain.

Further supporting the notion of complex interactions between socioecological factors, the study identified that barriers and facilitators of physical activity were rarely black and white. That is, the same factors could act as either a barrier or facilitator dependent upon the way in which it was encountered by employees. For example, computer technology was largely seen as a contributor to sedentary behaviour by reducing the need to move to complete work tasks and communicate with others. However, laptops were viewed positively as they enabled employees to move locations and facilitated working from anywhere. Smart technology, such as FitBit watches were also viewed favourably in actively promoting and encouraging movement throughout the workday, a finding consistent with wider literature that has noted a steady increase in the acceptability and use of technology to track physical activity data (Jin et al., 2020). These findings suggest that labelling occupational elements as barriers or facilitators may be overly simplistic and that researchers and practitioners should take into consideration more nuanced, context-dependent interactions when designing workplace physical activity interventions.

Building upon the barriers and facilitators identified by the co-creators, a second set of co-creation workshops was held to address research questions eight, nine and ten. The second set of co-creation workshops, as outlined in chapter 5, empowered participants to design new interventions to tackle workplace physical inactivity. Research question eight sought to understand which behaviour change strategies were used by employees when designing interventions and whether this differed from those that were used by researchers within the meta-analysis conducted in chapter two. Through BCT coding of the co-created interventions it was identified that the most commonly utilised BCTs were; *5.4 Monitoring emotional consequences, 12.2 Restructuring the social environment* and *12.5 Adding objects to the physical environment.* Adding objects, such as exercise equipment, into the workplace is a fairly common intervention strategy (Ben-Ner et al., 2014; Carr et al., 2012). Indeed, within the meta-analysis conducted in chapter 2 the BCT *12.5 Adding objects to the physical environment* was also one of the most commonly utilised intervention strategies within the included studies. However, none of the studies included within the aforementioned meta-analysis had utilised the BCTs *5.4 Monitoring emotional consequences, 12.2 Restructuring the social environment*. It has been noted within workplace health policy research that the explicit consideration of emotions is relatively rare despite known associations with health behaviour (Seppälä et al., 2018). Whilst emotions may not be the primary target of workplace physical activity interventions, the consistent connections made between physical activity, reduced stress and improved mood by the co-creators suggests that emotions play a particularly salient role in enhancing intervention engagement. As such, future intervention research within this domain should recognise that employees may engage with physical activity interventions for reasons other than to improve physical health and that the emotional consequences of physical activity are more fully considered. The absence of the BCT *12.2 Restructuring the social environment*, from the studies included within the meta-analysis in chapter 2 suggests that researchers may be hesitant to change social structures as part of the intervention strategy. Indeed, a key rationale for intervening in the workplace domain is to capitalise on pre-existing social structures (Edmunds & Clow, 2016; R. C. Plotnikoff et al., 2005) and therefore seeking to change them may appear counter-intuitive. However, through BCT coding of the co-created interventions it was identified that adjustments could be made, to break times and the locations in which physical activity is performed, to provide more opportunities for employees to interact and to provide a change of scenary so that employees could see each other in a different light. The discrepancy between the BCTs used within the included studies of the meta-analysis (chapter 2) and the co-created interventions (chapter 5) suggests that existing interventions may not be tapping into the interventions strategies that are most desired by employees themselves. Through the identification of specific BCTs desired by employees, yet not present within published interventions the study has contributed a tangible list of BCTs that could potentially be targeted by both researchers and practitioners to meet the needs of employees; further bridging the gap between research and practice.

Alongside BCT coding qualitative content analysis was used to address research question nine, which sought to identify common intervention implementation and evaluation strategies outlined by the co-creators. Three key implementation strategies were identified; '*Guide, Don't Tell', 'Employers Cannot Do Everything', and 'Break Times: The Golden Hour'.* Firstly, within the theme *'Guide, Don't Tell'* employees did not want their interventions to be mandated by employers. It was important that employees were given choice and overly rigid implementation was viewed as being less likely to engage employees. The rationale behind why the interventions were being implemented also needed to be transparent and communicated clearly to employees. Simply implementing the interventions would not be enough. Indeed, the co-creator's critiques reflect wider criticisms of workplace health promotion initiatives that have not consulted with employees to ascertain their needs (Spence, 2015). Furthermore, leaders needed to be seen visibly engaging with the interventions after they have been implemented. This finding was consistent with the extant literature that has identified managerial support as being an important factor in enhancing participation rates with workplace physical activity programmes (DeJoy et al., 2009).

Within the theme *'Employers Cannot Do Everything',* employees were also acutely aware that employers would not be able to do everything. There was an appreciation of the costs and resources required to deliver physical activity programmes. To overcome these, the co-creators suggested interventions which drew upon mutually beneficial partnerships between organisations, providing online resources and leveraging the availability of freely available outside spaces. Certain guidelines for employers have suggested that employee expectations need to be managed to ensure health promotion interventions are realistic (NICE, 2015). However, through the analysis of the co-created interventions it was clear that not only are employees aware of potential costs but can actively help to overcome them if involved in the intervention design process; further supporting the need for more participatory approaches to intervention development and implementation.

The final implementation strategy identified was to anchor interventions around break times. Lunch breaks play an important role in fatigue recovery (Trougakos et al., 2014) and employees are known to self-select the strategy of using lunch break to increase physical activity whilst at work (Croteau, 2004). The strategy of anchoring interventions around break times was therefore consistent with wider literature. However, additional breaks were added to the workday within the co-created interventions suggesting than existing lunch breaks may not be sufficient in promoting physical activity. There is evidence to suggest that additional physical activity breaks embedded within the workday can be effective (Taylor et al., 2016) and so may represent a viable strategy for enhancing intervention engagement and reach. Combined, the analysis of implementation strategies used by the co-creators has given tangible information as to how researchers and practitioners could maximise intervention efficacy. This is important to note as interventions are unlikely to be fully effective if they cannot reach the target population or are implemented inappropriately (Fernandez et al., 2019).

Qualitative content analysis was also used to address research question ten, which sought to understand how employees determined intervention effectiveness. A primary concern expressed by the co-creators was that sharing personal health data with employers may lead to resistance. This perception is consistent with wider concerns around the ethical issues of tracking individual health data (Marcengo & Rapp, 2014). As such, the co-creators suggested that the sharing of individual data should be voluntary. However, organisations could potentially use aggregated data to determine intervention effectiveness. Whilst direct outcome measures of physical activity, such as weight, BMI and blood pressure were identified by the co-creators, emphasis was also placed on the importance of measuring mental health and emotional outcomes. Good mental health was identified as both a pre-cursor to intervention engagement and a desired outcome. Therefore, employees may be engaging with physical activity to reduce stress and improve mood rather than to improve physical health outcomes. Understandably, research studies within this domain tend to eschew measures of mental well-being in favour of either self-report or objective measures of physical activity to determine intervention effectiveness. This thesis has therefore highlighted a potential discrepancy between how employees and researchers evaluate intervention success. Such a discrepancy could be indicated of pedantic science practices, where the findings are of interest to researchers but of limited impact in real-world settings. As such, future research may need to take a more holistic approach in determining workplace physical activity intervention effectiveness beyond the direct measures of interest to the researcher themselves.

Finally, research question eleven was addressed within chapter seven. Chapter seven outlined how the co-creator’s contributions were synthesised into a new online intervention comprising of a workplace physical activity social network called Wellness@Work. Structural Equation Modelling revealed that a substantial amount of variance, 79%, of the behavioural intention to use Wellness@Work could be explained by a modified version of the UTAUT2, a questionnaire designed to measure technology acceptance and use. Specifically, the UTAUT constructs of performance expectancy, effort expectancy, social influence and hedonic motivation were used. Of these constructs, performance expectancy and hedonic motivation were identified as significant drivers of the behavioural intention to use the system. These findings were consistent for both males and females. Both performance expectancy and hedonic motivation have previously been identified as key drivers of use for digital physical activity logging applications (Carlsson et al., 2020). The significant effect of these UTAUT2 constructs in the context of Wellness@Work suggests that these may be important factors to target within digital workplace physical activity interventions. One area of differentiation between males and females however was the role of social influence. Social influence had a statistically significant positive relationship with behavioural intention to use Wellness@Work in females but not males. This is consistent with extant literature that has established that the effect of social influence on behavioural intention to use technology appeared to be stronger for females than males (Venkatesh et al., 2003). In light of this, the engagement of female employees with digital workplace physical activity interventions could potentially be enhanced by providing a platform to share thoughts and perceptions about the value of the intervention.

Outside of gender, age did not moderate the relationships between any of the UTAUT2 constructs and the behavioural intention to use Wellness@Work. Historically, there has been a common misperception that older adults do not want to use new technology (Olson et al., 2011). The findings presented within chapter 7, indicated that this was not the case and that, in workplace settings, digital physical activity interventions may be less effected by age differences as employees are often already familiar with diverse technologies. Combined, the research has provided insights into intervention elements, namely performance expectancy, hedonic motivation and social influence, which could be actively promoted to enhance interest and engagement during implementation. Such findings should help practitioners to translate the intervention into practice.

Furthermore, the study has demonstrated that a workplace physical activity social network, grounded in co-created materials, appears to be something that is well-received, employees would intend to use and would recommend to others.

8.1.2 Strengths and Limitations

First and foremost, the thesis has contributed a new, viable, workplace physical activity intervention to the literature. The intervention, grounded in co-created materials, represents a shift away from traditional top-down approaches and has instead been developed by employees for employees. The co-created intervention has helped to address a key critique of the extant literature which has historically underutilised participatory approaches to workplace physical activity intervention development (Parry et al., 2013). Therefore, the thesis represented an important paradigm shift in this specific research area. Through adopting co-creational approaches, the thesis has also contributed to a more nuanced understanding of the barriers and facilitators of physical activity commonly experienced by employees. The systematic identification of barriers and facilitators has provided additional context for researchers as to which elements of the working environment may benefit from intervention. Furthermore, as the co-creators both defined problems and developed solutions to overcome them, the thesis has identified a series of intervention design components which are desired by employees. As these components were developed by employees themselves, interventions which adopt them may be perceived as being more relevant and useful. Researchers and practitioners can therefore benefit from these intervention design components to help maximise intervention engagement. This is important as, historically, workplace physical activity interventions have witnessed substantial declines in engagement over time (Crandall et al., 2016; Vandelanotte et al., 2007). The inclusion of employees from a variety of organisational backgrounds and levels of seniority was also a key strength of the co-creational approach. This enabled the thesis to consider a range of perspectives and experiences; helping to ensure that a breadth of barriers, facilitators and interventions were captured. Bringing together employees from diverse occupational backgrounds also helped the co-creators to understand and empathise with the experiences of others, offering outside perspectives and suggestions to help produce novel solutions. Through adopting co-creational approaches, the thesis has demonstrated that democratic, participatory methods are indeed viable intervention development strategies in an area where this has often been overlooked.

Complimenting the participatory and democratic contribution, the thesis has also demonstrated the viability of arts-based methodologies in workplace physical activity research. A dearth of literature currently exists that has used arts-based methodologies to investigate employee physical activity behaviours. Indeed, arts-based methods have been often been viewed as being divergent with mainstream psychological approaches (Carless & Douglas, 2016). The findings of this doctoral research have demonstrated that this is not the case. Arts-based approaches can be used to successfully explore complex health behaviours such as physical activity and are well received by participants. Furthermore, evidence has been provided that both novel arts-based methods, such as co-creation CUbes, and more traditional methods, such as photography and poster creation, can be applied successfully to understand the perceptions, experiences and ideas of employees. The methodologies and procedures outlined within this doctoral thesis therefore provide a foundation of support for authors who wish to adopt novel and creative methods in the exploration of employee health behaviours. Alongside demonstrating the viability of arts-based methodologies in workplace health research, the findings of this doctoral thesis have also demonstrated that participant generated photographs can be an invaluable source of data and so should be formally analysed as part of the research process. Through integrated visual thematic analysis, it has been demonstrated within the doctoral thesis that compositional and content similarities between participant generated photographs can be identified and grouped thematically to support wider text-based discussions. This stands in contrast to many photograph-based research studies which have often excluded the images themselves from the data analysis and instead utilised photographs as elicitation prompts for wider interview discussions (Smetaniuk et al., 2017; Stadtlander et al., 2017). It is therefore suggested that studies which exclude participant generated photographs from analyses may be underutilising important data; to help overcome this, examples of how such data can be handled and incorporated into the formal research analyses have been outlined within the thesis; supporting future research in this area.

Another key strength can be derived from the meta-analytic review of the workplace physical activity literature. The thesis has extended upon previous reviews by overcoming the potential limitation of self-report bias and considering long-term effects. Through the review, it was established that workplace interventions are indeed effective at increasing employee physical activity levels and reducing sedentary behaviour; supporting and justifying continued research in this area. A further strength of the review was its consideration of behaviour change techniques. Through this, the thesis was able to demonstrate how the number of techniques used can influence efficacy differentially for physical activity and sedentary behaviour focussed interventions. Such findings may help researchers to refine existing interventions and support the development of future interventions to maximise their impact. Intervention designers may benefit from simplifying interventions and drawing upon fewer behaviour change techniques when seeking to increase employee physical activity levels in the long-term.

Finally, an important contribution of the thesis was its deconstruction of factors that influence the behavioural intention to use a workplace physical activity social network. Through the use of the UTAUT2 and structural equation modelling, the thesis was able to identify that performance expectancy, hedonic motivation and social influence are important contributors to the behavioural intention to use such interventions. These findings make a valuable contribution to researchers and practitioners who design or implement website based physical activity interventions. A substantial amount of the variance on the behavioural intention to use the system could be accounted for by the research model within the thesis. Therefore, intervention designers who are working with similar digital interventions can leverage these findings to maximise intervention engagement.

The sample size within co-creation groups may be regarded as a potential limitation of the research. As part of the research process, co-creators were sought from a variety of organisations, job roles and levels of seniority. Such diversity enhanced the breadth of experience and ideas brought to the co-creation workshops. However, differences in geographical locations and working patterns made it logistically challenging to bring each of the co-creators together into a single workshop. Such logistical challenges are commonplace in co-creational based research. Indeed, it has been argued that for researchers co-creation is not an easy methodology and can be labour intensive requiring substantial organisation and co-ordination (Ward et al., 2018). To overcome these challenges, a two-tiered approach was developed. Co-creators whose locations and working patterns were compatible worked synchronously in smaller groups to complete the first workshop activities. At the beginning of the second workshop, participants were given the opportunity to look over the materials produced by the other groups, to reflect upon the ideas presented and were able to include ideas generated from both within and outside of their own group to support the design and development of their interventions. This represented an asynchronous approach to co-creation.

Alongside sample size, a second limitation of the research was that participants were shown a video demonstration of Wellness@Work rather than a functional, interactive version of the website. As such, the final intervention was assessed only in terms of its perceived usability and acceptability by employees. Therefore, the thesis is unable to comment upon whether the intervention would produce statistically significant changes on physical activity outcome measures. Given the complexity associated with developing a functional social network website, it was not feasible for the researcher to produce a live, interactive version with the resources available. An alternative approach could have been to integrate the content of Wellness@Work into an existing social network such as Facebook. However, all large social networks are proprietary and do not give researchers the ability to alter functionality to match study designs (Garaizar & Reips, 2014). There have also been concerns expressed around the protection of participant data which has been collected through independent social networks (Arigo et al., 2018). Therefore, this alternative approach was deemed unviable. However, whilst unable to comment upon actual behaviour change, through assessing the usability and accessibility of the website the thesis was able to demonstrate that Wellness@Work is a viable intervention and is likely to be used and recommended by employees. Given that grant applications are typically assessed in terms of originality, relevance and feasibility (Hug & Aeschbach, 2020), such early findings are promising for securing funding for the continued development of the co-created intervention.

8.1.3 Recommendations for future development and research

As stated, preliminary findings suggest that Wellness@Work is a viable and well-received intervention. The thesis has provided evidence that employees from a variety of occupational roles intend to use the platform and would also recommend it to others. In light of this, funding should be sought to continue the development of the platform so that a fully functional version can be tested in workplace settings with a broader range of employees from different demographic background. As Wellness@Work moves into the implementation stage, additional assessments of the intervention's efficacy will need to be performed. As identified by the co-creators within the thesis, outcome measures should comprise not only of physical activity and sedentary behaviour but also consider mental health and well-being outcomes too. This stands in contrast to the wider intervention literature within this domain which has predominantly focused upon physical activity and sedentary behaviour outcomes exclusively (de Cocker et al., 2010; Mason et al., 2018).

Alongside physical activity, sedentary behaviour and mental health outcomes the UTAUT2 constructs should also be reassessed following implementation. Whilst the behavioural intention to use a new piece of technology is significantly associated with subsequent use (Venkatesh et al., 2012), it important to confirm this post-implementation. Furthermore, the constructs of habit and usage should be added to the predictive model that was assessed within the thesis, as these constructs specifically relate to technology which is available for use by individuals (Venkatesh et al.,

2012) and can therefore only be measured post-implementation. The construct of facilitating conditions should also be revisited to assess the impact of organisational support and available resources on usage behaviour. Such factors were salient to the co-creators across the workshops and so may play an important role in actual usage behaviour.

Intervention efficacy should also be assessed longitudinally. A limitation of many health focussed co-created interventions is a lack of longitudinal impact evaluation, with authors often citing intensive resource requirements as a key barrier (Halvorsrud et al., 2021). Wellness@Work is well placed to overcome this limitation. As a digital social network, once the platform has been embedded within an organisation, intervention evaluation assessments can be sent directly to user accounts from within the platform itself. Users may also opt-in to sharing physical activity related data for research purposes, automating longitudinal data collection. The self-contained nature of Wellness@Work is therefore a key asset which should be utilised in establishing the long-term efficacy of the platform.

Outside of the continued development of Wellness@Work, the thesis has identified that both participatory and arts-based research methods are effective in supporting the development of viable workplace physical activity and sedentary behaviour interventions. Future research could therefore consider adopting creative, participatory methods to explore more specific occupational roles. For example, the rapid transition to remote working for many following the COVID-19 pandemic revealed a significant lack of knowledge around occupational health factors faced by remote workers including physical activity (Tronco Hernandez, 2020). The participatory and arts-based approaches utilised within the thesis my represent one way in which this lack of knowledge could be addressed. Outside of desk-based work, certain occupations, such as haulage drivers and taxi drivers, also spend a substantial portion of their workday engaging in sedentary behaviour due to the nature of their role (Passey et al., 2014).Such occupations are comparatively under-researched within the physical activity literature and so the methods outlined within the thesis could also be extended to help understand, support and design interventions to meet the needs of employees in these roles.

8.1.4 Conclusion

Workplace physical activity intervention research sits at a key inflection point. Previous evidence regarding the efficacy of such interventions has been mixed (Pereira et al., 2015; Taylor et al., 2012). One explanation for the mixed efficacy of interventions has been an underutilisation of participatory approaches (Parry et al., 2013). Indeed, within the meta-analysis conducted by the author only one of the included studies described involving employees in any capacity during the intervention design process; suggesting that an underutilisation of participatory approaches continues to be an issue. In the context of a widening gap between research and practice (Rynes-Weller, 2012) and growing distrust of even robust organisational research by employees (Rynes et al., 2018), the lack of stakeholder involvement within workplace physical activity intervention development was concerning. The author sought to address such issues through adopting a position of pragmatic science and by actively involving employees across the development process of a new workplace physical activity intervention.

As noted, across the thesis the author adopted a position of pragmatic science and sought to conduct research that was both academically rigorous and practically relevant. Each study has contributed to both a more nuanced understanding around influences of employee physical activity and sedentary behaviour. Furthermore, tangible targets for intervention development and adaptation have been identified through the use of BCT coding. For example, the meta-analysis conducted within the thesis not only identified whether workplace physical activity and sedentary behaviour interventions were effective but also identified the specific BCTs that contributed to intervention efficacy. Through the list of BCTs produced, practitioners are better placed to make informed decisions as to which elements of published interventions could be changed to meet client's needs without unduly compromising intervention efficacy.

Furthermore, through the use of co-creation methods the author has been able to identify key barriers and facilitators of physical activity from the perspective of employees themselves. This has helped to give a voice to employees within the literature in an area where participatory approaches have often been overlooked. Through the artefacts produced by the co-creators, and the subsequent analysis by the author, more contextualised information around the challenges and opportunities faced in real-world settings has been documented; providing a stronger connection between research and the environments in which practitioners operate. By actively involving employees in both the problem identification and solution formulation phases, the author was also able to identify what employees wanted and needed from workplace physical activity interventions and how this differed from approaches often taken by researchers. For example, employees evaluated the success of physical activity interventions by the impact it had on mental well-being, yet mental well-being is not often measured as a primary outcome within workplace physical activity intervention studies. Furthermore, through BCT coding of the co-created interventions inconsistencies between employee generated and researcher generated behaviour change strategies within interventions were determined. This made it possible to identify specific ways in which employees and researchers differ in their perceptions of how physical activity can be increased in workplace settings; highlighting explicit areas of the literature where a research-practitioner gap may be present.

Finally, a new digital workplace physical activity intervention, grounded in co-created materials, has been developed and its feasibility assessed. The new intervention was well received by employees and there were high levels of behavioural intention to use the system. Following further evaluation post-implementation, the new digital intervention could be directly applied by practitioners working in the field of employee health promotion. Furthermore, through the use of the UTAUT2, specific sociodemographic variables associated with the strength of the behavioural attention to use the system have been identified. Consistent with the pragmatic stance of the wider thesis, such information will enable both researchers and practitioners alike to adapt and enhance the intervention without unduly effecting the target population's behavioural intention to use the system; making it easier to implement in the different settings in which practitioners operate. Combined, the thesis has demonstrated that participatory approaches to intervention development are viable within workplace physical activity research and can successfully contribute knowledge that helps to bridge the gap between research and practice.

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Appendices

Appendix 1: Example search strategy

Physical Activity/Sedentary Terms
1. “Physical activit*” (TI) [8,512]
2. “Physical activit*” (AB) [20,413]
3. “Physical fitness” (TI) [712]
4. “Physical fitness” (AB) [1,779]
5. Exercis* (TI) [11,249]
6. Exercis* (AB) [47,779]
7. “Aerobic Exercis*” (TI) [444]
8. “Aerobic Exercis* (AB) [1,092]
9. Movement (TI) [22,922]
10. Movement (AB) [100,261]
11. Fitness class* (TI) [5]
12. Fitness class* (AB) [51]
13. Exercise class* (TI) [35]
14. Exercise class* (AB) [207]
15. Pedometer (TI) [131]
16. Pedometer (AB) [578]
17. Walk* (TI) [3,414]
18. Walk* (AB) [17,814]
19. Run* (TI) [3,893]
20. Run* (AB) [34,173]

21. Bicycl* (TI) [400]
22. Bicycl* (AB) [1,546]
23. Cycl* (TI) [9,876]
24. Cycl* (AB) [49,011]
25. “Cycle to work” (TI) [4]
26. “Cycle to work” (AB) [33]
27. Yoga (TI) [804]
28. Yoga (AB) [1,656]
29. Pilates (TI) [25]
30. Pilates (AB) [40]
31. Sedentary (TI) [747]
32. Sedentary (AB) [3,986]
33. “Sedentary lifestyle*” (TI) [25]
34. “Sedentary lifestyle*” (AB) [492]
35. Sitting (TI) [415]
36. Sitting (AB) [3,649]
37. “Occupational sitting” (TI) [8]
38. “Occupational sitting” (AB) [15]
39. Standing (TI) [964]
40. Standing (AB) [12,944]
41. Inactiv* (TI) [1,097]
42. Inactiv* (AB) [10.489]
43. OR 1-60 [286,256]
44. OR 1-60 *(Without movement & cycle TI/AB)* [143, 461]
Workplace Terms

45. Workplace* (TI) [7,030]
46. Workplace* (AB) [22,419]
47. Worksite* (TI) [563]
48. Worksite* (AB) [1,190]
49. “Place of work” (TI) [16]
50. “Place of work” (AB) [379]
51. Employer* (TI) [1,183]
52. Employer* (AB) [10,291]
53. Organisation*(TI) [3,207]
54. Organisation* (AB) [12,987]
55. Organization* (TI) [41,950]
56. Organization* (AB) [175,834]
57. Office* (TI) [5,317]
58. Office* (AB) [29,316]
59. Factory (TI) [518]
60. Factory (AB) [2,444]
61. “Occupational Health” (TI) [433]
62. “Occupational Health” (AB) [1,551]
63. OR 63-89 [273, 585]
Employee Terms
64. Employee* (TI) [10,684]
65. Employee* (AB) [44,420]
66. Worker* (TI) [14,259]
67. Worker* (AB) [69,241]
68. Workforce* (TI) [1,323]

69. Workforce* (AB) [8,804]
70. Staff (TI) [6,979]
71. Staff (AB) [57,132]
72. Personnel (TI) [5,697]
73. Personnel (AB) [27,491]
74. OR 91-105 [202,913]
Combining Terms
75. 61 & 90 & 106 [4,239]
76. 62 & 90 & 106 [2,727]
77. *(Limits applied to 108)* LIMITS – All journals, peer reviewed journal, peer reviewed (status unknown) , dissertation abstract [2,377]

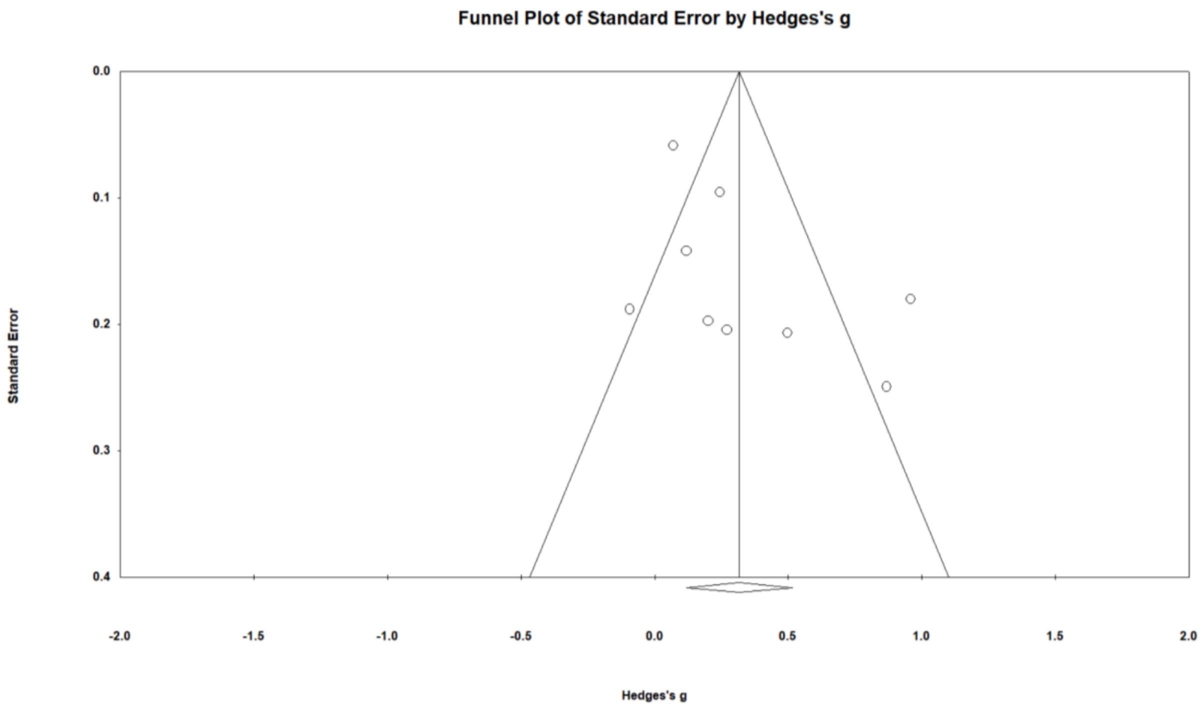
Appendix 2: Rationale for Meta-Analysis Exclusion Criteria

Primary empirical studies of interventions designed to target physical activity or sedentary behaviour within workplace settings were included. Non-primary studies, such as systematic reviews, meta-analyses, theoretical papers and discussion papers were not eligible for inclusion. As the focus of the review was to ascertain sustainable behaviour change over time no date limits were applied to the searches. To reduce potential for bias, no language limits were applied. Studies not written in the English language were translated into English via Google translate. Google translate has been determined to be a viable translation tool within previous systematic reviews and meta-analyses (Henderson et al., 2014; Hooi et al., 2017; Nikolaidis & Gray, 2010). Studies with varied intervention designs were also included. Whilst randomised control trials (RCT) are viewed as the strongest research design, in many workplace settings RCTs can often be problematic or even unrealistic (Neumann et al., 2010). Issues around cost and spill-over effects leading to contamination can make RCT study designs impractical to implement within organisational settings (Rossi et al., 1999). Therefore, RCTS, control trials, pre-post and quasi-experimental designs were eligible for inclusion into the study.

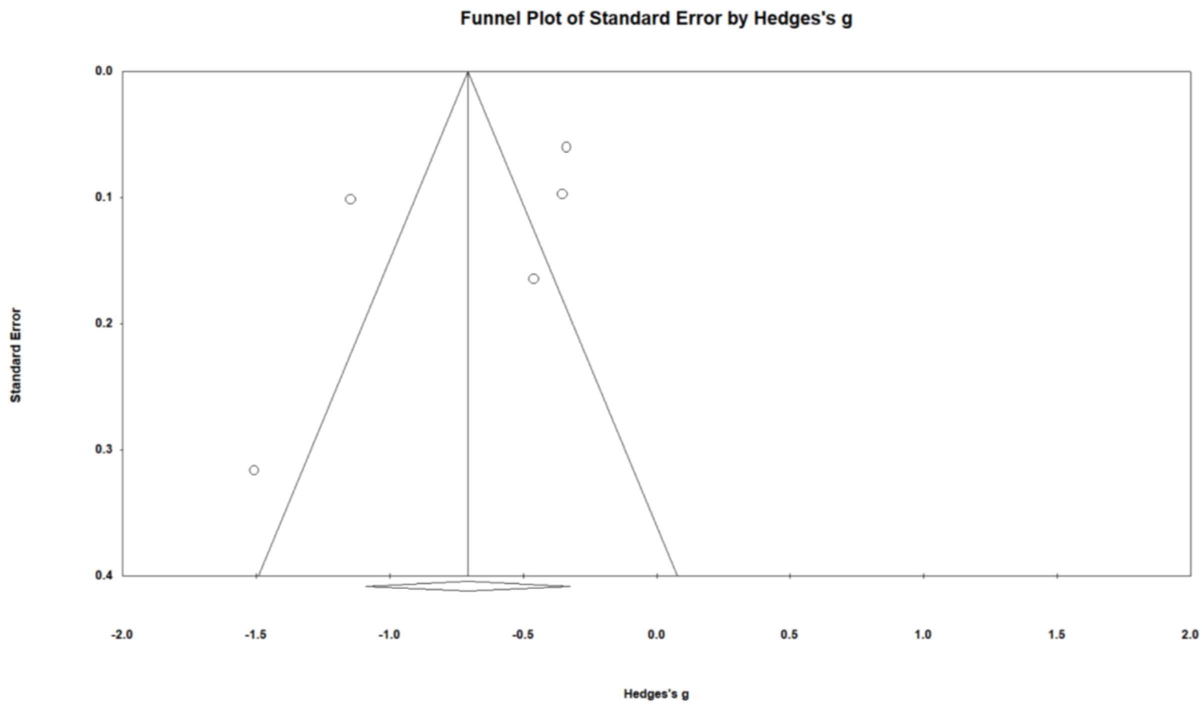
Studies that focused exclusively upon markers of employee fitness were excluded. Whilst there is a relationship between physical activity and physical fitness, physical activity is not synonymous with physical fitness (World Health Organisation, 2020). Physical fitness has been defined as a 'complex multidimensional construct consisting of cardiorespiratory fitness, muscular strength, flexibility, and body composition' (Petersen et al., 2021). Given their focus upon cardiorespiratory fitness and muscular strength, workplace fitness programmes often require investment in facilities such as; on-site fitness centres, qualified personal trainers and group exercise classes (Hunter et al., 2018). Such investments are often costly and may be impractical to implement *en masse* within workplace settings. Recent updates to government guidelines have removed the requirement for physical activity to be conducted in continuous bouts and instead recognises the potential health benefits of sporadic and incidental physical activity incorporated throughout the day (Piercy et al., 2018). In light of this, interventions targeting sitting time and light to moderate physical activity were also eligible for inclusion as they may represent a more accessible form of physical activity for employees and organisations alike.

As the primary focus of the review was to ascertain the effectiveness of interventions which aimed to influence physical activity and sedentary behaviour levels whilst employees were at work study interventions had to take place during formal working hours. This therefore precluded interventions based around active travel and initiatives, such as discounted gym memberships, which encourage physical activity outside of working hours. Also, study participants must have been considered generally healthy and were not using the intervention as part of a treatment for a self-identified or clinically diagnosed condition. Consistent with other meta-analyses, healthy was defined as individuals who did not possess a significant injury, long-term physical incapacity or were seeking treatment or rehabilitation from a chronic condition (Howlett et al., 2019). As the study sought to overcome the limitations of self-report measures, papers were required to have measured physical activity and sedentary behaviour objectively using either a pedometer or actigraph. Primary outcome measures would include the number of steps per working day, the number of minutes spent performing physical activity or sedentary behaviour and the percentage of the workday spent engaging in physically active or sedentary behaviours.

Appendix 3: Funnel Plots

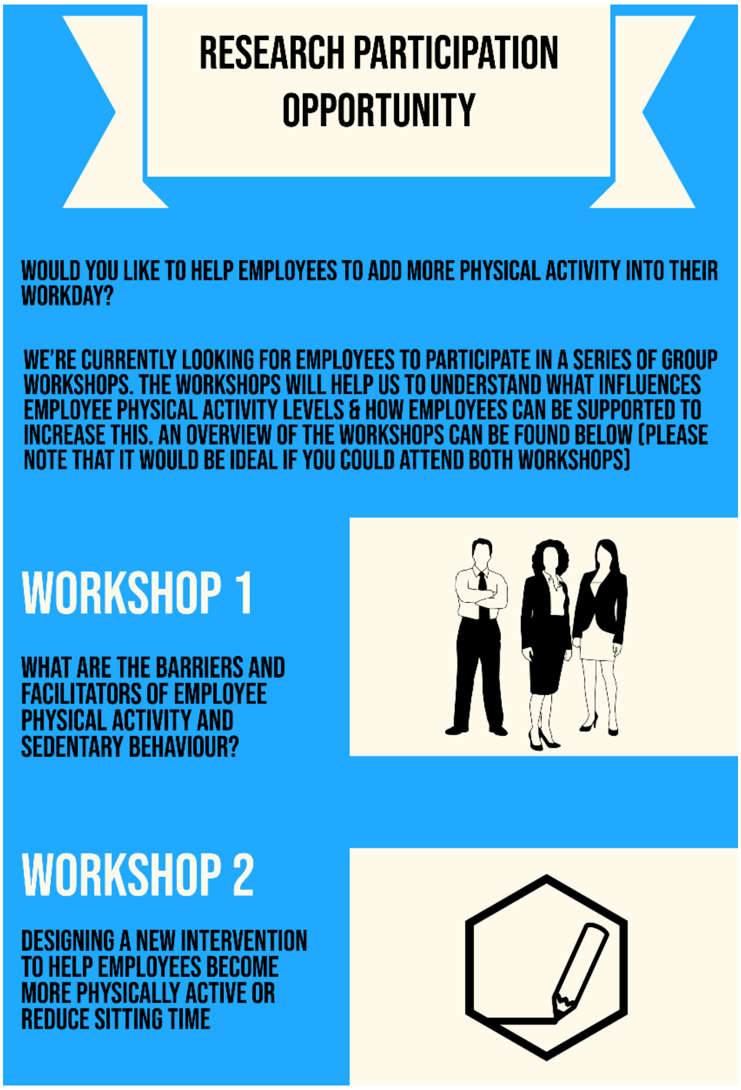


Funnel plot for studies investigating average steps per workday



Funnel plot for studies investigating average minutes spent sitting per workday

Appendix 4: Co-creation Study Advert

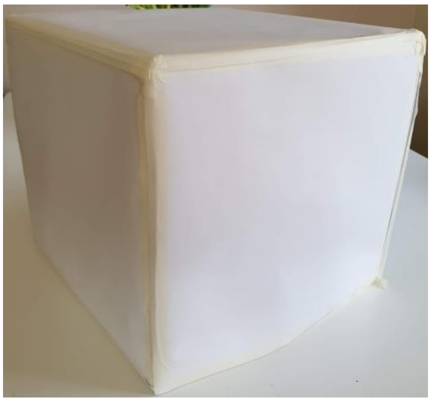


Are you interested in employee physical activity or the amount of time that employees spend sitting at work? I am looking for employees to participate in two workshops to help understand what influences employee physical activity and sedentary behaviour. During the workshops you'll be working in groups to identify the barriers and facilitators of employee physical activity and then have the opportunity to design an intervention that you feel would help employees to be more physically active whilst at work. It's a great opportunity to work with others and share your thoughts and ideas on this topic. As the two workshops are connected it would be ideal if you could attend both sessions. If you would like to know more information, or if you have any questions about the research study, please contact Anthony (ab9738@coventry.ac.uk).

Thank you for your time.

Appendix 5: Co-creation CUbe Instructions

You're about to be give a blank cube covered in paper:



In your group, you will be asked to work together to identify what the potential barriers and facilitators of employee physical activity are. You can write on any surface of the cube, you can draw pictures and you can draw lines between ideas that you feel are related.

Please write down the barriers of physical activity using the RED pen provided.

Please write down the facilitators of physical activity using the GREEN pen provided.

As the CUbe is portable, please do walk around the building and its perimeter as you think about the potential barriers and facilitators, you never know what might spark an idea! However, please do be mindful of your surroundings and avoid disturbing other employees. Also, please do not:

- Enter a location that has been explicitly identified as no access, limited access or restricted access by the organization
- Enter a location that puts yourself or others at physical risk
- Enter a location that would significantly disrupt the work being conducted by others

Appendix 6: Extract of Co-creation CUbe TDF Domain Coding

CUbe Statement - Facilitators	TDF Domain [AT]	TDF Domain [Co-creator]
Going to see clients and suppliers from local businesses within the area	Social/Professional Role and Identity	Agree
Meetings with other departments at their office	Social/Professional Role and Identity	Agree
Cross-functional meetings (I have to walk to other departments & desks)	Social/Professional Role and Identity	Agree
Scary boss can summon me to their office at any moment	Social/Professional Role and Identity	Disagree - Belief about consequence

Appendix 7: Co-creation CUbe Facilitators Mapped onto TDF Domains

TDF Domain	Frequency	Indicator [Participant group]
Social/Professional Role and Identity	31 (41.89%)	Going to see clients and suppliers from local businesses within the area [D] Meetings with other departments at their office [C] Cross-functional meetings (I have to walk to other departments & desks) [C] Teamwork – moving to help others around store [B] Busy times – rushing around dealing with customers and colleagues [C] Time limits & turnaround times to re-set puzzles in rooms. [B] Teaching: Standing up [A] Task- Stacking shelves & moving cages [B] Leading training sessions – stood at front [B]

		Floor moves (visual merchandising, moving items around the store, creating displays) [C] Laying out sales – moving and placing items in display cupboards [D Hosting – customer facing roles need to be animated and engaging [B] When customers call in and I have to go check the stock for them there and then [C] When I have visitors or suppliers in and I give them a tour and walk with them to different departments Seeing customers (moving to greet [C]) Showing our merchandise to customers in Birmingham and London. Have to pick up, collect, show and put away which involves a lot of movement.[C] Teamwork – moving to help others around store [B] Collecting post (work and personal parcels- ASOS!) [C] Walking around office to get bags, pick up printing etc [D]

		Re-filling office supplies e.g. paper in printer, getting staples, emptying shredder etc [D] Going to the equipment cupboard to pick up bits of equipment to open a watch [D] Finding ‘lost’ items – tracking down who is working them [D] Having to walk to different buildings/offices to give forms in face to face [A] Travelling to and from meetings [A] Getting deliveries from warehouse- walking, lifting [C] Travelling to the London office- walking to/from stations and tubes [C] Loading and unloading the van that transports goods between buildings [D] Opening the vault & closing the vault after picking up items [D]

		Walking between offices for a delivery [D] Seeing customers in a different building – have to walk between offices [D] Running errands: Moving between offices [A] Checking the other shop floors (level 1 & 4) [C]
Environmental Context & Resources	24 (32.43%)	Fire alarm drills – everyone leaves building & walks to safety point [B] Sunshine & Warm weather [A] Being away from main campus, lots of stairs [A] Availability of stairs [A] Nearest car park being far away [A] Stairs to key facilities e.g. canteen & toilets [B] Visible stairs [B]

		Tiny storage area for product makes me move stock between areas quite regularly [C] When the lift is broken and I have to take the stairs [C] Walking distance at work: between buildings, offices [A] Walking between offices/outside space [B] Moving between offices [C] Serving customers on till (standing up as no seating on till) [C] Laptop- the fact I have a laptop for work means that I can move around and work from anywhere [C] fitness equipment & facilities [A] Sit/stand desks & hot desking [B] Uncomfortable chairs [B] Lunchtime walks [B]

		Going out for lunch, coffee, visiting on site coffee shop and canteen- Yum! [C] Getting an hour for lunch- means I can walk into town [C] Making a cup of tea [D] Walking into town or home at lunchtime for food [D] Going to the loo [D] Getting a biscuit from the kitchen as it is on a different floor [D]
Social Influences	9 (12.16%)	Colleagues: Supportive & encouraging (X encouraging stairs!) [A] Socialising with colleagues and discussing the weekend [C] Workplace campaigns/charity [A] Workplace raising awareness [A] Charity events e.g. race for life [B]

		Meeting friends for lunch [B] Costa, coffee, lunch, shops – going out with colleagues for breaks [B] Positive peer influence [A] Going to look at something on another colleague's computer [D]
Beliefs about Consequences	2 (2.70%)	When my back starts hurting I have to move [D] Scary boss can summon me to their office at any moment [C]
Reinforcement	2 (2.70%)	Half-price gym membership and incentives [B] Limited break times to sit down for long periods of time [B]
Intentions	1 (1.35%)	Motivation [A]
Memory, Attention, Decision Process	2 (2.70%)	This study! [A] Writing on the box! [D]
Behavioural Regulation	2 (2.70%)	Fitbit [A]

		When my Fitbit tells me to move! [D]
Emotion	1 (1.35%)	Feeling well, general wellness [A]
Beliefs about Capabilities	0 (0%)	None identified
Optimism	0 (0%)	None identified
Goals	0 (0%)	None identified
Knowledge	0 (0%)	None identified
Skills	0 (0%)	None identified

Co-creation CUbe Barriers Mapped onto TDF Domains

TDF Domain	Frequency (% of total barriers)	CUbe Statement [Co-creation group]
Social/Professional Role and Identity	29 (52.73%)	Training courses (full day or more), face to face or online [B]
		Being sat down whilst in meeting [A]
		Meetings face to face/skype (sat down) [B]
		Staff reviews – back to back meetings to talk through development [C]
		Doing job interviews – long period of time sat down [C]
		Meetings with management when work is busy [C]
		Monday trade meetings (starting the week sat down) [C]
		Useless meetings (unnecessary) [C]
		Meetings involve sitting [D]
		Workload: Marking, being busy [A]
		To do list (lots of work to fit into day) [C]

		Lots of admin work to do [D] Safety procedures (having to wait for two people to move cages) [B] Paperwork – sat down at desk [C] Inputting delivery sheets (computer work) [C] Putting customer interactions above being away from station [B] Getting held up by ‘chatty’ customers when on the phone or sat down during valuations [D] Assisting colleagues (sat down at their desk) [B] Having to respond to lots of emails [C] Computers, emails [A] Dealing with customer enquiries via email [C] Replying to emails – sat down at desk [C] Answering phone calls and emails keep me at my desk [D]

		telephone conversations, emails [D] Situational constraints: job tasks which require sitting [A] Desk based work [B] Working on tills requires sitting down [B] Uncomfortable footwear/uniform [B] When I have a directors meeting and I have to wear heels – uncomfortable walking around for too long [C]
Environmental Context & Resources	13 (23.64%)	Illness & not feeling well [A] Cold & Wet [A] Heat & the weather [D] convenience of lifts [A] nearest car park being close [A]

		Building environment, poor heating & lighting in certain places discourages moving away from office [B] Carpark close to work [B] Using technology to communicate e.g. walkie talkie [B] IT – Zoom/Skype meetings mean I can talk to people anywhere but always connected to my desk. [C] Rubbish wifi in building means I have to use hard connection at desk [C] Office chairs & desks On sofa watching CCTV monitors – uninterrupted [B] Comfortable chairs [B]
Intentions	6 (10.91%)	Motivation [A] Laziness: Lack of motivation [A] My own laziness sometimes (especially on Mondays!) [C]

		Being lazy [D] As a manager, I often delegate tasks which are more physically active [C] Procrastination [A]
Reinforcement	3 (5.45%)	Tight deadlines- have to get work done quickly so can't afford to leave my desk [D] Staying late to get work done [A] Work volumes with deadlines [B]
Social Influences	3 (5.45%)	Colleague perception of being away from your desk (not working hard enough) [C] Socialising at colleagues desks e.g. asking what people have for dinner [D] Negative peer influence [A]
Emotion	1 (1.82%)	Work stress [A]

Behavioural Regulation	0 (0%)	None Identified
Knowledge	0 (0%)	None Identified
Skills	0 (0%)	None Identified
Beliefs about Capabilities	0 (0%)	None Identified
Optimism	0 (0%)	None Identified
Beliefs about Consequences	0 (0%)	None Identified
Goals	0 (0%)	None Identified
Memory, Attention, Decision Process	0 (0%)	None Identified

Appendix 8: Co-creation CUbes

Group A

Weather: Sunshine & Warm vs Cold & Wet

Laziness: Lack of motivation

Running errands: Moving between offices

Colleagues: Supportive & encouraging (Participant X encouraging stairs!)

Availability of stairs vs convenience of lifts

Walking distance at work: between buildings, offices

Car parking: Nearest car park being far away, nearest car park being close

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Health: Feeling well, general wellness vs Illness & not feeling well

Work stress

Staying late to get work done

Procrastination

Workplace campaigns/charity

Workplace raising awareness

Fitbit

Procedures: Having to walk to different buildings/offices to give forms in face to face

Peer influence can be positive or negative

Situational constraints: job tasks which require sitting

Workplace equipment: Office chairs & desks, fitness equipment & facilities

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Workload: Marking, being busy

Technology: Computers, emails

Teaching: Standing up

Office setting: Being away from main campus, lots of stairs

This study!

Costa, coffee, lunch, shops – going out with colleagues for breaks

Meeting friends for lunch

Motivation (can be a barrier or facilitator)

Meetings – Travelling to and from

Being sat down whilst in meeting

Group B

	Task- Stacking shelves & moving cages Stairs to key facilities e.g. canteen & toilets Limited break times to sit down for long periods of time Charity events e.g. race for life Half-price gym membership and incentives Teamwork – moving to help others around store		
	On sofa watching CCTV monitors – uninterrupted Using technology to communicate e.g. walkie talkie	Uncomfortable footwear/uniform Working on tills requires sitting down Safety procedures (having to wait for two people to move cages)	
	Hosting – customer facing roles need to be animated and engaging Time limits & turnaround times to re-set puzzles in rooms.		

Group C

Building environment, poor heating & lighting in certain places discourages moving away from office.	Work volumes with deadlines Assisting colleagues (sat down at their desk) Meetings face to face/skype (sat down) Desk based work Training courses (full day or more), face to face or online Carpark close to work Comfortable chairs	Putting customer interactions above being away from station	Sit/stand desks & hot desking Fire alarm drills – everyone leaves building & walks to safety point Visible stairs Lunchtime walks Walking between offices/outside space Leading training sessions – stood at front Uncomfortable chairs

Group D

Seeing customers (moving to greet)

Checking the other shop floors (level 1 & 4) Going out for lunch, coffee, visiting on site coffee shop and canteen- Yum!

Cross-functional meetings (I have to walk to other departments & desks)

Getting deliveries from warehouse- walking, lifting

Dealing with customer enquiries via email

Paperwork – sat down at desk

Staff reviews – back to back meetings to talk through development

Having to respond to lots of emails

As a manager, I often delegate tasks which are more physically active

Rubbish wifi in building means I have to use hard connection at desk

Tiny storage area for product makes me move stock between areas quite regularly

Scary boss can summon me to their office at any moment

Moving between offices

Meetings with other departments at their office

When I have a directors meeting and I have to wear heels – uncomfortable walking around for too long

Doing job interviews – long period of time sat down

Meetings with management when work is busy

When customers call in and I have to go check the stock for them there and then

Getting an hour for lunch- means I can walk into town

When I have visitors or suppliers in and I give them a tour and walk with them to different departments

Replying to emails – sat down at desk

My own laziness sometimes (especially on Mondays!)

Colleague perception of being away from your desk (not working hard enough)

Laptop- the fact I have a laptop for work means that I can move around and work from anywhere

Floor moves (visual merchandising, moving items around the store, creating displays)

Serving customers on till (standing up as no seating on till)

Busy times – rushing around dealing with customers and colleagues

When the lift is broken and I have to take the stairs

Useless meetings (unnecessary)

To do list (lots of work to fit into day)

IT – Zoom/Skype meetings mean I can talk to people anywhere but always connected to my desk.

Collecting post (work and personal parcels- ASOS!)

Travelling to the London office- walking to/from stations and tubes

Showing our merchandise to customers in Birmingham and London. Have to pick up, collect, show and put away which involves a lot of movement.

Socialising with colleagues and discussing the weekend

Inputting delivery sheets (computer work)

Monday trade meetings (starting the week sat down)

Group E

Getting a biscuit from the kitchen as it is on a different floor

Making a cup of tea

Socialising at colleagues desks e.g. asking what people have for dinner

Going to the equipment cupboard to pick up bits of equipment to open a watch

Re-filling office supplies e.g. paper in printer, getting staples, emptying shredder etc

Finding 'lost' items – tracking down who is working them

Opening the vault & closing the vault after picking up items

Getting held up by 'chatty' customers when on the phone or sat down during valuations

Seeing customers in a different building – have to walk between offices

Walking between offices for a delivery

Walking around office to get bags, pick up printing etc

Going to see clients and suppliers from local businesses within the area

Going to the loo

Writing on the box!

Heat & the weather

Lots of admin work to do; telephone conversations, emails, meetings involve sitting

Tight deadlines- have to get work done quickly so can't afford to leave my desk

Loading and unloading the van that transports goods between buildings

When my fitbit tells me to move!

Walking to local equipment suppliers/repairers

Travelling to London

When my back starts hurting I have to move

Answering phone calls and emails keep me at my desk

Being lazy

Going to look at something on another colleague's computer

Walking into town or home at lunchtime for food.

Laying out sales – moving and placing items in display cupboards

Appendix 9: Photovoice Activity Instructions

You’re about the be given a portable instant camera that is capable of printing a maximum of 10 photographs.

In your group, you will be asked to work together to take photographs of potential barriers and facilitators of employee physical activity. The photographs that you take can be literal (e.g. a picture of someone being physically active) or abstract (e.g. a picture of someone smiling to capture the emotion of happiness). As a group, you will be asked to choose two photographs that you feel best represent barriers of physical activity and two photographs that you feel best represent facilitators of physical activity.

Once you have selected your photographs you will then be asked to complete a short questionnaire, which will ask you to describe what each photograph shows and why it has been selected.

When taking photographs please do not:

- Take photographs of anyone outside of your co-creation group without first obtaining their written consent
- Take photographs that capture personal or sensitive data
- Take photographs that could reveal your location, the location of others or the identity of your organization
- Take photographs that invade the privacy of others
- Take photographs that would make yourself of others feel uncomfortable or put you at physical risk

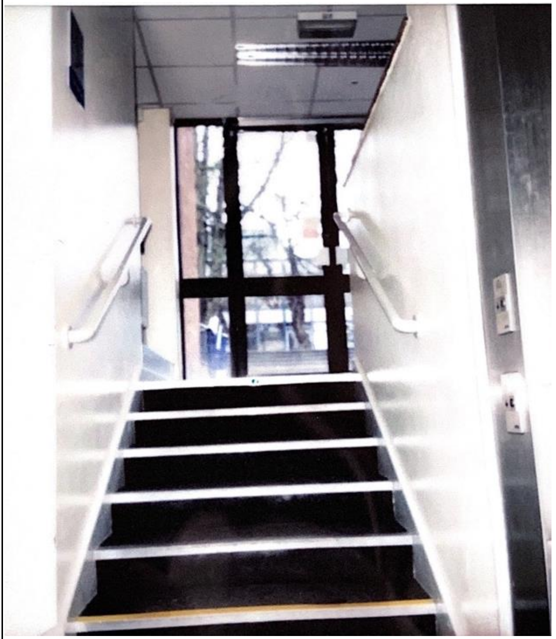
If you are unsure about whether your intended photograph would be ethical to take, please ask the researcher.

Appendix 10: Photovoice Images

Facilitators

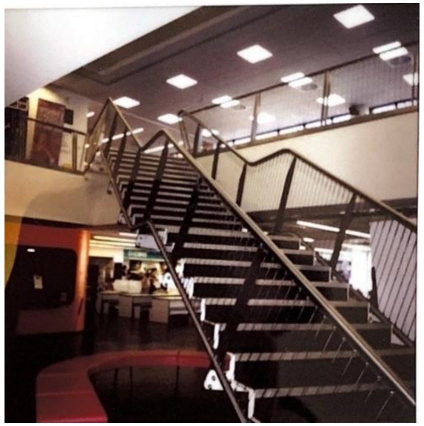
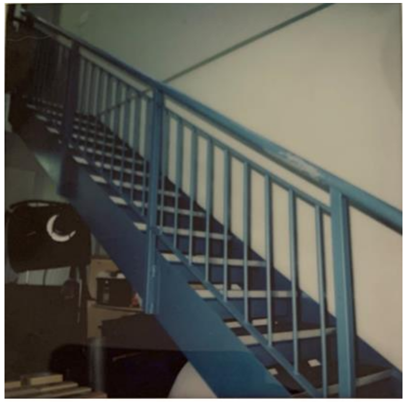
This item has been removed due to 3rd Party Copyright. The unabridged version of the thesis can be found in the Lanchester Library, Coventry University.

Group A – Facilitator 2

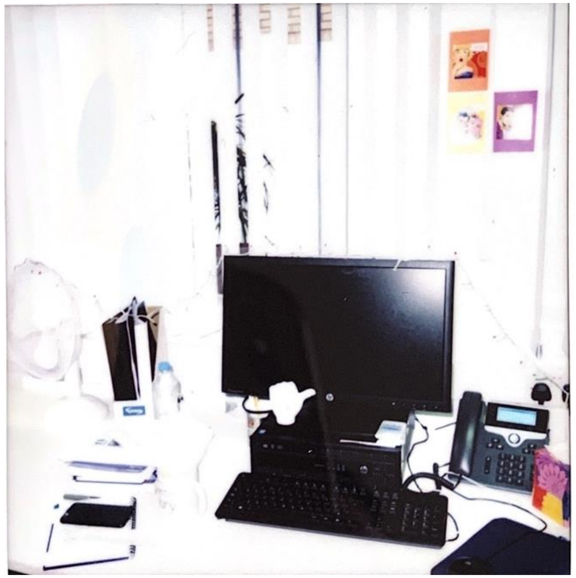
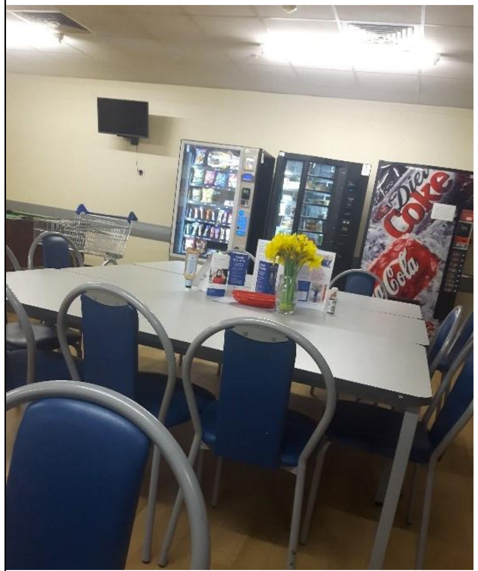


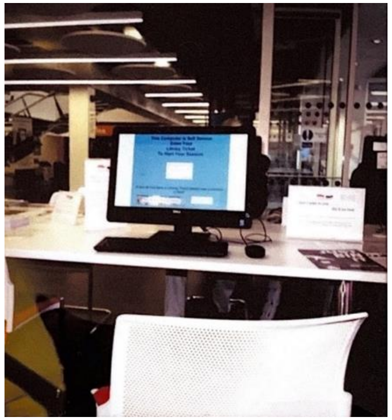
Group B – Facilitator 1

Group B – Facilitator 2

Group C – Facilitator 1	Group C – Facilitator 2	Group D – Facilitator 1	Group D – Facilitator 2
			
Group E- Facilitator 1 	This item has been removed due to 3rd Party Copyright. The unabridged version of the thesis can be found in the Lanchester Library, Coventry University.		

Barriers

Group A – Barrier 1	Group A – Barrier 2	Group B – Barrier 1	Group B – Barrier 2
			

Group C – Barrier 1 	Group C – Barrier 2 	 Group D – Barrier 1	Group D – Barrier 2 This item has been removed due to 3rd Party Copyright. The unabridged version of the thesis can be found in the Lanchester Library, Coventry University.
Group E – Barrier 1 This item has been removed due to 3rd Party Copyright. The unabridged version of the thesis can be found in the Lanchester Library, Coventry University.	Group E – Barrier 2 This item has been removed due to 3rd Party Copyright. The unabridged version of the thesis can be found in the Lanchester Library, Coventry University.		

Descriptive Coding

This image shows three women [1], standing in an office doorway. One of the women on the left side of the image [2] is outside of the doorway leaning into the room with a smile on her face. The other two women are in the centre of the frame and are waving towards the camera and are also smiling [3]. Below the waving hands of the two women, the viewer can see ID badges hanging from their necks [4]. Behind the two women, there is an open door [5] which connects the inner office to the outer hallway. The woman in the middle of the frame is grasping the door handle [6]. To the right of the image, the sleeve of a coat can be seen hanging from the wall [7].

Emotional Coding

This image sparks feelings of joy due to the close nature of the subjects, their smiles and enthusiastic pose. There is a sense of eagerness evoked by one subject already being outside of the room and another subject holding onto the door handle ready to close it.

Compositional Coding

Two of the key figure’s smiling faces and waving hands dominate the centre of the frame making these positive emotions the central focal point for the viewer. The remaining subject is leaning into the image at the centre left. She is positioned out of the room; the middle subject is in the doorway and the third subject is still inside the room. This staging creates a sense of motion as the eye is drawn from the centre to the left of the image with subjects moving from closest to furthest away from the camera. The hand on the door handle in the lower right frame completes this arc of movement. The subjects are stood relatively close together and are smiling which emphasises the social aspect of the image.

Descriptive Coding

This image shows three people arranged at multiple height levels. There is a woman stood on a seat looking directly at the camera [1]. Below the woman, there is a man kneeling on the floor [2]. To the right of the image, there is a man who is in a half kneeling and half standing position [3]. This man is holding hands with the woman who is standing on the seat with his right hand [4]. He is also holding hands with the man who is kneeling with his left hand [5]. The man who is kneeling is looking up into the face of the half-standing, half-kneeling man [6]. The man who is half-standing and half-kneeling is looking into the face of the woman who is standing upon the seat [7].

Emotional Coding

This image evokes a sense of support and teamwork. The clasping of hands shows trust and support and a direct connection between the subjects. This is reinforced by the gaze of the subjects who are looking directly into the faces of the person above them. This evokes both aspiration and focus which overcomes the barrier of hierarchy.

Descriptive Coding

This image shows a man sat at a work desk [1]. The man is looking at the monitor which is situated directly in front of him and is positioned in the centre of the frame [2]. To the man's left side, paperwork can be seen spread in a fan like shape on the desk [3]. At the left corner of the desk a selection of stationary can be seen [4]. The man is posed in position indicative of thoughtfulness with his hand touching the under side of his chin [5]. The man appears to be wearing a smartwatch [6]. A lamp can be seen on the top right of the image [7].

Emotional Coding

This image evokes feelings of concentration and focus, with the hand gesture and focus of the gaze on the monitor. There is a sense of being overwhelmed through the large amount of paper work fanned next to the computer. The abundance of readily available stationary suggests sparks feelings of organisation and structure.

Compositional Coding

The computer monitor is positioned almost perfectly in the centre of the image and dominates this entire section. The person is off-set to the right making them more of a secondary focus. The image has been taken in third-person perspective which gives a broader view of the scene and gives the image a sense of realism. The wider view also captures the rest of the desk with stationery and workload spread across it. This gives a sense of volume in relation to the work tasks which need completing. The pose of the person it thoughtful and creates a sense of concentration. This, in combination with their gaze being focused directly upon the monitor, creates a sense of work being all consuming.

<u>Descriptive Coding</u>

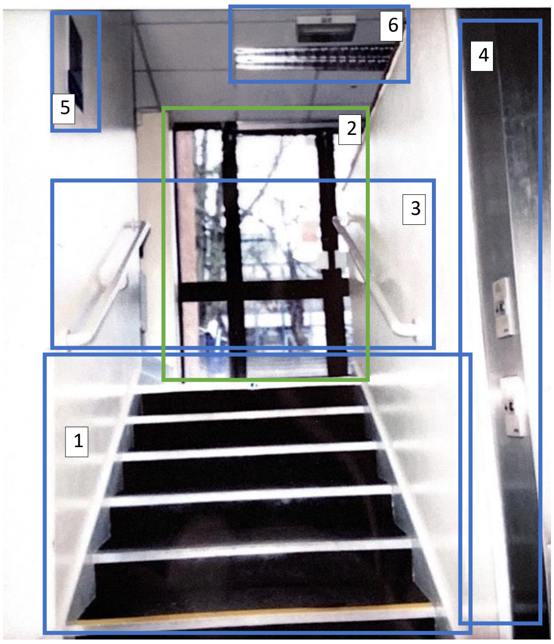
This image shows three people sat in a line at a desk [1]. Next to the laptop a book is open [2]. The man to the left of the image is covering his face with both hands [3]. The man in the centre of the image is covering his ears with both hands [4]. The woman to the right of the image is covering her mouth with one of her hands whilst the other rests on the desk [5]. The people are looking towards a laptop [6].

<u>Emotional Coding</u>

The posing of the subjects in this photo replicates the 'hear no evil, see no evil, speak no evil' phrase. By blocking their senses in the context of a workplace setting this evokes a feeling of constriction and frustration over not being able to fully express their agency. This feeling of censorship suggests resistance and dissatisfaction with this mode of working.

<u>Compositional Coding</u>

The centre of the frame does not feature any of the faces of the subjects. Instead, it is largely occupied by a laptop making it a key focal point of the image. The subjects are presented in a staggered manner with one subject close to the viewer then progressively moving further away. The contents of the table mirror this staging with work materials also being aligned through the lower centre and central portion of the photograph. The position of the work materials in the central portions of the frame almost makes the people present within the image secondary. Moving diagonally from the lower left to the upper right the image is predominantly dark. This contrasts with the lightness of the right diagonal side of the image which is predominantly light. Positioning the people within the image as dark and work materials as light. The people within the image are posed in the 'see no evil, hear no evil, speak no evil' actions whilst all are looking towards the laptop in the centre of the frame. This further places the laptop as the primary subject and also conveys a message of censorship in relation to the work in front of them.



<u>Descriptive Coding</u>

This image has been taken from the bottom of a flight of stairs [1] which is looking up to an exit door; on the other side of the door, there are trees and a bright outside space [2]. Along the elevation on either side of the stairs there are handrails [3]. To the right of the image, there is an elevator which is silver in colour [4]. Halfway along the staircase, at the top left of the image, there is signage [5]. At the top centre of the image, light fittings can be seen [6]. The lights are switched off.

<u>Emotional Coding</u>

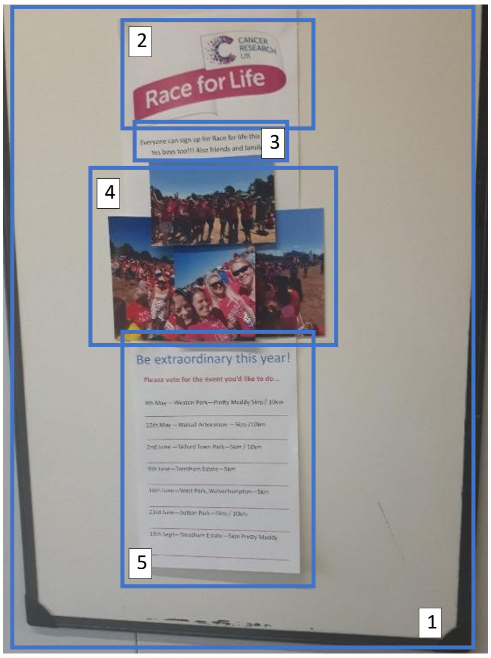
This image evokes a sense of escapism as the photograph connects the stairs to a bright outside space.

<u>Compositional Coding</u>

The photograph has been taken from the bottom of a flight of stairs looking upwards to an outside space. The positioning, depth and angle of the staircase and outside space across all of the central thirds draws the eye upwards and emphasises this outside space. The silver elevator and elevator buttons have been captured on the right side of the image. However, this is given very little space and is located well outside of any intersection of the thirds. This positions the elevator as a minor, tertiary component of the image.

<u>Iconographic Analysis</u>

The inclusion of a physically inactive option next to the physically active option of the stairs suggests choice



<u>Descriptive Coding</u>

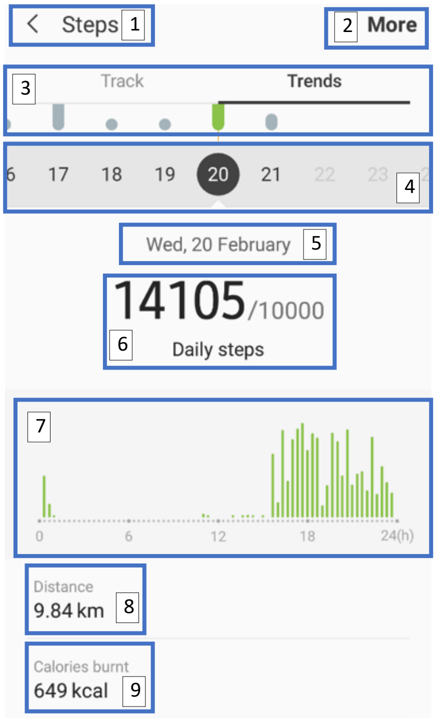
This image shows a communal whiteboard mounted to the wall[1]. Affixed to the whiteboard are six pieces of paper. The topmost piece of paper reads 'Cancer Research UK, Race for Life' [2]. This paper contains the Cancer Research UK logo and the race for life text is written in large white font with a bright pink background. Below this, a smaller piece of plain white paper with black text reads 'Everyone can sign up for Race for Life this year. Yes, boys too!!! Also friends and families' [3]. In the centre a selection of images can be seen of people wearing pink who have participated in previous Race for Life events. In these images, people are presented in groups in sunny outdoor spaces, with the centre most of these images showing a group of women smiling. Below this, another piece of paper has been affixed to the whiteboard [5]. At the top of this paper, in large blue letters the phrase 'Be extraordinary this year!' can be seen. Below, in smaller red text the words 'please vote for the event you would like to do' are presented. This is followed by a list of seven events with different times and locations writing in smaller black text with a line separating each event.

<u>Emotional Coding</u>

This image evokes feelings of joy and happiness. The bright colours and photographs of happy people working in groups also generates feelings of comradery and enjoyment. As the is for charity it also creates a feeling of altruism and the enjoyment gained from doing charitable work.

<u>Compositional Coding</u>

The photographs of happy people completing the race for life have been positioned in the centre of the image. The bright colours contrast against the predominantly which background of the image which brings them to the viewer's attention and makes them a key focus of the image. The photographer has captured all components of the advert including that it is open to everyone and the full list of events which gives the viewer additional context to the image.



<u>Descriptive Coding</u>

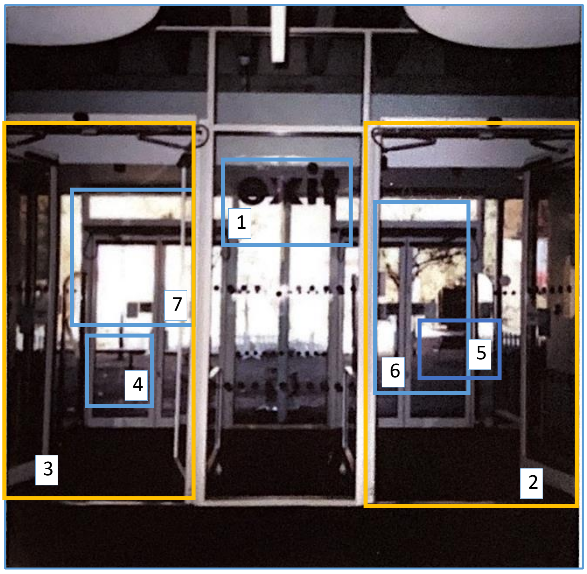
This image is of a step tracking function on a mobile device. The screen that has been photographed has two menu options at the top of the image, one which says steps [1] and another which says more [2]. Directly below the menu options is a box which displays step count trend data in a pseudo bar chart format [3]. The current date's data is highlighted in green whilst all other dates are in grey. The bar charts show variability with the first and fourth bars being higher than the others. Below this appears to be a timeline of dates which has the number 20 highlighted in a grey circle [4]. Below this is a short piece of text which outlines the date 'Wed, 20 February' in small grey font. In the centre of the image in a larger font is the step count for the date indicated [6]. The step count of 14,105 is presented in a large, bold black font whilst the daily step count is presented to the right of it in a smaller grey font. Below the step count there is another bar chart which displays the number of steps counted across hours within the 24 hours of the indicated date [7]. The bar chart shows steps initially around midnight which then trails off and starts to recommence around 10 am with a large number of stems being completed from approximately 4pm onwards. Below the bar chart the distance in kilometres that the person has walked that day is displayed which is 9.84km [8]. A the bottom of the image, the number of kilocalories burnt, 649kcal, is displayed [9].

<u>Emotional Coding</u>

This image sparks feelings of motivation and determination. The health data and visual trends are encouraging and creates feelings of progress being made. The presentation is somewhat clinical which dulls these feelings somewhat.

<u>Compositional Coding</u>

This image is a screenshot of a pedometer app on a mobile phone. As this has not been actively composed by the creator it cannot be compositionally coded.



Descriptive Coding

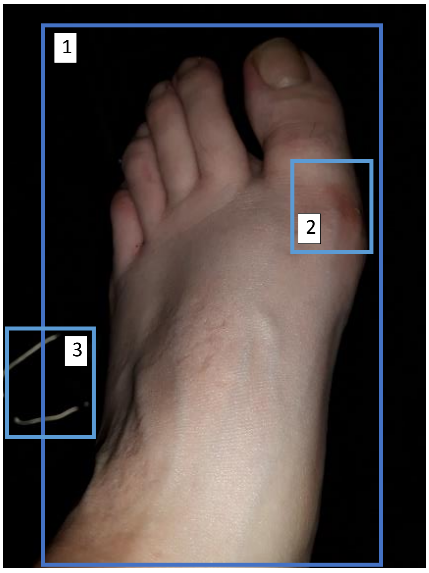
This image shows the exit doors to a building. The word 'exit' can be seen in approximately the centre of the frame in big, bold, black text [1]. To the right [2] and left [3] left of this can be seen automatic doors which are both open and lead outwards. On the other side of the doors there appears to be a large outside space which contains two benches, one to the left [4] and one to the right [5]. A tree can also be seen through the doors on the right side of the image [6].

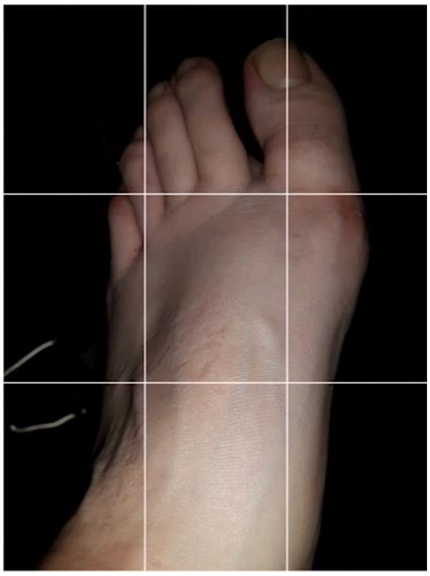
Emotional Coding

This image evokes feelings of freedom and escapism. Looking out onto a brightly lit outdoor space with nature sparks feelings of happiness.

Compositional Coding

This photograph has been taken from the inside of a building looking outwards into a brightly lit courtyard. The bright outside space has been positioned horizontally across the central left, middle and right thirds which sets it in contrast with the dark topmost and bottommost thirds. This makes the outside space a key focal point within the image. The word exit intersects the centre and top centre third making its position a key element of the composition. The image is largely symmetrical which reduces distraction.





Descriptive Coding

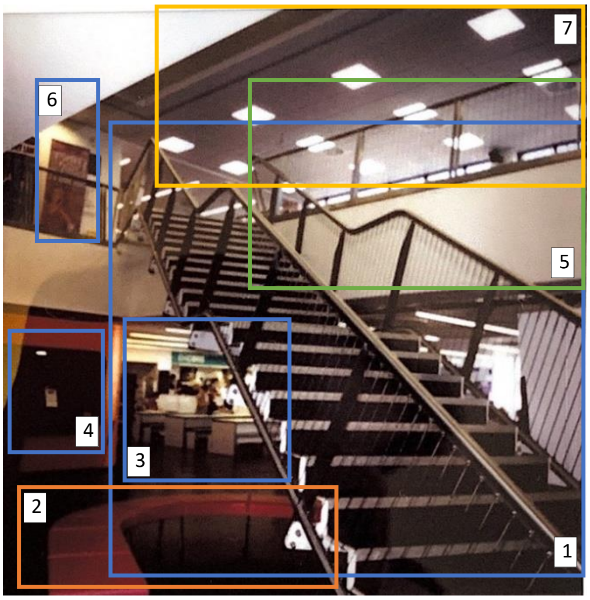
This image shows a person's left foot against a predominantly black background [1]. There appears to be a patch of red skin below the hallux [2]. To the bottom left of the image, the reflective laces of the person's shoe can be seen [3].

Emotional Coding

This image sparks feelings of discomfort. The red area creates feelings of pain and the close-up nature of the image suggests that this discomfort and pain is salient and noticeable.

Compositional Coding

The foot has been photographed close-up in the first-person perspective. This creates a sense of embodiment as it places the viewer in the position of the subject who the foot belongs to. The background is predominantly black, further emphasising the foot as the sole focus of the image.



<u>Descriptive Coding</u>

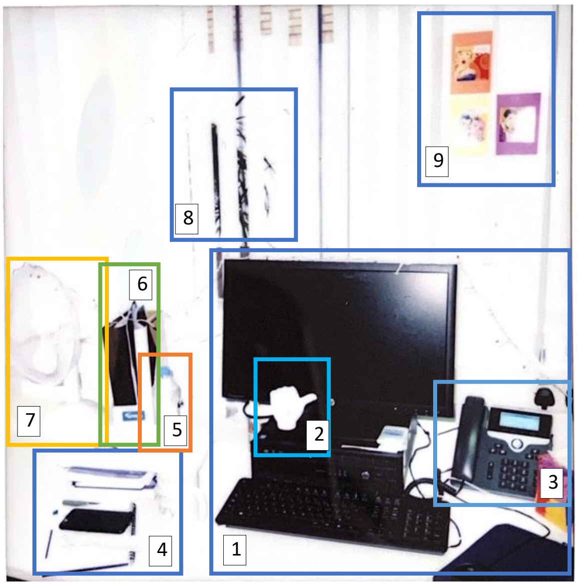
This image shows a staircase which joins the ground floor with an upper floor [1]. The staircase is the focal point of the image cutting across the frame from the lower right section to almost the upper left section. The photograph has been taken from the bottom of the staircase looking upwards. The under side of the staircase has been emphasised by red contrast flooring [2]. Behind the staircase at the back of the frame there is a large seating area with tables and benches [3]. On the lower left of the frame there is a glass panel with a mall piece of paper affixed to it [4]. At the top right of the image, on the upper floor, there is a balcony with protective mesh fencing [5]. The mesh fencing affords an unrestricted view of the staircase. At the top of the staircase there is a large poster on display [6]. The upper floor is illuminated by rows of fluorescent lighting [7].

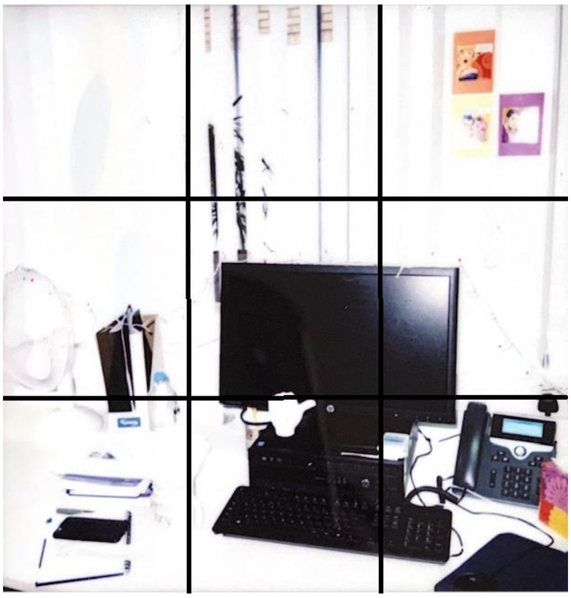
<u>Emotional Coding</u>

This image generates feelings of effort. The sharp angle of the image looking up emphasises the effortful nature of climbing the stairs.

<u>Compositional Coding</u>

The image has been taken at the foot of the stairs and slightly to the side. This allows the image to capture the full height of the staircase. The staircase has been shot from the bottom up rather than top down. Bends in the handrail almost directly intersect with the top corners of the central third and the staircase itself intersects the majority of the image from bottom right to the top left. This positioning draws the viewers eye up to the top of the staircase simulating the act. The lower left corner of the image is darker and the upper right of the image is brighter which further draws the gaze in an upward motion.





Descriptive Coding

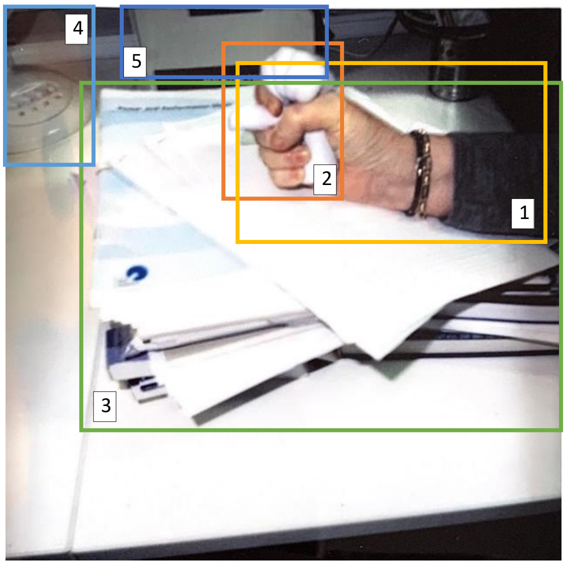
This image shows an office workstation. In the lower centre of the frame the person's computer and keyboard can be seen [1]. The monitor is switched off. Resting on the computer is a small white stress ball in the shape of a hand in the thumbs up expression [2]. To the right of the computer is an office telephone [3]. In the lower left side of the frame a selection of notepads and paperwork can be seen [4]. Above this, there is a water bottle [5], a storage box containing multiple folders and paperwork [6] and a white fan [7]. At the top centre of the image, there is a plant which can be partially seen emerging from between white blinds [8]. At the top right of the image, there are three colourful, A5 size posters affixed to the wall [9].

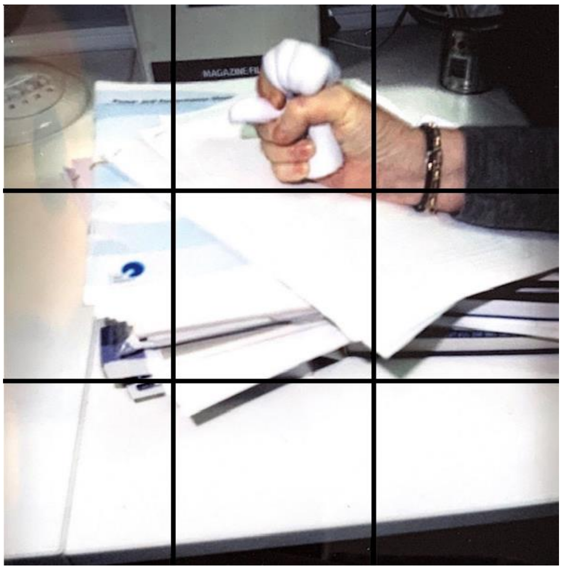
Emotional Coding

This image evokes feelings of coping. The paperwork and office equipment is being off-set by the stress ball, plant and colourful posters which have been added to the environment to help increase feelings of happiness and coping.

Compositional Coding

The black computer, telephone, mouse mat and files are in stark contrast to the predominantly white background which emphasises their presence. This image has been composed slightly off-set. The computer is the primary subject of the photograph, intersecting the central, lower central and right central third. The image has been taken in a first person perspective from an angle where a person would usually interact with the computer. Artefacts of work dominate the lower two thirds of the image whilst the to third contains personal accessories such as a plan and colourful posters. The personal accessories stand out as they are more vibrant in colour than the rest of the monochromatic setting.





Descriptive Coding

This image shows a woman's hand, which is wearing a bracelet, resting on top of a pile of paperwork [1]. The woman's hand is tightly squeezing a stress ball which is in the shape of a white thumbs up expression [2]. There is a large selection of paperwork dominating the majority of the frame which is piled on top of one another [3]. To the top right of the image, the corner of a fan can be seen [4] and a white cardboard box [5].

Emotional Coding

This image evokes feelings of stress, anger and frustration. The strong grasp of the stress ball suggests that these are very powerful and salient emotions. The expression of these emotions on top of the paperwork links these feelings directly to the workload as being the cause.

Compositional Coding

The upper two thirds of this image are dominated by a pile of paperwork. There are multiple layers of papers stacked on top of one another why gives a sense of volume. The majority of the image is in white tones which makes the presence of the hand contrast and draw the viewers' eye. The hand is firmly grasping a stress ball to convey an emotion of stress. The hand rests stop of the paperwork creating a direct connection between it and the emotion being portrayed.

<u>Descriptive Coding</u>

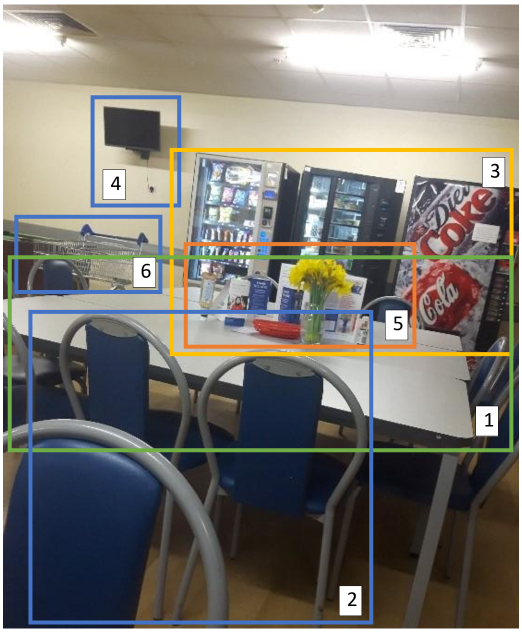
This image shows a large metallic elevator which dominates the main focal point of the photograph [1]. To the rightmost section of the image, the edge of a large signage poster can be seen [2]. To either side of the elevator there are two metallic red pillars [3 & 4]. The pillars are in a bright red colour which contrasts with the surrounding environment. The contrasting pillars frame the elevator. Directly above the elevator is a large glass panel which allows individuals to see where the elevator is [5]. To the top right of the image there is a sensor which is facing to the space immediately outside the elevator [6]. To the centre left of the image, office workers can be seen at their desk [7].

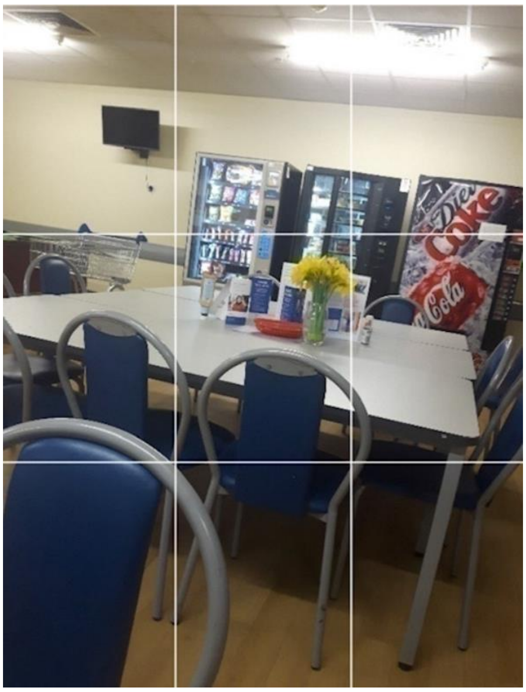
<u>Emotional Coding</u>

This image creates a feeling of resignation. It feels almost that using the elevator is inevitable. The image also sparks feelings of patience whilst waiting for an elevator.

<u>Compositional Coding</u>

This elevator is the primary subject of this image, crossing into all thirds of the photograph. The elevator is also framed on either side by red pillars. The contrast in colour of these pillars with the muted hues of the rest of the image also serves to draw the attention to the elevator. The image has been taken in a first person perspective from the point of view similar to someone waiting for an elevator.





Descriptive Coding

This image shows a lunch break area. At the centre of the frame there is a large table which is comprised of three smaller tables pushed together [1]. Around the table are 6 chairs which are blue and grey [2]. Towards the back of the frame there are three vending machines; the left most selling crisps and chocolate bars, the centre selling larger food items and the right most selling soft drinks [3]. To the top left of the image, there is a television attached to the wall which is switched off [4]. At the centre of the image, resting on the centre of the table are a selection of condiments, a paper menu, small triangular adverts and a vase with daffodils [5]. To the centre left, there is an empty shopping trolley [6].

Emotional Coding

This image portrays feelings of boredom. There are no other subjects in the room and the television is switched off. Despite the natural element of the daffodil, the image feels quite cold and impersonal.

Compositional Coding

The centre of the image contains the bright yellow daffodil flowers. Their colour contrasts the predominantly blue and grey setting. The table and chairs dominate the frame, covering the lower two thirds of the image. The image has been taken at a distance to capture both the seating arrangements and the vending machines in the background, linking the two aspects together.

Descriptive Coding

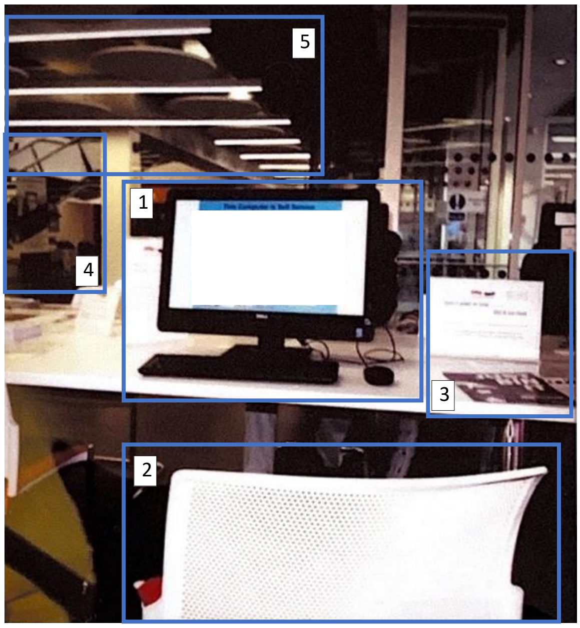
This image shows a woman sat at a workstation. The woman is sat towards the centre of the frame and is talking on the telephone whilst simultaneously typing on the computer [1]. The woman is sat on a padded blue office chair [2]. In front of the woman is a computer and keyboard [3]. Next to the computer is an office telephone [4]. Adjacent to this in the lower right frame there is a calculator [5] and an A5 notepad with biro pen [6]. To the centre right of the frame there is a which desk fan which is facing the woman [7]. Above this, there is a whiteboard which has to paper documents affixed to it [8]. At the top centre, a shelving unit can be seen with multiple objects on it [9]. In the centre of the frame, attached to a blue desk divider, additional paperwork can be seen affixed to it [10].

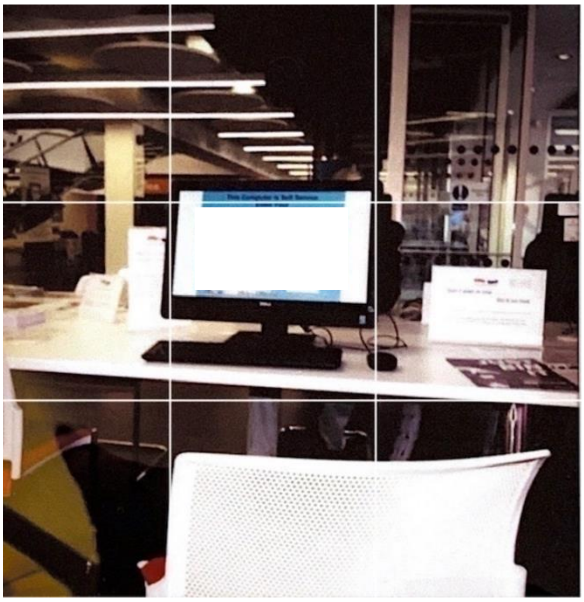
Emotional Coding

This image evokes feelings of being overwhelmed due to the completion of multiple work tasks simultaneously. There is a sense of professional pride at being able to complete the work in spite of this.

Compositional Coding

Artefacts of work are presented in an arc around the subject of the image. Every angle of the desk contains some form of object associated with work which creates a sense of volume and a lot of work to be completed. This is further emphasised by the subject being on the telephone and typing simultaneously. The image has been taken from a third person perspective which enables a wider field of vision to help capture these multiple actions and sources of work being completed.





<u>Descriptive Coding</u>

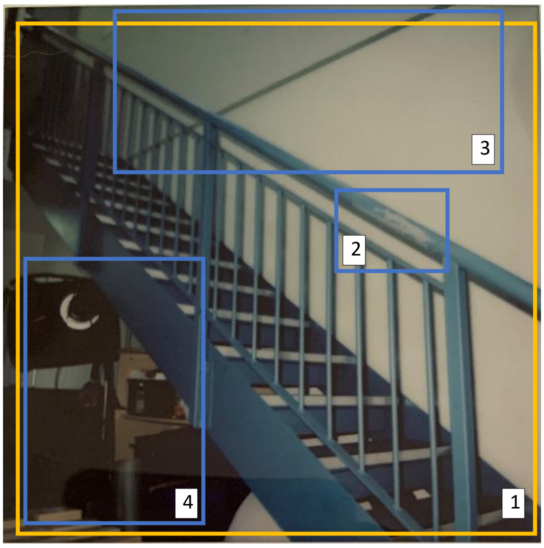
This image shows a workstation. At the centre of the frame there is a computer which is switched on and a mouse and keyboard [1]. In front of this there is a white mesh office chair [2]. To the right of the frame there is paperwork [3]. Towards the left of the image a staircase can be seen [4]. At the top left of the image rows of fluorescent tube lighting can be seen [5].

<u>Emotional Coding</u>

This image generates feelings of familiarity and comfort. The perspective of the photograph from behind the chair makes it feel like a comfortable place.

<u>Compositional Coding</u>

The computer is positioned in the direct centre of the image and is the primary subject of the photograph. The white desk intersects the image horizontally across the centre of the photograph. At the front of the image, close to the viewer's perspective there is a white chair which has been set slightly to the slide whilst still facing the computer monitor. This angle, combined with its proximity to the viewer and the first person perspective creates a sense of inviting them to sit.



Descriptive Coding

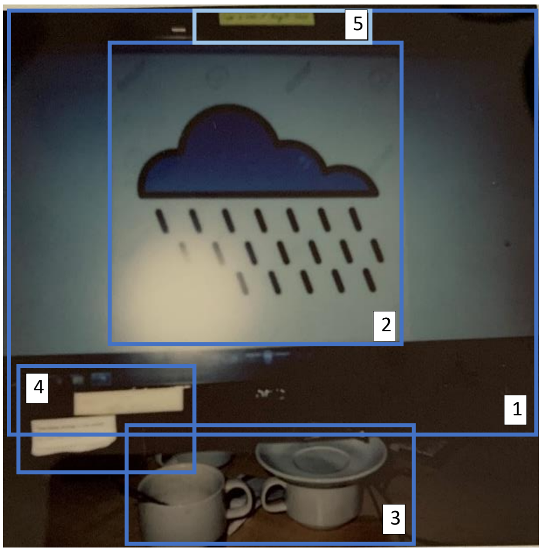
This image shows a metallic staircase which dominates the image, cutting across the frame from the lower right through to the top right of the photograph [1]. The photograph has been taken side on from the bottom of the staircase looking upwards. Part of the pain on the handrail has worn off revealing the metal underneath [2]. The staircase is set next to a plain white wall with a green stripe running across it at the level of the next floor [3]. Below the staircase, at the lower right side of the frame, numerous objects have been stored [4].

Emotional Coding

This image generates a feeling of depression. The staircase is dimly lit and ascends into darkness and below the stairs objects are stored untidily.

Compositional Coding

The image has been taken at the foot of the stairs and slightly to the side. This allows the image to capture the full height of the staircase. The staircase has been shot from the bottom up rather than top down. The staircase itself intersects the majority of the image from bottom right to the top left. The lower left of the image is darker than the top right which helps to place the staircase as the primary focus.

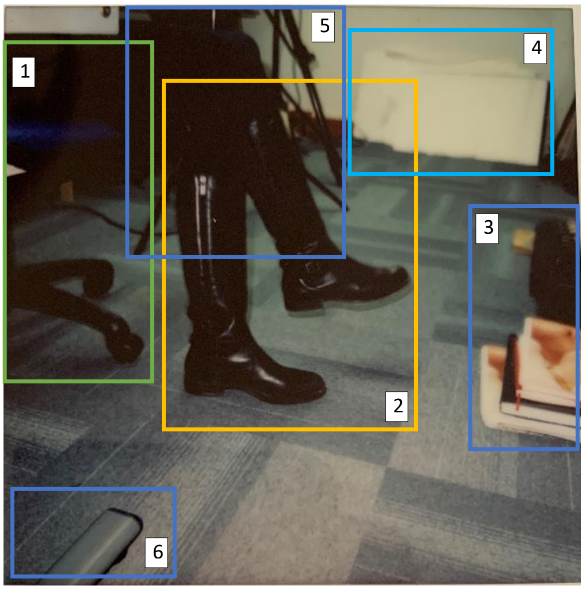


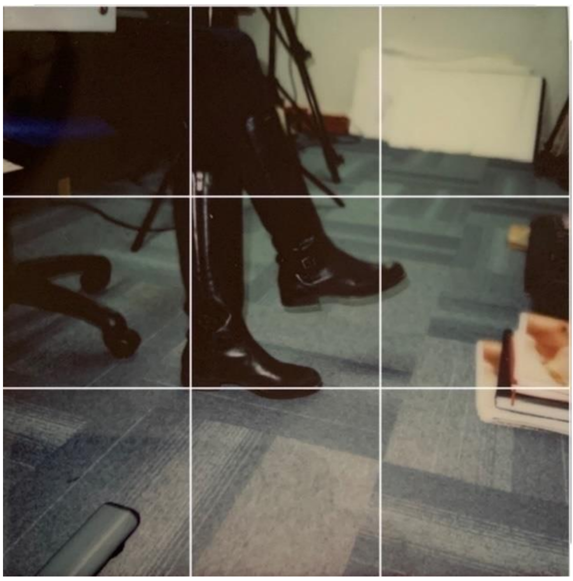
<u>Descriptive Coding</u>

This image shows a close-up photograph of a computer monitor [1]. On the monitor, at the centre of the screen, a large cartoon representation of a raincloud can be seen [2]. The cloud is blue in colour with a large black border. Below the computer monitor a selection of cups and saucers can be seen [3]. Affixed to the lower edge of the monitor are a couple of post-it notes [4] and there is also a post-it note affixed to the top of the screen [5].

<u>Emotional Coding</u>

This image evokes feelings of sadness and a lack of joy. The rain cloud creates a sense of feeling trapped inside with the cups below adding to this sense.





Descriptive Coding

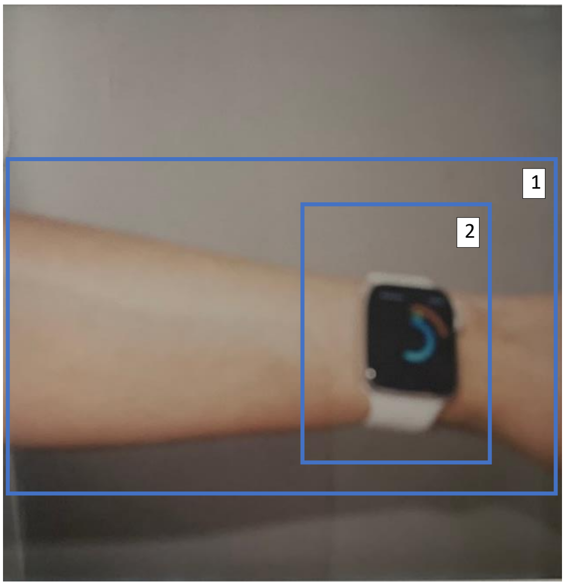
This image shows a woman sat in a padded blue office chair [1]. At the centre of the frame, and the main focal point of the image, the woman's shoes can be seen [2]. To the right of the frame, paperwork can be seen on the floor [3]. Paperwork and large sheets of paper can also be seen at the top right of the frame [4]. Next to this, a metallic tripod can be seen behind the woman [5]. At the lower left of the image, the foot of a desk can be seen [6].

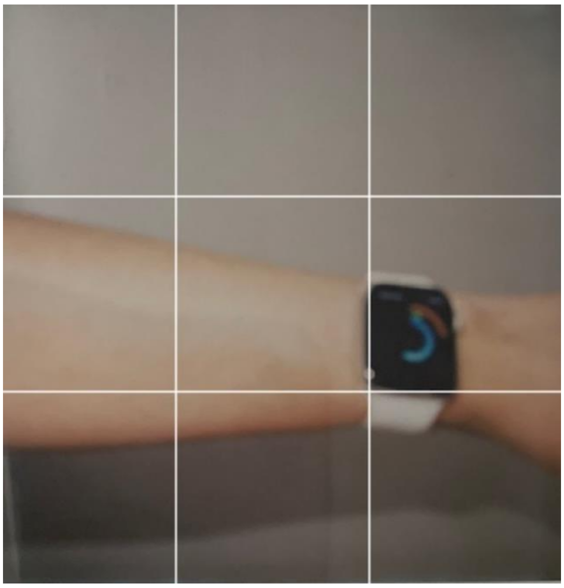
Emotional Coding

This image generates a feeling of purpose and intent. The subject appears to be ready for action and despite being surrounded by work.

Compositional coding

The woman's boots dominate the centre of the image and are the primary subject of the image. The boots have been photographed side on from a third person perspective. Whilst the person is sat down, one of the boots is raised off the floor indicating more motion than if both feet had been placed on the floor. Artefacts of work dot around the shoes like a compass with; books, papers, a chair leg and the foot of a desk being shown above, below and to either side of the boots.





<u>Descriptive Coding</u>

This image shows a person's arm [1] with an Apple Watch wrapped around the wrist [2]. The watch screen is displaying the activity rings of the person's daily activity levels.

<u>Emotional Coding</u>

This image generates a feeling of self-awareness and health consciousness. There is a feeling of optimism and determination to complete activity.

<u>Compositional Coding</u>

This image has been taken against a largely neutral background. The neutrality of the background and the warm tones of the skin do not sharply contrast and so make them a secondary focus of the image. This draws the eye to the smart watch which, with the black screen and colours on the display, draws the attention of the eye. Whilst not central, this contrast with the surrounding colour scheme makes the watch the primary focus of the image. The photograph has been taken from a first person perspective as though the viewer themselves is checking the watch. This image is somewhat out of focus.

Appendix 12: Poster Presentation Instructions

In your group, you will be asked to work together to design a new intervention that you feel could benefit employees in adding more physical activity or reducing sedentary behaviour in their workday.

To help get you started, you'll be given a list of all of the barriers and facilitators of employee physical activity that were generated by all of the co-creation groups within the previous workshop. You'll be given 10 minutes to look through these as a group and talk through any initial thoughts or ideas that come to mind.

After this you'll be given an A1 sheet of blank poster paper, a selection of coloured pens, a selection of magazines, scissors and glue. You can use these materials to create a poster that outlines what your new intervention will look like, how it works and how you would measure its effectiveness. You'll be given 30 minutes to create your poster.

After this, you'll be asked to present your poster back to the researcher to explain your new intervention. This presentation will be audio-recorded. To help guide your presentation, please see the poster prompt question sheet.

Appendix 13: Poster Presentation Discussion Prompts

Poster Prompts

When designing your intervention, have a think about the following:

- Who would be responsible for implementing your intervention?
- How does your intervention motivate individuals to add more physical activity into their day?
- What equipment/resources (if any) would be required to make it work?
- Are there any potential difficulties in implementing your intervention? If so, how might they be overcome?
- How would you evaluate your intervention to show that it works?

Appendix 14: BCT Coding of Co-Created Interventions

Group	BCTs Present	Quotations
A	1.2 Problem Solving	"ask your employees themselves what would they like to do; what do they find helps them to be active and what kind of activities do they want to do?"
	2.3 Self-monitoring of Behaviour	"have a specific area or a tracker ability, so it can be as simple as having a piece of paper on the wall and for every 15 minutes of active work you do you colour in a little square next to you name"
	3.1 Social Support (Unspecified)	"encourage social outings and friendships" "encourage the social aspect"

	4.1 Instruction on how to Perform the Behaviour	"Give health and safety information regularly; anything that is specific… you can say remember to drink plenty of fluids and all that basic information "
	5.4 Monitoring Emotional Consequences	"a 1 to 10 scale so hopefully you would see an increase then in the morale about being active; how happy, excited etc to having an active lifestyle within the workplace" "another scale to see if it's a happy workplace"
	7.1 Prompts/Cues	"encourage things like comfortable shoes and clothes, where you bring them along with you"
	7.8 Associative Learning	"If they're active they're getting endorphins released. If they doing that with people at work then by association they're going to associate being active with these people makes me happy, being with these people makes me happy, being at work makes me happy so, chemical conditioning"
	10.1 Material Incentive	"find businesses within walking distance of their premises and have offers or discounts or partnerships with them" "giving perks to staff to encourage active lifestyle"

		"have discounts, offers, partnerships in place and then it's down to the people whether they want to use them"
	10.2 Material Reward	"if everybody goes after work today either the gym will give you a discount or we will give you some kind of reward"
	12.1 Restructuring the Physical Environment	"have maybe like lockers or something where they can go put these things [exercise clothes]" "some men don't feel comfortable working out in front of women and some women don't feel comfortable working out in front of men so have a gender specific or floor specific space"
	12.2 Restructuring the Social Environment	the employers need to encourage group activities so, allow the employees to have the same break time to encourage them to go out and do things together" "Find local drinking places; pubs, coffee houses… everybody walks to the pub and they have a drink and they can do it when they're standing ideally or walking around a park with one of these drinks"
	12.5 Adding Objects to the Environment	"a specific break room where they've got a treadmill" "making sure that the equipment is there to enable this kind of creative activeness to happen"

B	1.2 Problem Solving	"It would be led by people's interests probably, they themselves would suggest what they would like to do" "whoever is leading the [exercise] class can encourage you, like 'I noticed you didn't attend; how can we help you attend tomorrow?
	1.9 Commitment	"If [an exercise] session is booked, you'd have to attend the session… you would have to go to the session because you've committed yourself"
	2.1 Monitoring of Behaviour by Others Without Feedback	"[monitor] attendance rates, so if there was already a class before or if you're setting up a new one, you can monitor the people going to the classes" "[monitor] how many people are using the classes or equipment"
	3.1 Social Support (Unspecified)	"have group activities; like bike riding or other kinds of exercise.. so it's things to bring you and your colleagues together" "People themselves getting together, peer group stuff"
	3.2 Social Support (Practical)	"five-a-side football, volleyball"

	4.1 Instruction on how to Perform the Behaviour	“someone external comes in and does classes” “Yoga classes” “Boxfit”
	5.4 Monitoring of Emotional Consequences	“bringing stress relief dogs to work…helps with the stress that the other group mentioned”
	6.1 Demonstration of the Behaviour	“someone external comes in and does classes” “Yoga classes” “Boxfit”
	7.1 Prompts/Cues	“You can send people reminders about when the class is”
	8.1 Behavioural Practice/Rehearsal	“someone external comes in and does classes” “Yoga classes”

		"Boxfit"
	12.2 Restructuring the Social Environment	"external meetings. You can go out of the office to a pub, have a drink, get away from the office in a new environment" "[an extra] three o'clock break to break up the day for like 40 minutes" "get out of your normal office environment…[to] a more casual setting" "spending time with your colleagues so you get to see them in a different light"
	12.5 Adding Objects to the Physical Environment	"[add] some unstable seating so that you have to use some effort to sit in it" "[add] some exercise equipment" "[add] ball things to again to strengthen your core" "bringing stress relief dogs to work"
C	1.2 Problem Solving	"it's important that workplace employees have an input into what's actually going on and what's being developed; which means that they're going to need to set it up in partnership with the organisation" "an online platform or group forum to get the initial ideas of what employees want and also what they don't want"

	2.1 Monitoring of Behaviour by Others Without Feedback	“tracking employees in terms of them going in and out of a gym room or into the zen room. So just scanning their workplace card, their staff card, to know how long they’ve been in there”
	2.4 Self-monitoring of Outcome(s) of Behaviour	“you can measure my blood pressure, you could measure my BMI”
	2.7 Feedback on Outcome(s) of Behaviour	“information sent out and results might be recorded if it’s chosen to be so. So it’s an area that information can show the impact on an individual’s stats “
	3.2 Social Support (Practical)	“[promoting] the social aspect so they could be cycling, swimming, going jogging together” “use a buddy system and share goals” “having that continuous prompt there where you’ve got somebody who is constantly messaging you or something coming through even at times if you feel a little bit down you'll get back up and start again”

	4.1 Instruction on how to perform behaviour	"they could then obviously be the one to teach other people"
	5.4 Monitoring of Emotional Consequences	"workplace zen… the relaxation aspect of it in terms of mental health on top of physical health" "It would be de-stressing bcause I'm actually doing something physical and my workload is reducing at the same time" "coping with your workload while you're doing your little fitness thing … could be quite fun but your mental well-being could be quite improved"
	6.2 Social Comparison	"a few months of some stats getting an email once a month and… people have done this many hours of exercise then maybe I could do a little bit" "looking towards somebody who's doing it and you kind of follow on as well" "physical leaders in the organisation on board to be doing the exercise at their desk or using the facilities that encourages others"

	6.3 Information About Other's Approval	"an organisational attitude change that if you see somebody kind of cycling under their desk it's the norm rather than something odd"
	7.8 Associative Learning	"a bit of classical conditioning going on. If you're getting all of these endorphins going through you whilst you're doing something boring, dull, monotonous, it's win-win because it's getting done and you're getting happier at the same time"
	10.1 Material Incentive (Behaviour)	"[interventions] subsidised and made really attractive to the staff"
	12.1 Restructuring the Physical Environment	"a place to go that you could just do some yoga, some meditation or what-have-you" "Availability of equipment, you don't have to go anywhere to find it" "a quiet space for the zen" "a decent, quiet space, with a plug in"

		"Having [a space] where you haven't got to book it out, or it's booked out by someone else, it's just open for people to go in and out"
	12.2 Restructuring the Social Environment	"encouraging employees to take up more physical activity outside of the workplace" "so getting people to go outdoors in the environment together" "an online platform or through group forums things like that just to get the initial ideas of what employees want" "the availability of the outside as well"
	12.5 Adding Objects to the Environment	"providing equipment in the workplace to facilitate more activity" "having the opportunity to exercise using particular exercise machines or standing desks" "yoga mats" "some bikes just in the corner of the room" "step machines…bikes…stretch bands…bouncy balls… communal Pelaton"

	13.1 Identification of the Self as a Role Model	“employees that are training the employees” “employees have got to be seen as if they’re pushing it forward” “There’s usually going to be somebody, particularly within large organisations, somebody who already does yoga or a different form of exercise, so they could then obviously be the one to teach other people”
D	2.3 Self-monitoring of Behaviour 2.4 Self-monitoring Outcomes of Behaviour 2.7 Feedback on Outcome(s) of Behaviour	“A survey… [measuring] how many steps they’ve taken” “A survey…[measuring] weight” “talk to that person…so you go, ‘Ok you were at this weight and this BMI’ and once you see the results you would be like ‘oh brilliant’

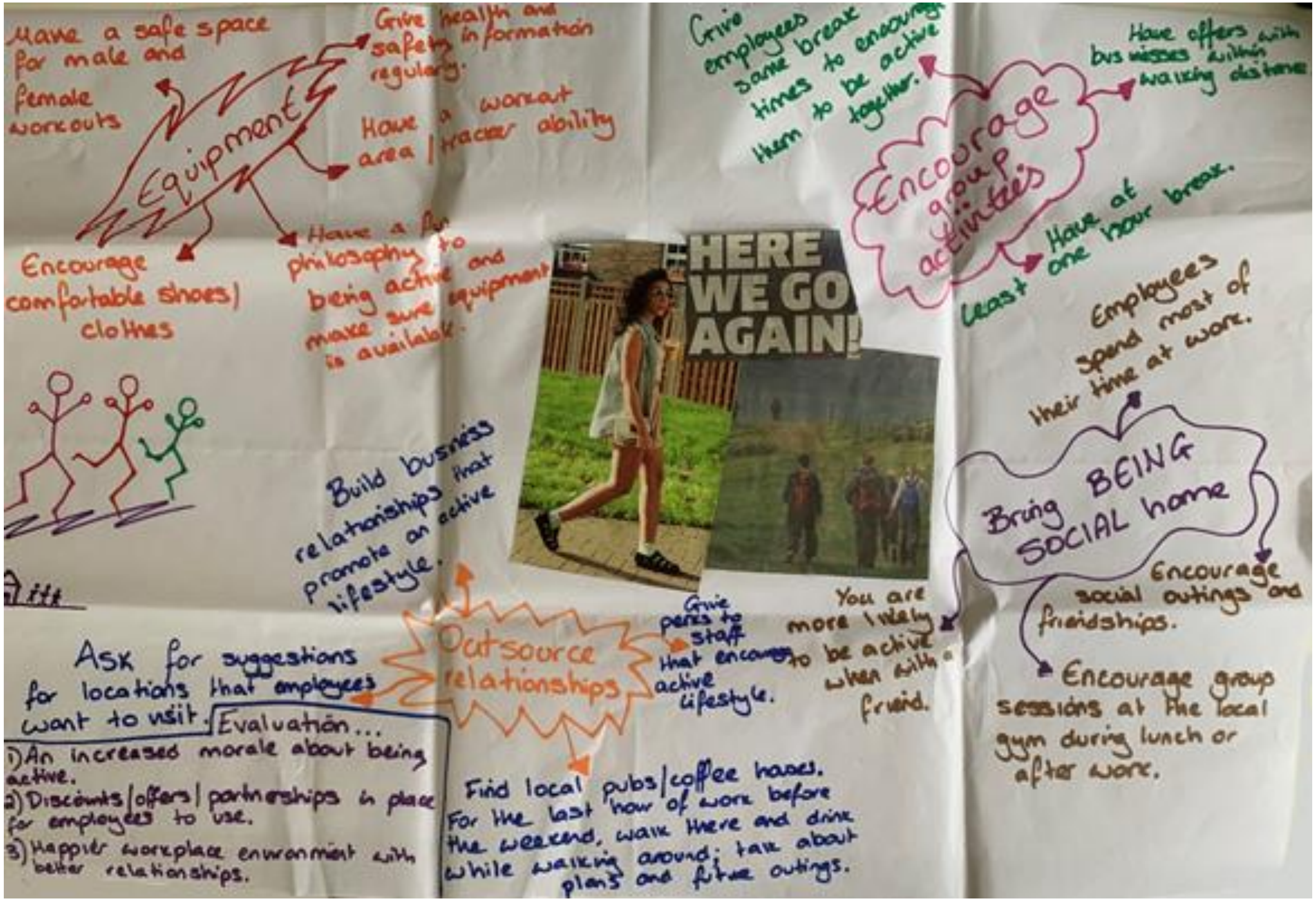
	3.2 Social Support (Practical)	"have a project leader who is championing the idea and motivating people" "a positive character and just pushing people saying this is why we're doing it"
	5.1 Information About Health Consequences	"rather than say dictating to someone you tell them the reasons why. You give them the narrative of what they're doing" "tell someone the reasons why you are doing this and what it benefits them for" "Sometimes you need to know the story behind it rather than just being told to do it"
	5.4 Monitoring of Emotional Consequences	"checking on people's mental health" "provide a happy environment" "[measure] If people's mood has improved" "you were encouraged to exercise, de-stress"

	6.1 Demonstration of the Behaviour	“senior managers they have to lead by example”
	6.2 Social Comparison	“…your colleagues because if you do it, I’d do it with you” “Oh, I don’t want to feel like the awkward one out”
	10.1 Material Incentive (Behaviour)	“Staff uniforms and staff shoes. Anything like that provided by the company so you don’t have to buy your own equipment”
	10.2 Material Reward (Behaviour)	“If we get to the end then we get a badge”

	12.1 Restructuring the Physical Environment	"make the tables higher so they have to stand up" "Turning the lifts off and making people walk"
	12.2 Restructuring the Social Environment	"[encourage] exercising in their break times" "[Get] more staff because if you're asking the staff to be like take the stairs, stairs take longer than the lift, so maybe productivity won't be as great because people are taking their lunches and being active. So you might need more staff to cover that amount of work"
	12.5 Adding Objects to the Physical Environment	"Bikes and physical equipment" "running machine"
	16.3 Vicarious Consequences	"That charity thing makes everyone go on walks at lunchtime because we feel like we're doing it for charity and you've made a donation to charity to do it"

Appendix 15: Co-Creation Group Intervention Posters

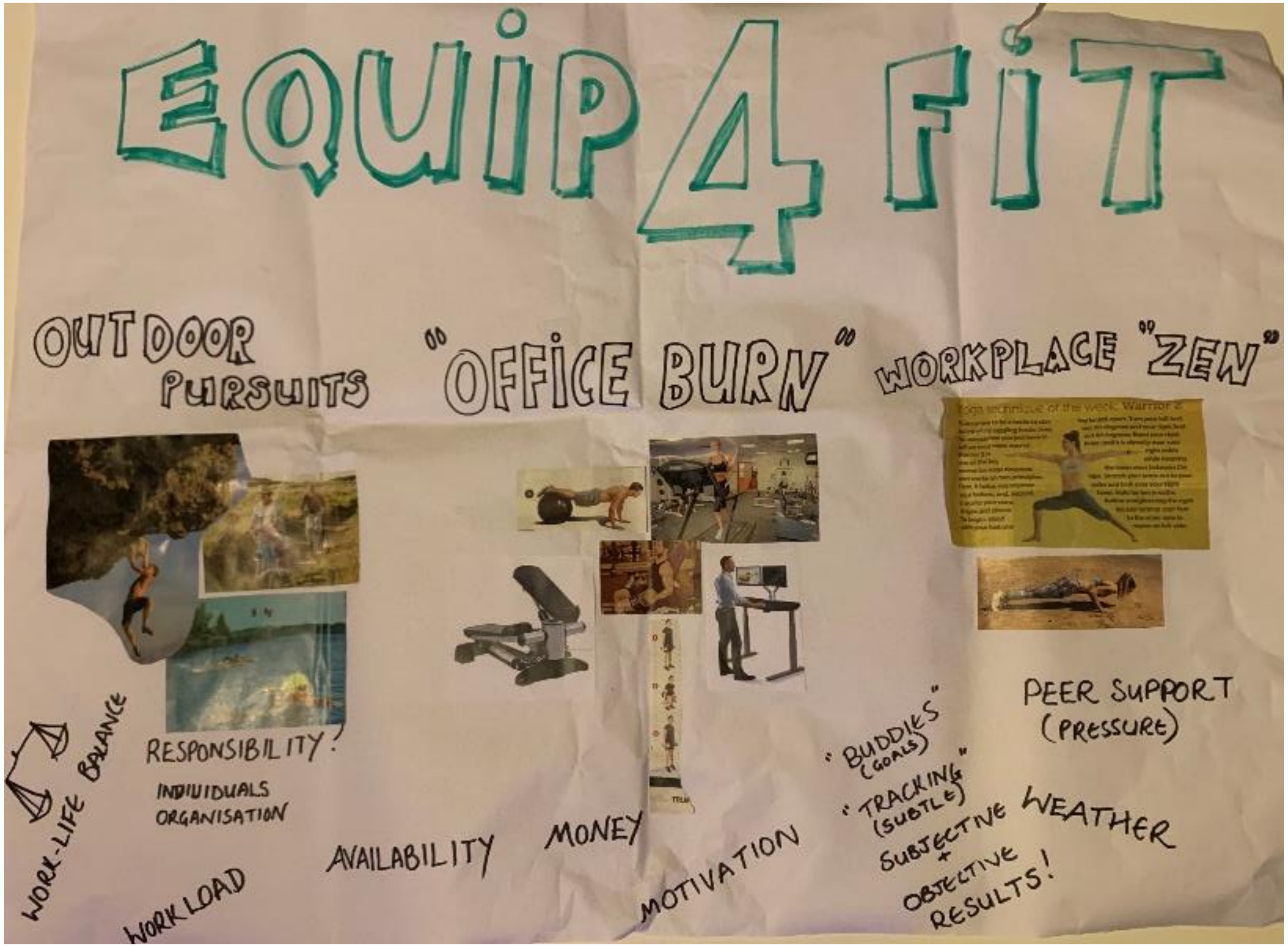
Group A



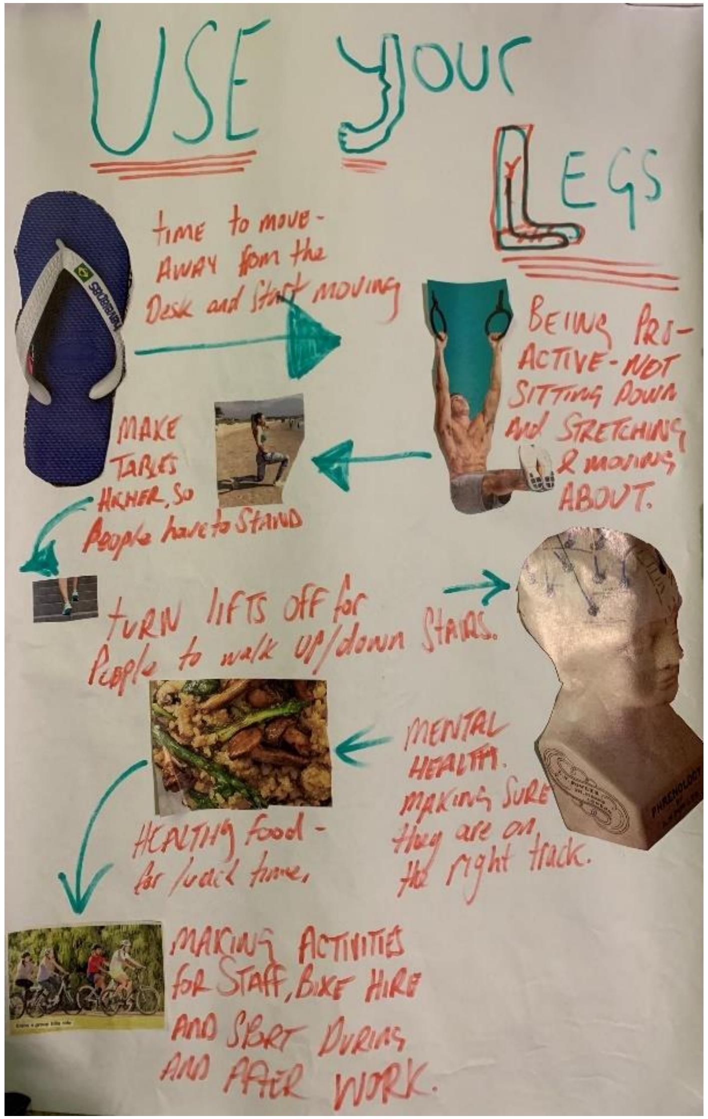
Group B


TED BAKER
LONDON
UNSTABLE SEATING
--- CORE ---
39
EXERCISE EQUIPMENT/ CLASSES
STRESS RELIEF DOGS
DOG WALKING
GROUP ACTIVITIES
EXTERNAL MEETINGS

Group C


EQUIP4FIT
OUTDOOR PURSUITS
"OFFICE BURN"
WORKPLACE "ZEN"
Yoga technique of the week. Warrior 2
PEER SUPPORT
(PRESSURE)
WORK-LIFE BALANCE
RESPONSIBILITY?
INDIVIDUALS
ORGANISATION
WORKLOAD
AVAILABILITY
MONEY
MOTIVATION
• "BUDDIES" (GOALS)
• "TRACKING" (SUBTLE)
SUBJECTIVE + OBJECTIVE RESULTS!
WEATHER

Group D


USE your LEGS
time to move - AWAY from the Desk and Start moving
BEING PRO-ACTIVE - NOT SITTING DOWN And STRETCHING & moving ABOUT.
MAKE TABLES HIGHER, SO People have to STAND
turn lifts off for People to walk up/down Stairs.
MENTAL HEALTH. making sure they are on the right track.
HEALTHY food - for lunch time.
MAKING ACTIVITIES FOR STAFF, BIKE HIRE AND SPORT DURING AND AFTER WORK.

Appendix 16: Study Advert for Intention to Use Wellness@Work Study

Are you interested in employee physical activity or the amount of time that employees spend sitting at work?

Following a series of workshops with employees from a variety of industries we have developed a new website to support employees in adding more physical activity and reducing sitting time in the workday. We're now looking to explore whether the co-created website would be well received by a wider audience.

If you would like to share your thoughts please click through to the study link below. During the study you will be asked to answer a few questions about yourself and how physically active your work is. You will then be shown a video demonstrating the new website and asked questions about your views on it.

Your thoughts and insight are very valuable, it would be great to see them reflected within the study. Thank you for your time.

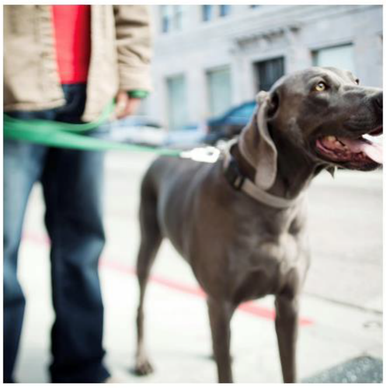
Appendix 17: Prototype of the Wellness@Work Platform

Homepage

This item has been removed due to 3rd Party Copyright. The unabridged version of the thesis can be found in the Lanchester Library, Coventry University.

Upcoming Events

This item has been removed due to 3rd Party Copyright. The unabridged version of the thesis can be found in the Lanchester Library, Coventry University.



Dog's Home Volunteering - Lunchtime Dog Walk

Wed 05 Aug | Location is TBD

Book

Mindfulness Meditation

Fri 03 Apr | Room B24

Book

Lunchtime Walk

Tue 31 Mar | B13 8RD

Book

FORUM

Start conversations with your colleagues, share ideas, thoughts and tips about adding more physical activity into the workday.

Forum

VOTE ON WHERE THE 2020 WELL-BEING BUDGET SHOULD BE ALLOCATED

£100

Free Weights

A selection of free weights for the exercise room

Vote

£100

Tai Chi Classes

A professional Tai Chi instructor to teach classes bi-monthly

Vote

£100

Suggestions

Here you can provide suggestions for next year's budget options

Suggest

Webpage: Latest Research

LATEST RESEARCH

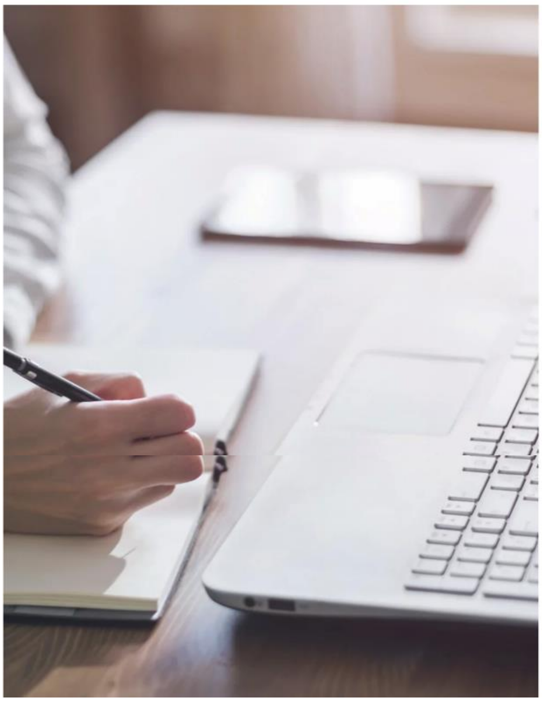
See concise summaries of the latest academic research in the field of workplace phsyical actvitiy and sedentary behaviour

WORKPLACE INTERVENTIONS EFFECTIVE AT INCREASING PHYSICAL ACTIVITY & DECREASING SEDENTARY BEHAVIOUR IN THE MEDIUM-LONG TERM

A recent meta-analysis (a study which combines the findings of multiple research studies) has found that workplace interventions are effective in increasing employee physical activity levels and decreasing sedentary behaviour levels. The results show that daily step counts and activity minutes were significantly higher in intervention groups than control groups and the benefits persisted for up to 12 months.

Source: Thompson *et al (2020)* *https://www.researchgate.net/project/Which-Objectively-Measured-Interventions-are-Effective-at-Disrupting-Sedentary-Behaviour-and-Increasing-Physical-Activity-in-the-Medium-to-Long-Term-in-Adult-Employees-Within-the-Workplace-A-Meta-Anal*

Learn More



Webpage: Helpers & Hinderers

HELPERS

Elements of workplaces which can support your physical activity.

Learn More

HINDERERS

Elements of workplaces which can inhibit your physical activity

Learn More

SUGGESTIONS

Let your organisation know about elements which help or hinder you in being physically active whilst at work.

Suggest

POTENTIAL HELPERS

Hover of the images to find more information

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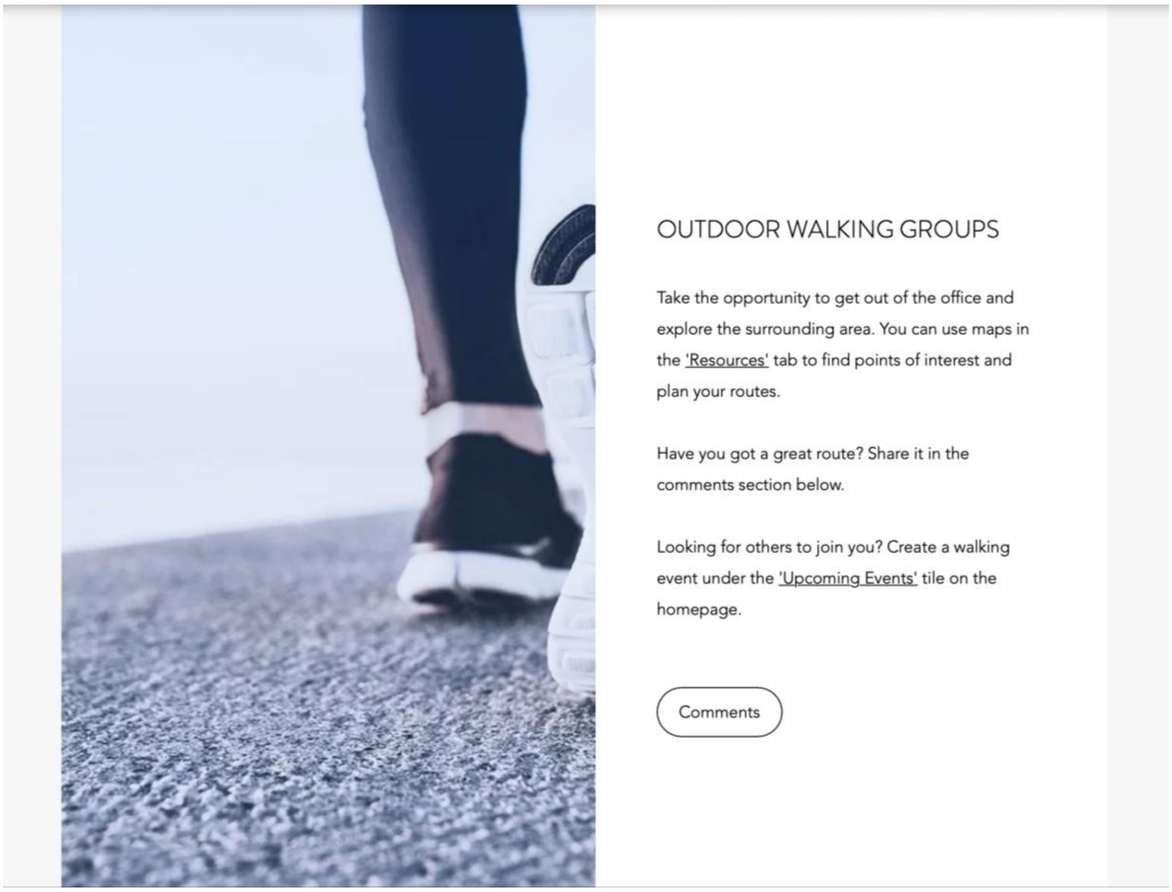
Webpage: Intervention Library



Webpage: Design Your Own Intervention

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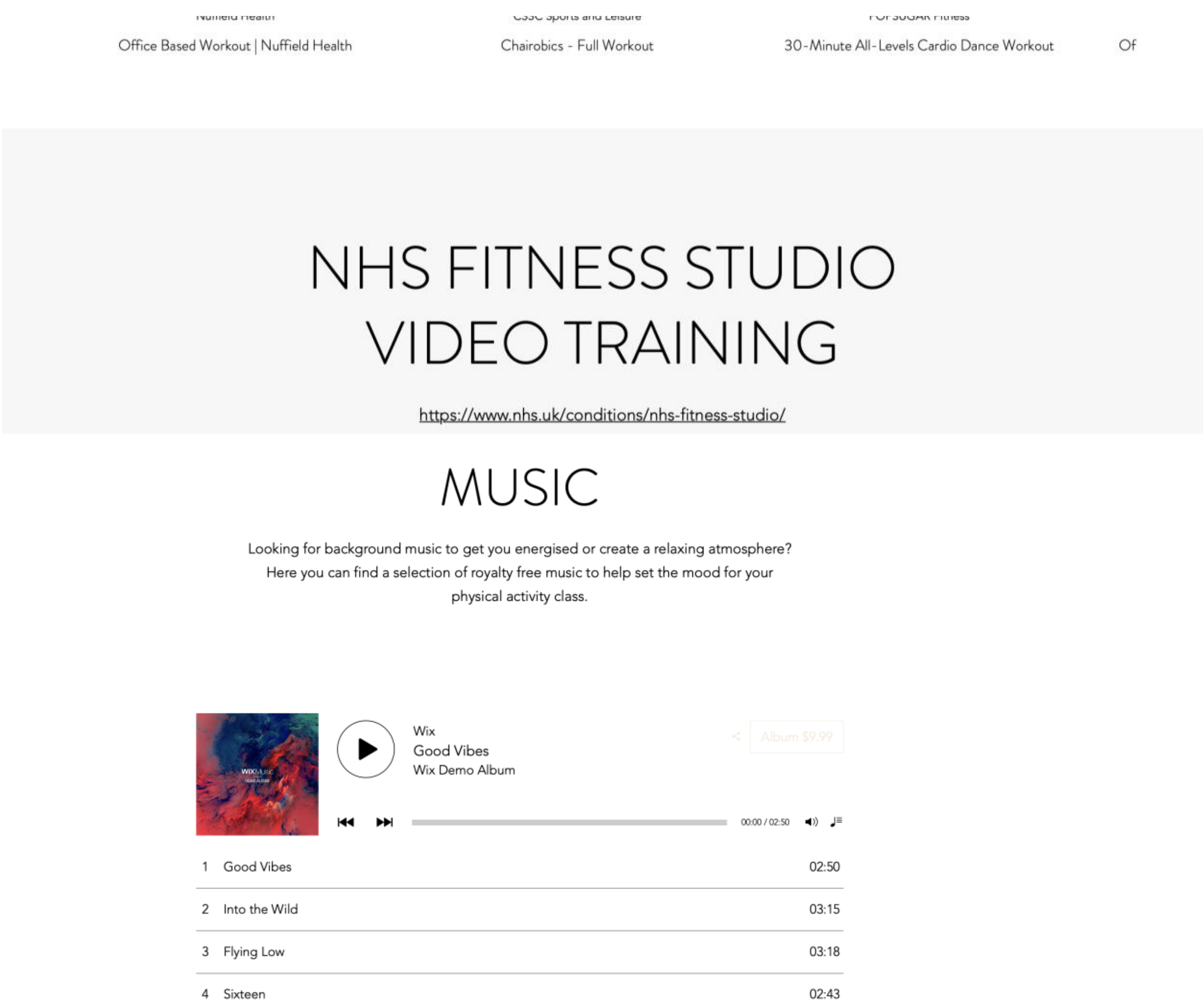

Thi

MAPS

Looking to get out of the office? Here you can find a map of the local area. You can customise the map to add pins to places of interest or create walking routes which best suit you.

Webpage: Could You Teach?

SHARE YOUR SKILLS

If you have a physically active hobby that you feel would be suitable for work, register your interest in teaching it below!

First Name

Last Name

Email

Phone

Company

Position

Submit

Webpage: Track Your Progress

PHYSICAL ACTIVITY QUESTIONNAIRE (IPAQ)

IPAQ Quesitionnaire

OCCUPATIONAL SITTING QUESTIONNAIRE (OSPAQ)

OSPAQ Questionnaire

SMART GOAL SETTING SHEET - WITH MILESTONE TRACKING

SMART Goal Setting Sheet

WEARABLE DEVICE STEP COUNT DIARY

Log your daily steps and see trends here

MENTAL WELLBEING SCALE

Warwick-Edinburgh Mental Wellbeing Scale

CLASSES/EXERCISE ROOMS ATTENDED

See which exercise classes you attended and which exercise rooms you accessed here.

SUGGEST

Would you like to see other ways of measuring your physical activity added to this section?

Share your ideas below!

Suggest