OPTIMISING THE SETTING AND PURSUIT OF PHYSICAL ACTIVITY GOALS IN INSUFFICIENTLY ACTIVE ADULTS: AN EXPLORATION OF HOW GOAL TYPES AND GOAL MOTIVES CAN IMPACT PHYSICAL ACTIVITY AND WELL-BEING

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ABSTRACT

This thesis contributes to the growing body of goal setting literature by offering novel insights into the effects of different goal types on not just physical activity, but additionally the psychological variables associated with long-term engagement, particularly for insufficiently active adults. Additionally, it is the first body of work, that we are aware of, that looks to assess both the *how* (i.e., goal types) and *why* (i.e., goal motives) of goal setting for physical activity. These additions seek to improve the setting and pursuit of goals to improve global physical activity levels and population health. To summarise, the overall aim of this research programme was to explore the effects of different goal types (e.g., specific, open, learning goals) on physical activity and psychological variables (motivation, self-efficacy and affect); and to assess the effect of goal types on goal motives (e.g., autonomous and controlled), and the subsequent impact this has on physical activity and well-being. These overarching aims are addressed by seven objectives presented over five empirical chapters.

A systematic review and meta-analysis is presented in Chapter 3 that identified specific goals are effective for physical activity in insufficiently active adults, but less so for psychological variables. However, these effects are only comparable to no goal, highlighting a need to test additional goal types in this population. Chapter 4 identified that of all of the mechanisms and moderators suggested by Goal Setting Theory (Locke & Latham, 1990, 2002), task complexity was the only variable to influence physical activity and mental well-being. Thus, questioning the applicability of the theory in a physical activity context. In Chapter 5 the Self Concordance Model alongside previous goal setting literature was used to inform a proposed model of the associations between goal motives, psychological variables, physical activity, and mental well-being. Chapter 6 identified that although goal types do not alter performance in simple and complex tasks, perceptual differences were found that when related to a physical activity context could impact upon future engagement and adherence. Finally, Chapter 7 provided initial insights into the comparative effects of different goal types on physical and psychological variables over time in insufficiently active

adults, highlighting the need for a more individualised approach to goal setting in this context and for this population.

The findings presented in this thesis offer novel insight providing context specific answers to poignant critical questions raised in literature surrounding goal setting for physical activity for insufficiently active adults. A greater understanding of the types of goals and the underpinning motives effects on physical and psychological variables is provided, ultimately imploring further research to explore additional factors that could result in varied individual responses to goal setting for physical activity, specifically for insufficiently active adults.

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TABLE OF CONTENTS

PREFACE

Research undertaken towards this thesis has contributed to the peer-reviewed publications and conference presentations listed below, relevant training completed during this time is also listed:

Peer-Reviewed Publications

Garstang, K. R., Jackman, P. C., Healy, L. C., Cooper, S. B., & Magistro, D. (2024). What Effect Do Goal Setting Interventions Have on Physical Activity and Psychological Outcomes in Insufficiently Active Adults? A Systematic Review and Meta-Analysis. *Journal of Physical Activity and Health, 21*(6), 541-553. https://doi.org/10.1123/jpah.2023-0340

Garstang, K. R., Magistro, D., Jackman, P. C., Cooper, S. B., & Healy, L. C. (2025). Psychological Mediators of the Relations Between Goal Motives, Physical Activity and Well-being: Testing a Model of Path Analysis. *Journal of Health Psychology*, 13591053251330430. https://doi.org/10.1177/13591053251330430

Garstang, K. R., Magistro, D., Jackman, P. C., Cooper, S., & Healy, L. C. (2025). *Do the 'How' and 'Why' of Goal Setting Matter for Complex Tasks? Findings in a Novel Walking Task* [Manuscript Submitted for Publication, Under Review]. School of Science and Technology, Nottingham Trent University, Nottingham, UK.

Conference Presentations

Garstang, K. R., Magistro, D., Jackman, P. C., Cooper, S., & Healy, L. C. (2022, June 15-16). *An Exploration of Individuals Motives and Goal Preferences for Physical Activity and the Relationship with Psychological Outcomes* [Oral Presentation]. NTU School of Science and Technology Annual Research (STAR) Conference, Nottingham, United Kingdom.

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Garstang, K. R., Magistro, D., Jackman, P. C., Cooper, S., & Healy, L. C. (2024, July 15-19). *Longitudinal examination of the effect of specific and non-specific goal types for physical activity promotion in an insufficiently active population* [Poster Presentation]. European Federation of Sport Psychology (FEPSAC) Biennial Conference, Innsbruck, Austria.

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Training

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LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

α	Alpha
AFFEXX	Affective Exercise Experiences
APA	American Psychological Association
AWAP	As-well-as-possible
β	Beta
BCT	Behaviour Change Techniques
BREQ-2	Behavioural Regulation in Exercise Questionnaire-2
CFI	Comparative Fit Index
CI	Confidence Interval
df	Degrees of freedom
DYB	Do-your-best
EXES	Exercise Self-Efficacy Scale
EQ-5D	Euroqual-5 Dimensions
f/g/d	Effect
GRADE	Grades of Recommendation, Assessment, Development, and Evaluation
GSE	Generalised Self-Efficacy Scale
GST	Goal Setting Theory
HADS	Hospital Anxiety and Depression Scale
I^2	Heterogeneity statistic
IPAQ	International Physical Activity Questionnaire
IPAQ-SF	International Physical Activity Questionnaire Short Form

κ	Kappa
LNIT	Letter/Number Identification Task
MARS	Meta-Analysis Reporting Standards
MET	Metabolic Equivalent
NHIS	National Health Interview Survey
PA	Physical activity
PACES	Physical Activity Enjoyment Scale
PANAS	Positive and Negative Affect Schedule
PICO	Population, Intervention, Comparison, Outcome (framework)
POMS	Profile of Mood States
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
PROSPERO	International Prospective Register of Systematic Reviews
R	Multiple correlation coefficient
R^2	Model fit
RAI	Relative Autonomy Index
RCT	Randomised Control Trial
RMSEA	Root Mean Square Error of Approximation
ROB-2	Risk of Bias-2
ROBINS-I	Risk of Bias in Non-Randomised Studies – of Interventions
SDT	Self Determination Theory
SE	Standard Error
SEQ	Self-Efficacy Questionnaire

SF-36 MCS	Short Form-36 Mental Component Scale
SF-36 MHS	Short Form-36 Mental Health Scale
SMART	Specific, Measurable, Achievable, Realistic, Timebound
SMD	Standard Mean Difference
sPACES	Short Physical Activity Enjoyment Scale
SWEMWBS	Short Warwick-Edinburgh Mental Wellbeing Scale
SWiM	Synthesis Without Meta-Analysis
TLI	Tucker-Lewis Index
WHO	World Health Organisation
+ve	Positive
-ve	Negative
η^2	Partial eta squared
χ^2	Chi-squared
6MWT	6-minute Walk Test

CHAPTER 1: INTRODUCTION

1.1 Physical Activity

The physical and psychological benefits of physical activity[1] (PA) are widely reported (e.g., Cekin, 2015), with consistent, maintained PA behaviours suggested to be fundamental for health (Warburton & Bredin, 2017).[2] For an adult aged 18-64 years old to be considered physically active, World Health Organisation (WHO) guidelines suggest individuals should complete a minimum of 150-minutes of moderate-intensity activity[3], or a minimum of 75-minutes of vigorous-intensity activity[4], or a combination in minimum bouts of 10-minutes (WHO, 2020). Individuals completing sufficient amounts of PA can benefit from a reduced risk of all-cause mortality and chronic health conditions such as type 2 diabetes mellitus and cardiovascular disease (Aune et al., 2015; Löllgen et al., 2009; Vasankari et al., 2017). However, the prevalence of these chronic diseases has only increased (WHO, 2020), and if PA levels are not improved to reduce the prevalence and development of these (Dogra et al., 2021), it is predicted that a further 499.2 million preventable conditions will present by 2030 (Santos et al., 2023).

PA is considered to be an effective remedy for chronic health conditions, yet the prevalence of physical inactivity is high and has been considered a global pandemic (Flint et al., 2014; Ozemek et al., 2019). It is estimated that worldwide there are 1.4 billion adults that are insufficiently active, with the highest insufficient activity levels[5] in higher income countries (43%; Guthold et al., 2018); lower PA and higher sedentary behaviours[6] are particularly prominent in office workers (Bailey, 2021). The detrimental effects of being insufficiently active can lead to conditions such as obesity and hypercholesterolemia (Kokkinos, 2012), with higher sedentary behaviours also negatively

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[1] *Physical activity* is defined as any movement that is produced by skeletal muscles that increases energy expenditure from a rested state (Casperson et al., 1985).
[2] This thesis makes conscious note of referring to 'physical activity' and not 'exercise', a subcategory of physical activity, as it considers all activity whether planned or unplanned, structured or unstructured, and for fitness development and maintenance or not (Casperson et al., 1985).
[3] *Moderate-intensity activity* refers to any physical activity that is performed at an intensity of 40-59% heart rate reserve (Warburton et al., 2007), or 3-6 times the intensity of activity in a resting state, scoring ~5 on an intensity scale of 0-10 (WHO, 2020).
[4] *Vigorous-intensity activity* refers to any physical activity that is performed at an intensity of 60-84% heart rate reserve (Warburton et al., 2007), or more than 6 times the intensity of activity in a resting state, scoring ≥7 on an intensity scale of 0-10 (WHO, 2020).
[5] *Insufficient physical activity levels* refers to an individual not currently meeting physical activity guidelines, e.g., WHO (2020) (Tremblay et al., 2017).
[6] *Sedentary behaviour* is defined as any activity, while awake, when energy expenditure is ≤1.5 METs, e.g., sitting, or lying (Tremblay et al., 2017).

contributing to health by increasing the risk of diabetes (Zhu et al., 2023), cardiovascular disease (Wilmot et al., 2012), all-cause mortality (Chau et al., 2013), and mental health severity of depression (Zhai et al., 2014) and anxiety (Allen et al., 2019). To offset the detrimental effects of lower levels of activity and higher levels of sedentary behaviours individuals must increase the amount of moderate-vigorous intensity PA (Ekelund et al., 2016). In order to combat these high levels of inactivity, WHO (2018) is aiming to reduce physical inactivity by 15% by 2030.

To target and improve population health through PA, researchers are consistently trialling interventions aiming to improve PA levels (see meta-analyses from Conn et al. [2011], Freak-Poli et al. [2020], Howlett et al. [2019], & O'Brien et al. [2015]). Although current interventions report immediate increases in adults PA levels (e.g., Shcherbina et al., 2019), these PA behaviours are often not maintained long-term (Howlett et al., 2019; McEwan et al., 2022), and particularly in inactive adult populations, these PA interventions have only shown to report small effects on initial PA behaviours (d = 0.32, 95% CI 0.16-0.48, n = 2,346; Howlett et al., 2019), and even less so for maintenance of PA behaviours (d = 0.21, 95% CI = 0.12-0.30, n = 2,190; Howlett et al., 2019), resulting in the sustained low global PA levels (WHO, 2023). As individuals most at risk of developing chronic health conditions are insufficiently active adults (Howlett et al., 2015), it is of the greatest importance to improve PA levels in this population. One such intervention technique for behaviour change, namely PA behaviour change, is goal setting (Howlett et al., 2019; Michie et al., 2013).

1.2 Goal Setting for Physical Activity

A number of reviews have assessed the behaviour change strategies implemented to increase PA behaviours in adults (e.g., Howlett et al., 2019; McEwan et al., 2022). These reviews identified goal setting as the most employed behaviour technique, with the findings of a systematic review and meta-analysis assessing the longevity of behaviour change intervention effects on PA by McEwan et al. (2022) reporting 33 of the included 171 studies utilised goal setting for adults PA behaviour. More specifically, a systematic review and meta-analysis by Howlett et al. (2019) evaluated the effectiveness of PA interventions in a solely healthy inactive population and found that of the 26 included studies, 22 reported using goal setting for PA behaviour. Together, these reviews provide key evidence of the widespread use of goal setting in the context of PA.

The most commonly known framework in relation to goal setting is Goal Setting Theory (GST), proposed and developed by Locke & Latham (1990; 2002; 2006; 2013; 2019). GST (Locke & Latham, 1990) suggests that goals should be specific and challenging, and denotes two goal types: performance goals, which are focused on a specific outcome, and learning goals, which focus on strategies and processes to achieve a desired outcome. This has transpired into current goal setting practices and guidelines (e.g., WHO, 2020) for PA employing specific goals that tend to align with 'SMART' goals (Doran, 1981). Similar to GST (Locke & Latham, 1990) the SMART acronym was established in a business/workplace context. The most up to date meaning of the SMART acronym is for goals to be: *specific*, i.e., have a definitive desired outcome; *measurable*, i.e., to assess goal progress/success; *achievable*, i.e., matched to an individual's abilities/knowledge; *realistic*, i.e., challenging but still possible; and *time-bound*, i.e., an assigned timeframe to be completed within. Although commonly used, Swann et al. (2020) found that these specific goals, e.g., SMART goals, can actually result in higher levels of pressure and tension when compared to open goals in a walking task. Coupled with the potentially detrimental effects from setting ill-informed goals (McPherson et al., 2014), McEwan et al. (2016) reported no differences between specific and vague goal types, thus raising the question if goal setting guidance needs to change, and how.

1.3 Current Issues with Goal Setting and Goal Setting Theory

There are several issues with current goal setting and GST, specifically when applied to a PA context and for insufficiently active adults, that are discussed in this section. Locke and Latham's (1990) GST promote the use of specific, challenging goals which has been continued in PA contexts and become best practice (Swann et al., 2023). These types of goals are said to engage individual's by motivating them to employ sufficient efforts to match the demands of the task (Locke & Latham, 2015b), with GST suggesting that there is a linear relationship between how difficult a goal is and performance in goal pursuit (Locke & Latham, 1990). However, specific, challenging goals have the potential to negatively impact performance for individuals in the early stages of learning new tasks and engaging in new behaviours (Locke & Latham, 1991). Particularly with insufficiently active individuals who are new to PA, any activity is better than none at all and even small increases in PA levels in this population can provide benefits for reductions in morbidities and mortality (Madigan et al., 2021) and so performance of the goal is less important than partaking in goal pursuit, thus questioning the need and efficacy for specific challenging goals in this population. In addition, McEwan et al.'s (2016) systematic review and meta-analysis found no differences between the effect of specific (d = 0.59, p <.001) and vaguer goals (d = 0.51, p <.001) on PA outcomes contributing to the rising number of questions concerning the efficacy of the proposed specific, challenging goals in this context.

Although McEwan et al.'s (2016) review concluded that there were no differences between goal types (specific vs. vague) on PA, recent early experimental findings in exercise tasks have found that this may not be the case for psychological responses to goals (Hawkins et al., 2020; Swann et al., 2020; Swann et al., 2022). Yet there is still limited evidence on how psychological variables[7] could be influenced over longer-periods of time. These psychological responses are another factor which is failed to be considered by GST suggestions for goal setting. Given that psychological responses, such as affective responses[8] (Rhodes & Kates, 2015) and self-efficacy[9] (Bauman et al., 2012), can predict long-term PA behaviour, it is fundamental that researchers identify which goal types are most beneficial, specifically for insufficiently active individuals, to boost PA levels and reduce all-cause mortality for those most vulnerable. The psychological responses to goals can vary between active and insufficiently active adults (Hawkins et al., 2020; 2024), and so to understand how goals are truly effecting PA behaviours in this population we need to look beyond the effect had on PA outcomes and assess the effect of goals on psychological outcomes that are associated with PA. This could lead to more diversity in pursuit of goals and result in researchers and practitioners moving away from this 'one-size fits all' approach of setting specific/SMART goals for PA, ultimately resulting in goals being more effective for those setting and pursuing them.

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[7] Psychological variables noted throughout this thesis relate to measurable cognitive and/or emotional constructs that are individual to a person and could result in individual responses to the same stimuli.

[8] *Affective responses* are defined as the pleasure or displeasure an individual experiences (Ekkekakis et al., 2008).

[9] *Self-efficacy* is defined as an individual's belief in their capabilities to be successful in achieving or performing a task (Bandura, 1986).

Furthermore, and as mentioned in GST, context of the activity is an essential consideration for effective goal setting, specifically task complexity (Locke & Latham, 1991). However, the main body of goal setting literature fails to consider this. For individuals who are insufficiently active, and PA is a new task for them, PA can be considered a complex behaviour (Dishman, 1994; Rhodes & Nigg, 2011) due to its high component, coordination, and dynamic complexity [10] (Swann & Rosenbaum, 2018). Previously, it has been suggested that in this context where PA is complex and the individual is new to the behaviour, these challenging, specific goals should be avoided (Locke & Latham, 1990; Seijts et al., 2013). Therefore, other goal types are required in this context and so testing these further than the early experimental studies is required. Collectively, alongside the previously discussed concerns this highlights the need for further examination to understand how different goal types are working in a PA context for insufficiently active individuals for both physical and psychological outcomes so that a more informed decision can be made when setting goals in this context for this population, offering a holistic approach to PA behaviour change using goal setting.

1.3.1 Goal Setting Compared to Other Behaviour Change Techniques

Although goal setting is one of the most employed techniques, it should be noted that there are a total of 93 behaviour change techniques (BCTs; Michie et al., 2013) that can be employed in interventions, in combination, with the aim to increase its effectiveness at changing behaviours (Michie et al., 2020). As stated within GST, goal setting is not suggested to be used in isolation (Latham, 2016) and instead should be used alongside other BCTs, including feedback (see Michie et al., 2014 for full list of BCTs). Notably, McEwan et al. (2022) found that although goal setting and action planning showed to have medium effects on PA behaviour, large effects were shown by interventions that incorporated scheduled consequences (e.g., behaviour cost, rewarding completion), comparison of behaviours (e.g., demonstration, social comparison), and reward and threat (e.g., incentives, rewards, future punishment). As goal setting seems to be less effective when compared to other BCTs, there is a need to understand how it is being employed in interventions and to explore

[10] *Component complexity:* the number of dimensions a person must attend to at once (i.e., complex tasks require more actions or cues to attend to than simple tasks); *Coordination complexity:* the sequencing and coordination of acts (i.e., simple tasks would require fewer acts to coordinate then complex tasks); and *Dynamic complexity:* the ability to adapt to changes (i.e., complex tasks require greater flexibility and capacity for change than in simple tasks) (Drach-Zahavy & Erez, 2002).

ways in which goal setting effectiveness can be improved. Although important to consider all intervention components, the purpose of this thesis is not to assess effective combinations of BCTs with goal setting for PA, but to explore the how and why goal setting may be effective for a specific population.

1.4 Goal Motives for Physical Activity

In addition to the types of goals set, it is equally as important to consider the reasons for a desired behaviour or goal, i.e., goal motives. Goal motives offer an explanation as to why an individual may pursue a goal. Motives for goals can be referred to as either autonomous or controlled and play a role in participation and engagement in a behaviour (Sheldon & Elliot, 1999). Fundamentally, autonomous motives are more enduring over time and are supposedly better at increasing efforts, resulting in greater goal attainment (Sheldon & Elliot, 1999). Furthermore, this relationship is said to directly influence a person's basic psychological needs of autonomy, competence and relatedness, which when enhanced can result in increases in perceived well-being (Sheldon & Elliot, 1999).

The goal motives underpinning goal pursuit for PA are particularly important as they could impact upon goal attainment, and consequently, health outcomes. As previously discussed, specific, challenging goals are suggested to be the optimal goal, but only when an individual has the adequate knowledge and skill set of the task (Locke & Latham, 2002; 2013); for an insufficiently active adult trying to be more active they most likely do not conform to this guideline and so the best practice of setting specific goals in this population (Swann & Rosenbaum, 2018; Swann et al., 2023) seems redundant as the goal is likely perceived to be unattainable. Although untested, it is predicted that different goal types could be associated with different motives as autonomy is greater in an open goal for instance (Swann et al., 2022). Even though autonomous motives are considered more long-lasting for behaviours, it can be more taxing for an individual to disengage from an unattainable goal (Ntoumanis et al., 2014b). Therefore, it is critical to identify how alternative goal types and goal motives are associated to prevent any negative consequences on PA participation and adherence.

1.5 Current Thesis

This thesis will advance our knowledge of PA goal setting by addressing several gaps in the current literature. Although there is ample meta-analytical evidence for the effect of goals on PA (e.g., Howlett et al., 2019; McEwan et al., 2022), these reviews fail to detail the content of the goal, and do not distinguish between the types of goal being set. McEwan et al.'s (2016) review of goal setting intervention over time in a mixed activity population did detail two goal types in their findings, specific and vague, reporting no significant differences. However, the activity level of this study's population was both active and insufficiently active and therefore cannot be made specific to those who are more at risk of non-communicable disease (i.e., solely insufficiently active adults). More recently studies have sought to examine multiple goal types in this population during single exercise bouts (e.g., Carter et al., 2021, Hawkins et al., 2020), however, current literature is yet to examine the effect of these different goal types for PA in an insufficiently active population over a prolonged period of time. This thesis offers novel insight and seeks to address this gap by examining the effect of different goal types during prolonged PA for solely insufficiently active adults.

Additionally, it is important to understand the holistic effects of goal setting in PA contexts not only for PA outcomes, but also for variables that could contribute to long-term behaviour adherence. For PA, goal setting has shown to be moderately effective (d = .55, 95% CI 0.43-0.67, p <.001 [McEwan et al., 2016]; d = 0.44, p <.001 [McEwan et al., 2022]), however the effects on psychological variables that contribute to long-term PA are relatively unknown. The importance of understanding the effect of different goal types on these variables, such as affective responses to exercise which influence long-term PA, is key to better understand how different goal types may, or may not, be influencing long-term behaviour via additional individual and contextual considerations (Rhodes & Kates, 2015). Although some studies have started to assess the effects of goal types on psychological variables in different contexts such as enjoyment during PA (Hawkins et al., 2020) and confidence in a cognitive task (Schweickle et al., 2017), these findings are preliminary in nature and further examination is needed. Therefore, this thesis offers novel contribution to the gaps in the current literature base by examining the effect of different goal types on psychological variables associated with PA.

Alongside the type of goal being set, i.e., the *how* of goal setting, brings the question of *why* an individual may be pursuing a goal. Similar to literature on goal setting, goal motives have received copious amounts of attention in PA contexts (see Knittle et al. [2018] and Teixeira et al. [2012] for reviews on motivations for PA). Yet, to date research has not assessed the relationship between *how*, i.e., goal types, and *why*, i.e., goal motives, and how this could be influencing PA behaviours. If the relationship between goal types and goal motives is better understood, researchers and practitioners will be more able and certain when setting goals that the desired type of motivation, autonomous or controlled, is incited. This thesis offers initial novel findings to contribute to this gap in the current PA literature by examining the effect of goal types on goal motives in isolated tasks and over time.

1.6 Thesis Aims and Objectives

The overarching aim of this thesis is twofold:

1. Explore the effects of different goal types (specific, open and learning) on PA and psychological variables (motivation, affect and self-efficacy);
2. Assess the effect of goal types and goal motives, and the subsequent effect on PA and well-being.

Predominantly specific goals are used for PA (Swann & Rosenbaum, 2018), yet PA levels have remained low (Guthold et al., 2018). Research started to question if those who were not active and not meeting WHO PA guidelines (2020), i.e., insufficiently active adults, required different types of goals as PA was novel and complex (Swann & Rosenbaum, 2018). This suggestion is supported by meta-analytical evidence reporting no differences between specific and non-specific goal types for PA (McEwan et al., 2016). As a result, alternative goal types have been explored for PA for insufficiently active adults, including open goals (e.g., Hawkins et al., 2020; 2024; Swann et al., 2022). With the effects of these goal types on PA known (Howlett et al., 2019; McEwan et al., 2016; 2022), the effects these goal types are having on psychological variables remains unclear. Psychological variables are important mediators that demand consideration when targeting PA behaviour. By developing greater understanding of how different goal types are affecting psychological variables, it may result in greater depth of understanding of how these goal types are influencing long-term PA behaviours. Therefore, it is essential that the effects of goal types on psychological variables associated with PA are explored to understand the most beneficial goal type for PA in insufficiently active adults to increase levels of PA and improve global health.

Additionally, it is vital to understand not only *how*, i.e., goal types, goals are working in this population for PA, but also how these goal types may be influencing *why*, i.e., goal motives, and individual may be engaging in PA. As documented in the literature, autonomous and controlled goal motives can be effective, yet autonomous goal motives are preferential for long-term sustained behaviours (Teixeria et al., 2012). By exploring if goal motives are influenced by different goal types practitioners and goal users could make more informed choices when selecting goal types to ensure that the desired motive is achieved. In order to achieve these two overarching aims, seven objectives were established and are addressed throughout the thesis. An overview of these objectives is presented below along with the rationale for them.

1.6.1 Objective 1 and 2: Examining the Current Evidence on Goal Setting for Physical Activity and Well-being Interventions in Insufficiently Active Adults

The first objective was to develop understanding of the impact of goal types on psychological outcomes (e.g., motivation, self-efficacy) in insufficiently active adults, and the second looked to examine and assess the current literature base of the use of goal setting for PA and well-being interventions in adults. Research to date has reported the effects of goal types on PA (e.g., McEwan et al. 2016). PA outcomes are not the only consideration for maintained behaviours, psychological variables are also key to contributing to long-term maintenance (Kim et al., 2017; Napolitano et al., 2008; Rhodes & Kates, 2015, Schmid & Reimann, 2019). More recently, literature has reported different goal types can cause varied psychological responses in active and insufficiently active adults (Hawkins et al., 2020; Swann et al., 2020; 2022). These objectives were addressed by conducting a Systematic Review and Meta-Analysis (Chapter 3). This approach allows for a comprehensive understanding of the impact of different goal types on the physical and psychological outcomes that contribute to long-term PA behaviours.

1.6.2 Objective 3: Exploring Individual's' Goal Setting Practices for Physical Activity

The third objective of this thesis was to develop our understanding of the application and relevance of GST mechanism and moderators for PA, which was addressed by conducting a survey compromised of questions relating to the application of GST mechanisms and moderators for PA goals, PA, and mental well-being (Chapter 4). GST suggests that specific challenging goals are better for performance when an individual has the knowledge and skill level to succeed (Locke & Latham, 2013). However, those who are not active do not meet these requirements, and so there is a need to explore the moderators and mechanisms of the theory in a PA context. Although research promotes the use of specific goals for insufficiently active adults, there is limited knowledge on the effect of specific goals on psychological outcomes. By understanding the preferred goal setting approaches of individuals in relation to Locke and Latham's (1990; 2002) GST we would be better able to identify how the theory works, or doesn't, in a PA context.

1.6.3 Objective 4: Understanding Goal Motives in Relation to Physical Activity and Psychology Outcomes

The fourth objective was to enhance the understanding of the impact goal motives have on PA and psychological outcomes (motivation, affect, self-efficacy and mental well-being). Goals are underpinned by motives for the behaviour (Sheldon & Elliot, 1999), and these motives can result in behaviour changes (Deci & Ryan, 2000), i.e., PA, in addition to well-being (Sheldon & Elliot, 1999). However, motives are not the only known variables to influence upon PA and well-being, there are several psychological variables documented in research that can have an effect; namely self-efficacy (Bauman et al., 2012), motivation (Knittle et al., 2018), and affective experiences (Ekkekakis and Brand, 2019). Although the direct relationship between these variables is somewhat known, the indirect relationship between these variables remains unclear. This objective was addressed by conducting a survey compromised of questions relating to one's goal motives, self-efficacy, motivation, affect, PA and mental well-being (Chapter 5). This approach allowed a more comprehensive picture of the relationship between key variables that can both contribute and inhibit participation and long-term adherence to PA to be developed.

1.6.4 Objective 5: Examining Goal Types and Goal Motives on Performance Outcomes in a Novel Task

The fifth objective was to explore how goal types (specific, open and learning) effect goal motives and how this influences performance outcomes (WalCT score, goal perceptions, challenge/threat appraisal and future interest) during simple and complex trials in a walking task. The evidence suggesting that different goal types can elicit differences on PA and performance tasks is growing (e.g., Hawkins et al., 2020; Pilcher et al., 2022; Schweickle et al., 2017), yet these studies fail to consider the motives underpinning goal pursuit. Thus, it remains unknown if different goal types result in pursuing goals with more or less adaptive goal motives. Given that autonomous goal motives are more preferable than controlled motives for long-term behaviour adherence (Deci & Ryan, 2008), it is of great importance to understand if different goal types are more likely to result in this form of motive. Additionally, there is need to consider contextual factors of goals for PA, e.g., task complexity (Locke & Latham, 2002; Swann & Rosenbaum, 2018), as while this has been suggested as being important in determining what type of goal is appropriate this has yet to be empirically tested. This objective was addressed by conducting an experimental study (Chapter 6). This study offers novel insights into how goal types may impact upon motives for PA, and if different goal types are optimal in differing task complexities.

1.6.5 Objective 6 and 7: Examining the Longitudinal Effect of Goal Types and Goal Motives on Physical Activity and Psychological Outcomes

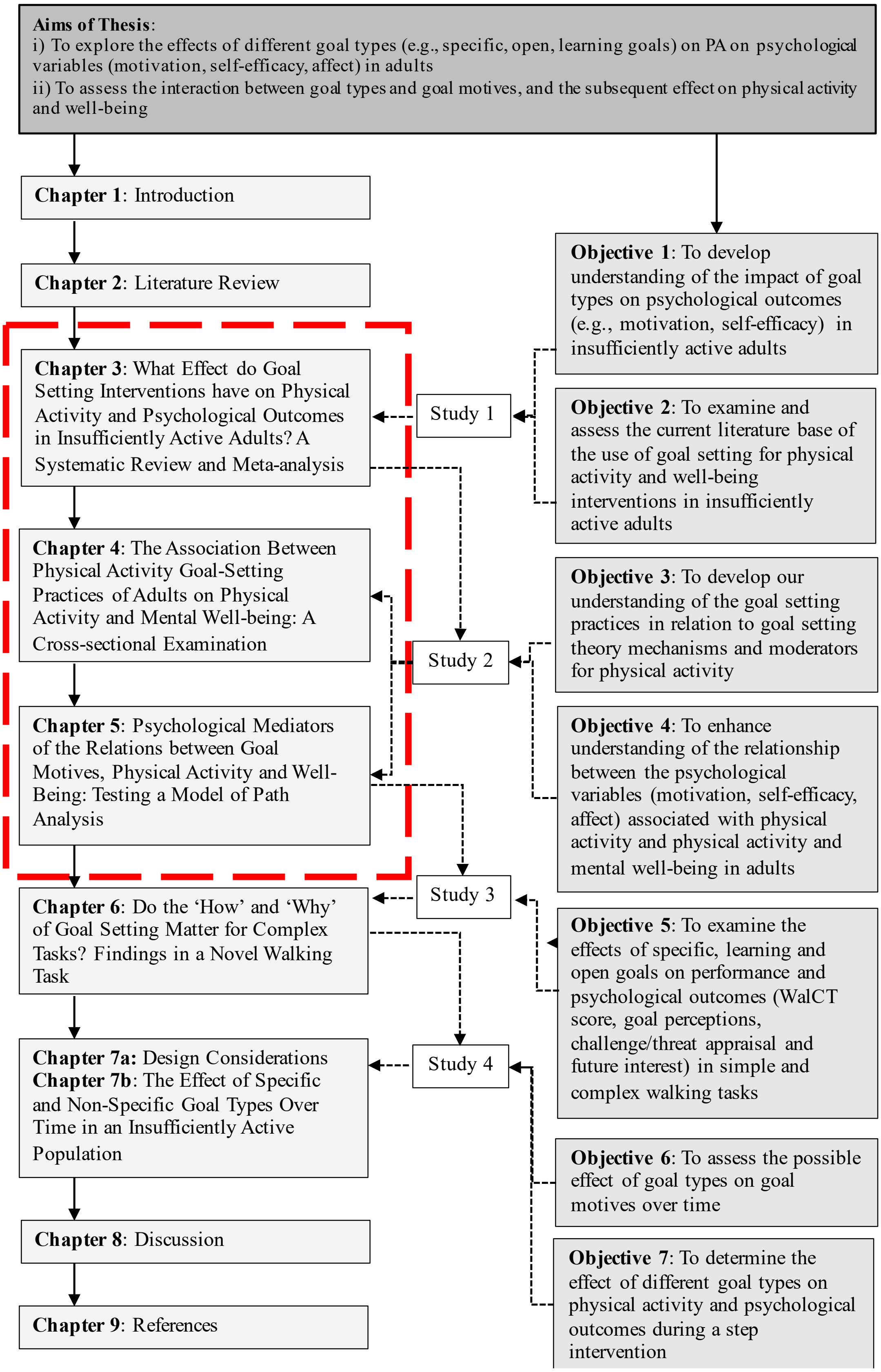
The sixth objective was to assess the possible effect of goal types (specific, open and learning) on goal motives overtime, and the seventh objective was to determine the effect of different goal types (specific, open and learning) on PA and psychological outcomes (motivation, self-efficacy, affect, mental well-being and goal perceptions) during a step intervention. Research suggests that vague goal types are more effective for insufficiently active adults compared to specific goals (e.g., Hawkins et al., 2020). However, research to date reports findings from laboratory trials and fail to assess these effects over time. Additionally, factors such as goal difficulty are not addressed (e.g., Pilcher et al., 2022; Schweickle et al., 2017). The sixth and seventh objectives of this thesis were addressed by conducting a step intervention for insufficiently active adults (Chapter 7). A pilot trial was conducted to determine an appropriate goal difficulty for this population, ahead of the 7-week intervention. To conclude, this study offers novel insight into the effects of different goal types over time on PA and psychological variables with the potential to provide a more tailored approach to goal setting for insufficiently active adults.

1.7 Thesis Framework

This thesis includes nine chapters (Figure 1). Following this introductory chapter is a review of the literature on GST and goal motives in PA contexts, and the physical and psychological outcomes of goal setting for PA. Critique of the literature is provided to support the need for this thesis and the studies reported within it in Chapters 3-6. Chapter 3, Study 1, reports the findings of a systematic review and meta-analysis that identified, evaluated, and summarised the effects of goals on PA and psychological outcomes in insufficiently active adults. Chapter 4, Study 2, is a cross-sectional study that explores current goal setting practices of GST mechanisms and moderators for PA goals and the effects on PA and mental well-being. Chapter 5, Study 3, proposes a path analysis model of goal motives, psychological variables, PA and well-being. Chapter 6, Study 4, is an experimental study that explored the effect of goal types on goal motives during a walking task when accounting for task complexity. Chapter 7, Study 5, is a longitudinal experimental study that assessed the effect of goal types on goal motives and the subsequent effect on step count and well-being. The general discussion of this thesis, and findings of the studies presented in the previous chapters, are presented in Chapter 8. Chapter 9 presents the references.

Figure 1

Thesis Framework



1.8 COVID-19 Impact Statement

I commenced my PhD on 5th January 2021 which was the day after another lockdown order was served. As a result, the first 6 months to a year of this PhD was impacted by the Coronavirus Pandemic. Consequently, access to participants was severely restricted and study options limited during this time. Figure 1 identifies the affected chapters outlined in red. In order to make progress to submit within the required timeframe, along with my supervisory team, we decided it best to conduct a systematic review of the literature in this population to further identify gaps in the literature to be explored during this thesis. As the restrictions were still not lifting, again with my supervisory team, we sought to conduct a remote online survey which addressed two objectives addressed in Chapter 4 (to develop our understanding of the application and relevance of GST mechanism and moderators for PA) and 5 (to enhance the understanding of the impact goal motives have on PA and psychological outcomes). Although the work presented in these three chapters may not have been conducted in the same manner without the COVID-19 restrictions, they allowed the thesis to progress towards completion, and I believe they still provide a strong basis of knowledge and offer substantial contribution to the thesis and wider literature.

CHAPTER 2: REVIEW OF THE LITERATURE

Goal setting, where a goal is defined as the objective of one's actions towards a desired outcome (Locke & Latham, 1981), is the most frequently used behaviour change technique for PA (Howlett et al., 2019; Howlett et al., 2021). Although best practice has become to set specific goals in this context (Swann & Rosenbaum, 2018; Swann et al., 2023), this notion is being questioned by more recent review and experimental research (e.g., Hawkins et al., 2020; McEwan et al., 2016; Swann et al., 2020). Particularly for those who are not physically active, PA could be too complex a task to pursue specific goal types (Swann & Rosenbaum, 2018), and alternative goal types may be more beneficial. More recently, literature has started to consider the psychological effects of different goal types in addition to the effects had on PA outcomes, particularly in an insufficiently active population. However, the current evidence base is still limited in the knowledge of how goal types influence motives for activity and how this plays a part in PA adherence. This chapter will review the existing literature on GST, goal setting for PA and psychological outcomes, and the role of goal motives in goal setting. The findings and limitations will be discussed and presented.

2.1 Goal Setting Theory

GST (1990) is an inductive theory that was coined in the late 20th century, and since its evolution it has led to over 1,000 studies being conducted from the theory (Mitchell & Daniels, 2003). GST is a theory of motivation which originated for a workplace context. Fundamentally, the theory states that every human has to engage in goal directed behaviours to fulfil their needs (Locke & Latham, 2013); both automatic and conscious goal directed behaviours. Since its origins grounded in work-place performance, GST has become one of the most used behaviour change techniques for PA (Howlett et al., 2019; Howlett et al., 2021). Yet, there are questions over the efficacy of the theoretical determinants of the theory when considered for PA as: (1) PA in nature is not a performance variable; (2) the influences of GST suggestions on psychological variables that influence PA behaviours are not considered; and (3) those of differing PA levels have different competencies that could result in detrimental effects if ineffective goals are employed. This sub-chapter discusses the development of GST, its components, the application of it in a PA context, and its limitations.

It is stated in GST that goals are the direct, initial source of an individual's motivations (Locke & Latham, 2013), and there are two elements that make up a goal, content (i.e., the desired object or result being sought) and the intensity (i.e., the effort needed to achieve the goal, the level of commitment, and perceived importance of the goal; Locke & Latham, 1990). Over 300 experimental research studies that pre-dated GST contributed to its development and produced two main findings. First, there is a linear relationship between goal difficulty and success (Locke & Latham, 1990), with early findings showing the most difficult goals can have >250% better performance than easy goals (Locke, 1967). Second, specific, difficult goals result in better goal performance compared to vague goals or no goal at all (Locke & Latham, 1990), with Locke et al.'s (1981) review of goal setting on performance in work-place settings finding that 51 of the 53 included studies reported benefits of some kind when setting specific, difficult goals. GST does not consider the benefits of vague goal types due to their subjective nature, with preference of specific goals as they provide clarity in acceptable performances in goal pursuit (Locke & Latham, 2013). Although performance may be an essential measure in business and work-place contexts, is it the most important in alternative contexts such as PA where there are a hierarchy of needs to be considered?

2.1.1 Mechanisms of Goal Setting Theory

As stated by Locke and Latham (1990) in GST, when goals are specific and challenging there are a number of mechanisms that contribute to successful performance and goal attainment, including: (1) directing attention; (2) increasing efforts; (3) instilling persistence; and (4) utilising relevant skills and knowledge (Locke & Latham, 1990). First, specific, challenging goals direct an individual's attentions towards appropriate cues (Locke & Latham, 1990). According to GST, the specific nature of a goal is also able to direct an individual's attention and efforts to appropriate task cues (Locke & Latham, 1990). The increased difficulty of a goal then mobilises efforts, such that individuals will also be more persistent when goal striving in comparison to when an open or vague goal is set (Locke & Latham, 1990). The final mechanism of goals relates to an individual's application of prior knowledge. When more specific, challenging goals are set, relevant knowledge and skills are required to attain goal success.

Although specific goals could be effective in drawing individual's attention to the goal (e.g., Trumpower et al., 2004), this could be inhibiting individuals from acquiring broader knowledge and skills that could be applied across multiple contexts (Trumpower et al., 2004). Trumpower et al. (2004) actually recommend the use of vague goals when in initial stages of learning as this can allow for wider breadth of knowledge and skill acquisition. However, if trained and/or has the appropriate knowledge and skill for the goal, specific, challenging goals can lead to greater performance; yet if the knowledge and skillset required is absent, this can lead to worse performance than easy goals (Early & Perry, 1987). Actually, if an individual lacks the required knowledge of skill level for goal pursuit/success, such is the case when an individual is new to a behaviour/task (e.g., insufficiently active individuals engaging in PA), a learning goal which focuses on task mastery can result in better goal performance than specific, challenging goals (Seijts & Latham, 2001; Latham & Locke, 2007).

2.1.2 Moderators of Goal Setting Theory

In addition to goal mechanisms, Locke and Latham (1990) report a number of moderating variables of goal success. Failing to consider the moderating variables detailed below 'is done at one's peril' (Latham, 2016, p.5), and according to Locke and Latham (1990) are vital when setting goals.

2.1.2.1 Ability

The appropriateness and potential of goal attainment can be determined by an individual's ability to utilise appropriate strategies to achieve it (Locke & Latham, 2002). Goals should be attainable but still challenging to ensure desired level of performance is achieved (Lunenberg 2011). The ability of the individual has a direct effect on goal performance, with high ability individuals able to perform better in regard to goal attainment than individuals of a lower ability (Locke & Latham, 2013), as generally, individuals cannot achieve a goal if they do not know how to do so (Locke & Latham, 2019). In the context of PA, if an individual does not have the prior knowledge or skill of what being physically active means or how to be active, for example the WHO [2020] guideline is to complete 150-minutes of moderate activity per week, however if an individual does not have the knowledge of what moderate activity is, they cannot successfully achieve the specific performance goals and alternative goals should be set (Swann et al., 2021). Therefore, the ability of an individual is a key consideration for goal setting not only in the intended business and workplace context of which GST originated, but also in wider contexts such as PA.

2.1.2.2 Performance Feedback

Feedback is another important variable in GST. Feedback works by allowing individuals to track their progress (Locke & Latham, 2019) and informs the individual whether effort needs to be maintained or increased for goal success (Locke, 2002). Setting a goal without providing feedback on the goal attainment makes the setting of the goal pointless (Strecher et al., 1995) as goals are ways for feedback to be used for action (Locke & Latham, 2015). When used together, goal setting and feedback is expected to be more effective for performance than when used in isolation (Locke & Latham, 1990), as they allow individuals to reflect on current strategies, and adapt if needed, to allow for progress and successful goal attainment (Locke & Latham, 2002). Because of this, particularly for initial stages of learning, feedback should be considered an essential element of goal setting. When translated into a PA context, for those who are insufficiently active seeking to be more active, feedback on goal progress could be an important element of goal attainment and healthier behaviours which could drive motivation for increased PA levels.

2.1.2.3 Goal Commitment

Individuals must also be committed to a goal for it to be effective at spurring an individual into action (Locke, 2002: Locke & Latham, 2019), but without the resources necessary, likelihood of goal attainment is low (Locke & Latham, 1990). Two overarching factors can determine how committed an individual is to a goal; perceived valence of the goal and the expected attainment (Locke & Latham, 2015b). Perceived valence refers to the desirability of the goal, this could include factors such as any incentives for goal pursuit/success, any perceived punishments of not achieving a goal, and satisfaction from pursuing/achieving a goal (Locke & Latham, 2015b). Expected goal attainment relates to an individual's perception in their ability to achieve a goal (i.e., their self-efficacy), and could include factors such as competition for goal attainment, and the intensity of the goal (Locke & Latham, 2015b). The role of commitment is particularly important the more challenging a goal is, one way to increase assurance that individuals will commit to a goal is to include them in the goal setting process (Lunenberg, 2011). If an individual does not deem the goal important, they will not be committed to it; that being said, in a PA context, individuals may remain inactive due to the lack of perceived importance of current PA guidelines (Swann et al., 2021).

2.1.2.4 Task Complexity

There are three components that make up and define the complexity of a task: (1) the number of dimensions a person must attend to at once (i.e., component complexity; complex tasks require more actions or cues to attend to than simple tasks); (2) the sequencing and coordination of acts (i.e., coordinating complexity; simple tasks would require fewer acts to coordinate then complex tasks); and (3) the ability to adapt to changes (i.e., dynamic complexity; complex tasks require greater flexibility and capacity for change than in simple tasks) (Drach-Zahavy & Erez, 2002). If the task is perceived too complex, or an individual is in the initial stages of learning a new skill or behaviour, a specific goal may be detrimental for goal attainment (Latham & Locke, 1991). Goals should be adapted in response to the complexities of the task, for instance as PA is considered a complex task for insufficiently active individuals, specific, challenging goals may not be best suited and alternative goal types should be explored for use in this context (Swann & Rosenbaum, 2018). Locke & Latham (2016) propose the substitution of specific, challenging goals for learning goals in this instance as they may be more appropriate.

2.1.2.5 Self-efficacy

Self-efficacy is the belief in oneself that they have the required ability to perform a task (Bandura, 1986). Self-efficacy has been identified as a moderator of goal success (Seijts & Latham, 2001) and can be a key determinant to whether an individual deems a goal to be attainable and commits or not (Lunenberg 2011). Those with lower levels of self-efficacy are less likely to commit to a more challenging goal compared to somebody with high self-efficacy (Latham & Locke, 2007), An insufficiently active individual, who potentially has lower beliefs that they can be active, may disengage with a specific, challenging PA goal and be less committed to it as a result of lower belief in their own capabilities, which then could result in sustained low levels of PA.

2.1.3 Other Influential Factors

2.1.3.1 Situational Constraints

Situational constraints refer to factors that can both promote and inhibit goal success (Locke & Latham, 2019). They can include social support, tangible resources, and access to adequate facilities (Locke & Latham, 2019). The necessary resources should be in place/available to an individual for a goal to be able to be achieved as if they are not, it can restrict the ability to do so, and influence the commitment to the goal (Latham, 2016). To set specific, challenging goals when there are inadequate situational constraints (e.g., support, resources, facilities), is not considered wise in GST (Locke & Latham, 1990; Swann et al., 2021).

2.1.3.2 Personality

Initially, individual personality differences were not considered an influential factor in GST. However, as the theory has evolved and been refined over time the authors have acknowledged that there may be a need to consider individual differences (Locke & Latham, 2015b). A meta-analysis by Judge and Ilies (2002) sought to understand the associations between the Big Five personality traits[11] and GST description of motivation. This review found that of the studies that reported the relationship between the Big Five and goal setting motivation, 19 reported the relationship with neuroticism, five with extraversion, four with openness, four with agreeableness, and 18 with conscientiousness and although report mixed findings, overall support the applicability and influence of personality traits on goal setting for motivation.

2.1.3.3 Affect

Locke & Latham (2019) describe a goal to be something that an individual values, and so they have the ability to affect an individual's emotions and feelings regarding attainment. A meta-analysis by Koestner et al. (2002) found nine studies examined the effect of goal attainment on affect. Generally, individuals associate increased positive affective experiences, and reduced negative affective experiences, when successfully achieving a goal (Koestner et al., 2002). However, although less attainable than their easier counterparts (Locke & Latham, 2019), specific, challenging goals are

[11] *The Big Five* personality traits (McCrae & Costa, 2008) include: (1) *Neuroticism* (i.e., anxious and worrisome); (2) *Extraversion* (i.e., outgoing and sociable); (3) *Openness* (i.e., inquisitive and unique); (4) *Agreeableness* (i.e., trusting and cooperative); and (5) *Conscientiousness* (i.e., diligent and disciplined).

still promoted by GST, and used for PA promotion, which negates the likelihood of positive affective experiences when goal striving. In this instance, specific, challenging goals may be perceived a threat rather than a challenge which is detrimental to goal performance (Latham & Locke, 2006) and question the utility of specific challenging goals for positive affect which could increase behaviours such as PA (Rhodes & Kates, 2015).

2.1.4 Is Goal Setting Theory Appropriate in the Context of Physical Activity?

Goal setting can provide motivation for PA and exercise when set appropriately (Anshel, 2014; Lunenberg, 2011). Current best practice in PA is to set specific and challenging goals (Swann & Rosenbaum, 2018). However, if the task is perceived too complex, a specific goal may be detrimental for goal attainment (Latham & Locke, 1991). Applying this principle to PA, an argument can be made that health behaviours, more specifically initiating PA, is a complex task (Swann & Rosenbaum, 2018) due to the adjustment to new behaviours and the multitude of stimuli and acts that must be coordinated to become more physically active (Drach-Zahavy & Erez, 2002). If applying a specific goal (e.g., WHO guidelines, 2020) to a complex task, an insufficiently active individual may be less likely to exhibit positive PA behaviour change or improved psychological well-being. In this instance, an alternative goal type, without a specific outcome, may be more beneficial, allowing goal success to be flexible and self-determined (McEwan et al., 2016). This is supported by research by Chae et al. (2015), who found that when specific goals were implemented, participants attributed lack of motivation for being inactive. An individual initiating PA may not cope with the stress of the specific goal, and experience less enjoyment, resulting in decreased goal commitment (Weinberg et al., 2001). Furthermore, if current practices are inadequate for improving PA levels of insufficiently active adults, policies, and government targets to improve the global population's PA will remain unmet.

Since the development of GST (Locke & Latham, 1990), there have been updates and clarifications to different elements of the theory. Namely, goal type, as Locke & Latham have evolved the theory to distinguish between performance goals that focus on outcomes and learning goals that focus on strategies for successful goal striving (Locke & Latham, 2015a). However, this distinction has not led to changes in goal setting approaches, with many contexts, including PA guidance (e.g., WHO, 2020), still employing generalised specific performance goals (Swann et al., 2021). Although warnings were made by the authors of GST of the need to consider contextual and moderating factors when setting goals (e.g., Latham, 2016), this has been ignored by some empirical studies (e.g., McEwan et al. [2016] review found three studies did not utilise feedback when setting goals for PA), which could be the cause of low global PA rates and poor health consequences (Swann et al., 2021).

Considering GST mechanisms in the context of insufficiently active individuals, directing attention and increasing efforts can lead to other learning cues being missed and with the lack of prior knowledge and skill, the individual may see the challenge as too high, resulting in performance plateauing or ceasing (Locke & Latham, 2002; 2013). Drawing attention solely to goal-related stimuli also prevents broader knowledge gain and learning. As learning is a key skill required for new behaviours (i.e., PA), vaguer goals may allow for wider scope in knowledge acquisition in the early stages of behaviours (Trumpower et al., 2004). Although within GST it is made explicitly clear that specific goals lead to better performance than when simply doing your best (Locke & Latham, 2007), for PA, and those new to PA, this is questionable and other goal types may be better suited (see evidence in a review by McEwan et al., 2016).

2.2 Goal Types

2.2.1 Defining Goal Types

Specific goal types are dominant in PA contexts (see reviews by Howlett et al. [2019]; McEwan et al. [2016]), however the emergence of vaguer, open goals (Swann et al., 2016) has brought the efficacy of specific goals into question; particularly, in the context of new exercisers who deem PA to be a complex behaviour (Swann & Rosenbaum, 2018). Furthermore, when asked about personal goals, individuals reported 51.4% (n = 611) of goals to be vague, with no specified outcome and perceived these vague goals to be equally as important to pursue as specific goals (M_{vague} = 5.73; M_{specific} = 5.78 [Wallace & Etkin, 2018]). This section initially presents and defines specific and non-specific goal types, and then goes on to discuss the reported effects of these goal types on PA, task performance, and psychological outcomes from initial experimental studies that have compared these goal types.

2.2.1.1 Specific Goal Types

2.2.1.1.1 Specific Goals. In GST, it is stated that specific, challenging goals are the most preferable goal for best performance and focus on a defined, measurable outcome (Locke & Latham, 1990). These specific goals can be phrased relative to an individual (e.g., walk 10% more steps) or as an absolute, generalised goal (e.g., walk 10,000 steps). As previously discussed, they work by directing attention, increasing efforts and persistence for the task, and encouraging an individual to utilise relevant skills and knowledge for goal pursuit (Locke & Latham, 1990). Progress in a specific goal (e.g., "find 10 errors in a row" in a text passage) can result in increased motivation for the task (Wallace & Etkin, 2018). GST originated in a business context (Locke & Latham, 1990) and although specific goals have proven efficacious for additional settings, including PA, there are theoretical assumptions that suggest such a goal may not be any more advantageous in comparison to vague goals in a PA context (Swann & Rosenbaum, 2018). Particularly when an individual is in the learning stages of a behaviour, specific, challenging goals are not as beneficial (Locke & Latham, 2013), and so for new exercisers, alternative goal types may be better and so the current literature base of other goal types needs to be assessed.

Table 1

Definitions and examples of specific goal types

	Definition	Example
Specific	A goal that focuses on performance outcomes.	"Walk 10,000 steps"
SMART	A goal that focuses on performance outcomes and is specific, measurable, achievable, realistic, and time-bound (Doran, 1981).	"Walk 10,000 steps a day"
Learning	A goal that focuses on implementing strategies for knowledge and/or skill acquisition that results in mastery of a strategy, process or procedure (Seijts & Latham, 2005; Seijts et al., 2013).	"Identify and implement a strategy to walk 10,000 steps a day"

2.2.1.1.2 SMART Goals. Similar to GST (Locke & Latham, 1990), SMART goals originated from a business setting (Doran, 1981). Current best practice for PA is guided by GST and is to set SMART goals (Swann et al., 2020), which could be exacerbated by how simple, memorable and widely known the acronym has become (McPherson et al., 2014; Swann et al., 2023). SMART goals are a frequently recommended goal type (e.g., ACSM, 2017; WHO, 2020). Although common for PA goal pursuit, the known effects of SMART goals on psychological outcomes are limited and warrants further investigation. Swann and colleagues (2023) scrutinised the SMART acronym in a narrative review, with the efficacy of the goal type questioned particularly for insufficiently active individuals. The authors reviewed a number of key problems. First, although potentially guided by theory, the SMART goal principle is not grounded in a scientific theory and does not follow stated assumptions of GST (Locke & Latham, 1990). Second, there is a lack of guidance for the use of this goal type. Third, not all of the acronym seems necessary. For example, specific goals are measurable as they refer to a defined outcome, therefore the 'measurable' criterion is redundant. Finally, in different contexts the goal could have more detrimental, rather than positive, consequences. Based on this review – and the widespread advocation for SMART goals in practice for setting PA goals – it is essential to reassess the efficacy of this goal types use for PA.

2.2.1.1.3 Learning Goals. Initially, GST promoted specific, challenging goals with a performance outcome (Locke & Latham, 1990). However, such goes are only optimal when the individual pursuing the goal is proficient in the knowledge/skill required to succeed (Locke & Latham, 1990). In such instance where this is not the case, learning goals have been suggested to replace specific, challenging performance goals (Locke & Latham, 1990; 2013). Although prominent in other contexts (e.g., business [Seijts et al., 2004]), learning goals have only recently been examined in relation to other goal types in a PA context (Carter et al., 2021). They work by developing metacognitions which result in increased ability to plan, monitor, and evaluate own progress towards achieving a goal (Locke & Latham, 2006). Where other specific goal types such as SMART goals draw individual's attention to task performance outcomes, learning goals focus on knowledge and skill acquisition (Seijts et al., 2013). If an individual lacks the required knowledge of skill level for goal pursuit/success, a learning goal focusing on task mastery can result in better goal performance than specific, challenging goals (Latham & Locke, 2007; Seijts & Latham, 2001; 2005), and in an academic setting have resulted in greater satisfaction than specific performance goals (Latham & Brown, 2006). By having a clear plan, or strategy, in place, which is what is asked of an individual pursuing a learning goal, can help to direct one's focus during goal pursuit (Koestner et al., 2002). And if an individual is pursuing a learning goal to develop competencies, they could then have an increased self-efficacy for performing the behaviour, which in itself is stated to be linked to goal success in GST (e.g., Locke & Latham, 1990; 2002). Additionally, learning goals have shown to be particularly effective in instances where negative feedback (e.g., not meeting a step count goal) is provided for complex tasks (Cianci et al., 2010), which for new exercisers, PA may be perceived as such (Swann & Rosenbaum, 2018).

2.2.1.2 Vague, Non-Specific Goal Types

2.2.1.2.1 Open Goals. Vague goals have been reported in PA contexts for decades (see review by McEwan et al. [2016] presenting the findings). More recently open goals were initially reported in a sport and exercise context in elite golfers in reference to optimal psychological states underpinning excellent performances (Swann et al., 2016). The ambiguity of open goals does not align with the dominant specific approach outlined in GST (1990; 2002), as open goals have no defined outcome, are exploratory in nature, for example 'see how far you can walk' (Swann et al., 2016), and encourage experimentation in goal pursuit (Hawkins et al., 2020). Although open goals have led to greater perceived performances and increased confidence (Schweickle et al., 2017) and enjoyment (Hawkins et al., 2020) in different contexts, there is conflicting evidence whether they are as efficacious for objective performance as specific goals (e.g., Schweickle et al., 2017; Swann et al., 2020) and further testing is required of the effects had on engagement and long-term PA and the psychological variables that are associated with this.

Table 2

Definitions and examples of vague goal types

	Definition	Example
Open	A goal that is exploratory in nature with no defined outcome (Swann et al., 2016)	"See how well you can do at walking more"
Do your best	A goal that focuses on a past 'best' performance (Hawkins et al., 2020)	"Do-your-best at walking more"
As-well-as-possible	A goal that focuses on the best performance in a given circumstance	"Walk as much as possible"

2.2.1.2.2 Do-your-best Goals. Do-your-best (DYB) goals are the most common type of vague goal (Wallace & Etkin, 2018). In GST, DYB goals are frequently compared to specific goal types when assessing the effects on performance outcomes (see Locke & Latham, 2013). Although similar to open goals, making no reference to what a completed performance entails (Locke & Latham 1990), they vary as where an open goal encourages experimentation, DYB goals can allow individuals to compare the current performance to previous performances which can then result in a previous standard of performance being aspired to (Hawkins et al., 2020). Therefore, identifying the nuances (if any) between these goal types is required to optimise goal pursuit.

2.2.1.2.3 As-well-as-possible Goals. As-well-as-possible (AWAP) goals are used interchangeably with DYB goals (e.g., Moon et al., 2016) when in fact they could be having different effects, however these effects are unknown as only one study has sought to assess the effect of AWAP goals in relation to other vague goal types in a PA task (Swann et al., 2022).

2.2.2 Comparison of Goal Types

There are many studies that have identified the effect of goal types on PA outcomes (see review by McEwan et al. [2016] of evidence of goals for PA). However, they fail to consider additional psychological variables that contribute to PA behaviours. Additionally, individuals can be at many stages of PA. For instance, they can be considered active (i.e., meeting WHO [2020] PA guidelines), insufficiently active (i.e., not meeting WHO [2020] PA guidelines), or even sedentary (i.e., not engaging in PA). As such, different goals may be more beneficial at different stages (Locke & Latham, 2013; Swann & Rosenbaum, 2018), yet it is unknown how different goal types may benefit different individuals physically and psychologically. To date, there are six experimental studies that have explored the PA and/or task performance effects, alongside psychological effects of specific and vague goals (Table 3); four in a six minute walk test (6MWT; ATS, 2002) PA context (Carter et al., 2021; Hawkins et al., 2020; Swann et al., 2020; 2022) and two in a Letter/Number Identification Task (LNIT; Hardy & Fazey, 1990) cognitive context (Pilcher et al., 2022; Schweickle et al., 2017). The 6MWT is an objective measure of PA measuring the distance walked in six-minutes and allows an individual to pace their own effort/intensity (Swann, Hooper et al., 2020). The LNIT requires an individual to search through rows of 30 randomly sequenced letters and numbers for a specified letter/number and record the amount of times it is identified; six attempts were completed with 60 seconds allocated for each. These studies have examined a range of goal types on different outcomes offering initial insights into the effects had in different populations. The goal types reported include open (*n* = 6), DYB (*n* = 5), SMART (*n* = 4), specific-challenging (*n* = 2), AWAP (*n* = 2), and learning (*n* = 1). Regarding the study population, the four studies that were conducted in a PA context reported participants PA levels at baseline, but only one study reported findings in relation to activity level (Hawkins et al., 2020).

Table 3

Experimental studies comparing the effects of different goal types

Authors	Context (Task)	N (M_{age} + SD) Activity Level	Control/Baseline	Specific			Vague		
				Specific, Challenging	SMART	Learning	Open	DYB	AWAP
Schweickle et al. (2017)	Cognitive (LNIT; Hardy & Fazey, 1990)	N = 95 (24.89 ± 9.27; n_{male} = 28, n_{female} = 67)	✓	✓	-	-	✓	✓	-
Hawkins et al. (2020)	Walking (6MWT; American Thoracic Society [ATS], 2002)	N = 36; Active: n_{male} = 9 (26.67 ± 2.88); n_{female} = 9 (24.89 ± 4.04) Insufficiently Active: n_{male} = 8 (27.75 ± 7.57); n_{female} = 10 (28.70 ± 5.62)	✓	-	✓	-	✓	✓	-
Swann et al. (2020)	Walking (6MWT; ATS, 2002)	N = 78 (55.88 ± 12.37; n_{male} = 20, n_{female} = 58) Highly Active = 32 Moderately Active = 31 Low Level of Physical Activity = 15	✓	-	✓	-	✓	✓	-
Carter et al. (2021)	Walking (6MWT; ATS, 2002)	N = 28 (29.75 ± 14.47; n_{male} = 11, n_{female} = 17) Highly Active = 14 Moderately Active = 12	✓	-	✓	✓	✓	-	-

		Low Level of Physical Activity = 2							
Pilcher et al. (2022)	Cognitive (LNIT; Hardy & Fazey, 1990)	$N = 66$ (30.42 ± 12.25; $n_{male} = 25$, $n_{female} = 41$)	✓	✓	-	-	✓	✓	-
Swann et al. (2022)	Walking (6MWT; ATS, 2002)	$N = 82$ (48.10 ± 16.49; $n_{male} = 23$, $n_{female} = 59$)	✓	-	✓	-	✓	✓	✓

Note. Control = “walk at a comfortable pace, that represents your typical walking activities” (Hawkins et al., 2020); SMART = specific, measurable, achievable, realistic and time-bound; Open = “see how far you can walk in 6 minutes” (Hawkins et al., 2020); DYB = do your best (e.g., “Your goal is to do your best” [Schweickle et al., 2017; Pilcher et al., 2022]; AWAP = As-well-as-possible (e.g., “Walk as far as possible for 6 minutes” [Swann et al., 2022]; Learning = “Identify and implement one strategy to increase your distance” (Carter et al., 2021); Open = “See how well you can do” (Schweickle et al., 2017; Pilcher et al., 2022); LNIT = Letter/Number Identification Task; 6MWT = 6-Minute Walk Test; Activity levels reported in line with WHO (2020) physical activity guidelines.

2.2.2.1 Comparing Goal Types' Effects on Physical Activity and Task Performance Outcomes

The six empirical studies that collectively explore the effects of specific, SMART, learning, open, DYB and AWAP goals report the effects of these goal types on a number of PA and task performance outcomes (Table 4). These include distance (Carter et al., 2021; Hawkins et al., 2020; Swann et al., 2020; 2022), performance accuracy (Schweickle et al., 2017; Pilcher et al., 2022), perceptions of performance (Carter et al., 2021; Hawkins et al., 2020; Schweickle et al., 2017; Swann et al., 2020), and heart rate (Hawkins et al., 2020). This section presents and discusses the effects found in these studies.

2.2.2.1.1 Distance. The 6MWT (ATS, 2002) was employed by four studies (Carter et al., 2021; Hawkins et al., 2020; Swann et al., 2020; 2022) with distance walked in metres reported as the measured outcome. All four studies reported main effects of goal conditions on distance achieved during the 6MWT. SMART, open and DYB goals resulted in greater 6MWT distance compared to a control in the 6MWT (Hawkins et al., 2020, Swann et al., 2020). Carter et al. (2021) reported the effects of open and SMART goals with the addition of learning goals, and all three resulted in greater distances being achieved to the control. When compared further, distances were greater in the learning goal condition compared to the open, however as no measurement of complexity was taken it is impossible to comment on the efficacy of this goal type as suggested by GST (Locke & Latham, 2013). Lastly, Swann et al. (2022) contributed to the body of research by examining the effects of open, DYB and SMART goals alongside AWAP goals. Again, all goal types reported greater distances in the 6MWT compared to the control condition. Overall, these studies collectively support the notion that there are no differences between goal types for PA (McEwan et al., 2016) and that the effect had on other performance related variables could be a deciding factor for which goal is most beneficial.

Of the four studies that used the 6MWT, three assessed the effect over multiple attempts (Hawkins et al., 2020; Swann et al., 2020; 2022). Hawkins et al. (2020) reported significant findings from the 6MWT over three attempts, with increases reported between an individual's first attempt and second, first and third, and second and third, with the greatest distance achieved in the third attempt no matter an individual's activity level or goal pursued. In the same 6MWT, Swann et al.

(2020) again reported significant effects of attempt on distance walked; distances were significantly different between baseline and attempt two and three, and also between attempt two and three, with the greatest distance covered in attempt three across the board. The third study that assessed the effect over multiple attempts also found a significant main effect on distance walked in the 6MWT (Swann et al., 2022). Over the three attempts, differences were found between baseline and attempt two and three, and between attempt two and three. With all three studies reporting main effects of attempt on distance walked during the 6MWT no matter the goal condition it suggests that over time, no matter the goal pursued, performance can improve in a walking task. This is an important consideration for the design of research aiming to examine the effects of goal setting on performance outcomes and also for longer term behaviour change.

Two of the above studies reported interaction effects of 6MWT attempt x goal condition (Swann et al., 2020; 2022). In attempt two, all goals, open, DYB and SMART, resulted in greater distances walked compared to the control condition; the same was reported for all goals compared to the control condition in attempt three (Swann et al., 2020). Similarly, Swann et al. (2022) also reported that at both attempt two and three, open, DYB, SMART and AWAP goals produced greater distances in the 6MWT compared to a no goal control condition. In conclusion, these results would suggest that all goal types are beneficial for improving outcomes during repeated activities and could be equally beneficial in a PA context where the long-term goal is to complete 150-minutes of moderate-vigorous activity per week (WHO, 2020) with participants gradually increasing to the target.

Aligned with the proposition that context, e.g., activity level, is an important consideration for goal setting (Locke & Latham, 1990), one study explored the effect of goal type and attempt with the baseline activity level of participants (Hawkins et al., 2020). Although no interaction was found between activity level (i.e., active or insufficiently active) and attempt, Hawkins et al. (2020) did report an interaction effect between activity level and goal type. Context, i.e., activity level, was considered key to performance under different goal conditions as active individuals were able to walk greater distances in the SMART compared to the open goal condition whilst those considered to be insufficiently active reported the opposite with greater distances achieved in the open goal compared to the SMART goal condition. Hawkins et al. (2020) also reported the interaction between all three variables, attempt x goal type x activity level. The findings showed that for the open goal there were differences at both attempt two and three, with insufficiently active individuals walking significantly greater distances in the 6MWT compared to active individuals; no other goal differences were reported. This could be a consequence of active individuals having the sufficient knowledge and skill to strive for specific, SMART, goals (Locke & Latham, 1990; 2002), whilst the insufficiently active individuals were unable to pursue this goal type as they may not have possessed the necessary pre-requisites of specific goals stated in GST and so alternative goal types were more beneficial for this context of individuals. Additionally, as more attempts were completed in the open goal condition, the increase could be explained by participants' perception of "how well they could do" increasing as competency increased, whereas in a specific goal not achieving a specific target could have been detrimental to performance as suggested by Locke and Latham (2013).

2.2.2.1.2 Performance Accuracy. Accuracy of performance was assessed using a cognitive task by two studies (Pilcher et al., 2022; Schweickle et al., 2017) with the Letter/Number Identification Task (Hardy & Fazey, 1990). Schweickle et al. (2017) reported findings that compared specific, open, and DYB goals and found that the specific goal condition reported better performance (i.e., accurate responses) in the LNIT compared to performance in the open goal, however no other differences were found between specific and DYB, and open and DYB goals. In addition, Pilcher et al. (2022) also found that open goals resulted in greater accuracy of performance when compared to baseline, DYB goals, specific-easy goals, and specific-unrealistic goals (Pilcher et al., 2022). Additionally, specific-challenging goals were reported to result in greater performance accuracy than baseline and DYB goals, thus contradicting GST's suggestion that performance and specific goals have a linear relationship (Locke & Latham, 1990). Interestingly, although Pilcher et al. (2022) found differences between open and specific goals, no differences were found between level of specific goal challenge (i.e., specific-easy, specific-challenging, specific-unrealistic) which could suggest that no matter how challenging a specific goal may be, they are not as effective for novel tasks as open goals for performance accuracy. However, this conclusion should be digested with caution as the baseline knowledge and skill level of the participants was not reported.

Table 4

Physical activity and task performance outcomes assessed by experimental studies comparing the effect of different goal types

	Outcome (Measure)	Control/Baseline	Specific			Vague		
			Specific, Challenging	SMART	Learning	Open	DYB	AWAP
Schweickle et al. (2017)	Objective performance	✓	✓	-	-	✓	✓	-
	Perceived performance*	✓	✓	-	-	✓	✓	-
Hawkins et al. (2020)	Distance walked (6MWT, Meters [ATS, 2002])	✓	-	✓	-	✓	✓	-
	Heart rate (Polar RS400 Monitor)	✓	-	✓	-	✓	✓	-
	Perceived performance (Schweickle et al., 2017)	✓	-	✓	-	✓	✓	-
Swann et al. (2020)	Distance walked (6MWT, Meters [ATS, 2002])	✓	-	✓	-	✓	✓	-
	Perceived performance (Schweickle et al., 2017)	✓	-	✓	-	✓	✓	-
Carter et al. (2021)	Distance walked (6MWT, Meters [ATS, 2002])	✓	-	✓	✓	✓	-	-
	Perceived performance (Schweickle et al., 2017)	✓	-	✓	✓	✓	-	-
Pilcher et al. (2022)	Accuracy**	✓	✓	-	-	✓	✓	-
Swann et al. (2022)	Distance walked (6MWT, Meters [ATS, 2002])	✓	-	✓	-	✓	✓	✓

Note. 6MWT = 6-Minute Walk Test; (*) = Developed measure developed for use in this study; (**) = Assessed by researcher.

Errors in the LNIT were also measured by Schweickle et al. (2017) and Pilcher et al., (2022). Although Schweickle et al. (2017) found no differences between specific, DYB and open goals on errors made during the task, Pilcher et al. (2022) reported specific-unrealistic goals resulted in higher rates of errors compared to baseline, open goals, and specific-easy goals. Thus, supporting suggestions that in a context where a goal is deemed unattainable, and too much of a challenge, it can be detrimental to performance (Latham & Locke, 2006) and so other goal types should be pursued. In the study that assessed specific, open and DYB goals (Schweickle et al., 2017) the interaction effect between the attempt and goal type was reported. Although there was no interaction effect to report for number of errors, there was an interaction effect of attempt and goal type of performance (i.e., accurate response). In the third, fourth, fifth, and sixth attempt, those pursuing a specific goal type had an increased performance compared to those in the open goal condition. This could suggest that after a few practices where an individual learns how to complete the task successfully and achieve the goal, they can perform better under a specific goal compared to a goal that is open ended and ambiguous in nature.

2.2.2.1.3 Perceived Performance. Four studies assessed perceived performance in addition to objective performance; three in a PA context using the 6MWT (Carter et al., 2021; Hawkins et al., 2020; Swann et al., 2020) and one in a cognitive LNIT (Schweickle et al., 2017). Two studies found no differences between goal types on perceived performance (Schweickle et al., 2017, Swann et al., 2020). Conversely, Hawkins et al. (2020) and Carter et al. (2021) both reported differences between goals identifying SMART goals, when compared to open and DYB goals (Hawkins et al., 2020), and control (Carter et al., 2021), produced lower perceived performance in the 6MWT. These findings would suggest that specific goals could be detrimental to perceptions in performance and could result in lower self-efficacy for the task. This could be catastrophic for confidence and desire to re-engage, which in a PA context could mean those who are insufficiently active remain so.

In addition to the effect of goal types, the effect of attempts on perceived performance was also reported (Hawkins et al., 2020; Swann et al., 2020). Where Swann et al. (2020) reported no effect over the three attempts, Hawkins et al. (2020) found perceived performance was significantly higher in the third attempt compared to the first suggesting that as a participant became more familiar with the task having completed it twice already, they perceived themselves to be more competent and perform better because of this. An interaction effect between activity level and goal type was also reported. Although the active group reported no differences, the insufficiently active group perceived performances to be better in the open and DYB goals compared to the SMART goal condition (Hawkins et al., 2020). This could be a result of open and DYB goals not specifying outcomes to achieve, and so individuals define what goal success means to them. Schweickle et al. (2017) and Swann et al. (2020) also report significant interaction effects, both on goal type and attempt. As individuals had more attempts at the task, perceived performance increased. Schweickle et al. (2017) reported greater perceived performances under the open goal compared to the specific goal in the last two attempts of the LNIT, and the final attempt under the open goal compared to the SMART and DYB in the 6MWT (Swann et al., 2020). If translated into a long-term behaviour, these vaguer goal types could prove to be more beneficial than specific goals for insufficiently active adults as they would have more positive perceptions of goal achievement (Koestner et al., 2002). Thus, increasing the likelihood of sustained engagement.

2.2.2.1.4 Heart Rate. Although the focus of the study was on psychological outcomes, Hawkins et al. (2020) did measure heart rate during the task. No matter the baseline activity level of participants, heart rate was significantly lower in the 6MWT during the control condition compared to the open, DYB and SMART goal conditions. There was no significant variation in heart rate response under different goal conditions suggesting that pursuit of any goal compared to no goal at all can result in physiological responses, of which heart rate increases could be signs of stress response (Chu et al., 2024). However, as there were no differences between goal types, it could be inferred that no particular goal incited higher stress levels compared to another.

2.2.2.2 Comparing Goal Types' Effects on Psychological Outcomes

In addition to the PA and performance outcomes, the six empirical studies that collectively explore the effects of specific, SMART, learning, open, DYB and AWAP goals report the effects of these goal types on a number of psychological outcomes (Table 5). These include psychological states (e.g., flow [12] and clutch [13]), participant perceptions (e.g., perceived exertion, perceived challenge), affect, arousal, enjoyment, future interests, motivation, self-efficacy, goal commitment, autonomy, and mental effort. This section presents and discusses the effects found in these studies.

2.2.2.2.1 Participant Perceptions. Perceptions were measured in five of the six studies in the form of perceived exertion in a PA task (Carter et al., 2021; Hawkins et al., 2020; Swann 2020; 2022), perceived challenge in a cognitive (Schweickle et al., 2017) and PA task (Hawkins et al., 2020), perceived confidence in a cognitive (Schweickle et al., 2017) and PA task (Carter et al., 2021; Hawkins et al., 2020), goal perceptions in a PA task (Carter et al., 2021; Swann et al., 2022), and post-exercise perceptions (Hawkins et al., 2020).

2.2.2.2.1.2 Perceived Exertion. Exertion was measured by all using the Borg's rating of perceived exertion scale (RPE; Borg, 1998), with two studies asking respondents to rank exertion on a 1 ("nothing at all") to 10 ("maximal exertion") scale (Swann et al., 2020; 2022) and the other two on a scale from 6 ("no exertion at all") to 20 ("maximal exertion") (Carter et al., 2021; Hawkins et al., 2020). All four studies reported main effects of goal type on RPE. Specifically, higher RPE was reported in the SMART, open and DYB goal compared to a control no goal condition (Hawkins et al., 2020; Swann et al., 2020;2022); no differences were found between AWAP and no goal (Swann et al., 2022), or between the goal types (Hawkins et al., 2020; Swann et al., 2022). Alongside open and SMART goals, Carter et al. (2021) found that all goals (SMART, open and learning) reported higher RPE than when no goal was pursued but that learning goals resulted in higher RPE compared to SMART goals. As is the nature of learning goals, individuals were required to "identify and implement one strategy to increase your distance over the 6-minute walk", which compared to a SMART goal instruction ("walk [control distance + 16.67%] metres"), may have been considered more taxing a task which could have resulted in increased RPE as individuals were not only striving for a outcome, but also to pursue a particular strategy.

[12] *Flow* is defined as an optimal psychological intrinsically rewarding state that underpins excellent performance when an athlete feels in control of the performance and everything feels as though it is just happening effortlessly (Jackson & Csikszentmihalyi, 1999; Swann et al., 2016).
[13] *Clutch* is defined as an optimal psychological state that underpins excellent performance which are effortful and intense in nature (Swann et al., 2016).

Table 5

Psychological outcomes assessed by experimental studies comparing the effect of different goal types

	Outcome (Measure)	Control/Baseline	Specific			Vague		
			Specific, Challenging	SMART	Learning	Open	DYB	AWAP
Schweickle et al. (2017)	Clutch (DFCS*)	✓	✓	-	-	✓	✓	-
	Flow (DFCS*)	✓	✓	-	-	✓	✓	-
	Perceived Challenge*	✓	✓	-	-	✓	✓	-
	Perceived Confidence*	✓	✓	-	-	✓	✓	-
Hawkins et al. (2020)	Affect (FS [Hardy & Rejeski, 1989])	✓	-	✓	-	✓	✓	-
	Felt arousal (FAS [Svebak & Murgatroyd, 1985])	✓	-	✓	-	✓	✓	-
	Enjoyment (PACES [Kendzierski & DeCarlo, 1991])	✓	-	✓	-	✓	✓	-
	Perceived challenge (Schweickle et al., 2017)	✓	-	✓	-	✓	✓	-
	Perceived confidence (Schweickle et al., 2017)	✓	-	✓	-	✓	✓	-
	Perceived exertion (RPE [Borg, 1998])	✓	-	✓	-	✓	✓	-
	Post-exercise perceptions: Motivation*, Confidence*, Intentions*	✓	-	✓	-	✓	✓	-

Swann et al. (2020)	Affect (SEES [McAuley & Courneya, 1994])	✓	-	✓	-	✓	✓	-
	Enjoyment (PACES [Kendzierski & DeCarlo, 1991])	✓	-	✓	-	✓	✓	-
	Interest in repeating the session*	✓	-	✓	-	✓	✓	-
	Motivation (IMI [McAuley et al., 1989])	✓	-	✓	-	✓	✓	-
	Perceived exertion (RPE [Borg, 1998])	✓	-	✓	-	✓	✓	-
Carter et al. (2021)	Affective valence (FS [Hardy & Rejeski, 1989])	✓	-	✓	✓	✓	-	-
	Enjoyment (PACES-8 [Raedeke, 2007])	✓	-	✓	✓	✓	-	-
	Felt arousal (FAS [Svebak & Murgatroyd, 1985])	✓	-	✓	✓	✓	-	-
	Goal perceptions*	✓	-	✓	✓	✓	-	-
	Interest in re-using goal type*	✓	-	✓	✓	✓	-	-
	Motivation*	✓	-	✓	✓	✓	-	-
	Perceived exertion (RPE [Borg, 1998])	✓	-	✓	✓	✓	-	-
	Perceived achievability (Swann 2022)	✓	-	✓	✓	✓	-	-
	Perceived mental fatigue*	✓	-	✓	✓	✓	-	-
	Self-efficacy (Hawkins et al., 2020)	✓	-	✓	✓	✓	-	-

Pilcher et al. (2022)	Goal commitment (GCS [Klein et al., 2001])	✓	✓	-	-	✓	✓	-
Swann et al. (2022)	Autonomy (BNSSS [Ng et al., 2011])	✓	-	✓	-	✓	✓	✓
	Interest in re-engaging using same goals*	✓	-	✓	-	✓	✓	✓
	Interest in repeating the session*	✓	-	✓	-	✓	✓	✓
	Mental effort (MERS [Paas, 1992])	✓	-	✓	-	✓	✓	✓
	Perceived exertion (RPE [Borg, 1998])	✓	-	✓	-	✓	✓	✓
	Goal perceptions: Realistic*, Achievable*	✓	-	✓	-	✓	✓	✓

Note. DFCS = Dichotomous Flow-Clutch Scale; FS = Feeling Scale; FAS = Felt Arousal Scale; PACES = Physical Activity Enjoyment Scale; RPE = Rating of Perceived Exertion; SEES = Subjective Exercise Experiences Scale; IMI = Intrinsic Motivation Inventory; MERS = Mental Effort Rating Scale; BNSSS = Basic Needs Satisfaction in Sport Scale; (*) = Developed measures developed for use in this study.

Of the four studies that reported RPE, three reported the effect of attempt (Hawkins et al., 2020; Swann et al., 2020; 2022). Only Hawkins et al. (2020) reported differences in attempt RPE score. Specifically, that RPE increased from the first to the second and third attempt, and from the second to the third attempt for both active and insufficiently active individuals. This may have been expected if the attempts were successive at one time point, but as each attempt was completed an average of 4.18 days apart it is surprising. There was also no interaction effect of activity level x goal type (Hawkins et al., 2020). In addition, both Swann et al. (2020, 2022) reported significant interaction effects between goal type and attempt during the 6MWT. During the second attempt open and DYB goals (Swann et al., 2020; 2022), and SMART goals (Swann et al., 2020) resulted in increased RPE compared to a control condition (Swann et al., 2020; 2022). Again, during the third attempt open, DYB and SMART goals resulted in higher RPE compared to a control, and open goals also led to higher RPE than DYB goals (Swann et al., 2020). These findings contradict initial research of open goals in a sport and exercise context which would predict the opposite, with open goals resulting in a more ‘flow’ state that is effortless, compared to a more specific goal that could result in a ‘clutch’ effortful goal pursuit (Swann et al., 2016).

Similar to exertion, mental toll is also equally as important as physical toll as physical and mental effects can have a bidirectional effect on behaviours. The mental toll of goals during the 6MWT was measured in the form of mental fatigue (“How mentally fatigued did you feel?”; Carter et al., 2021) and mental effort (Swann et al., 2022) via the Mental Effort Rating Scale (Paas, 1992). The learning, open and SMART goal conditions all resulted in higher ratings of mental fatigue compared to the control no goal condition (Carter et al., 2021), indicating that pursuing an activity with no goal at all is less mentally taxing. However, mental stimulation is not necessarily a negative consequence of goals and could potentially mean an individual has concentrated more on the task. Swann et al. (2022) only reportedly found DYB goals to be more mentally demanding than a control no goal condition and reported no differences between SMART, DYB and AWAP goals.

2.2.2.2.1.3 Perceived Confidence. Confidence, otherwise referred to as self-efficacy (Bandura, 1997), was measured using a single-item measure after completing the task/attempt in two PA task (Carter et al., 2021; Hawkins et al., 2020) and a cognitive task (Schweickle et al., 2017).

Where Hawkins et al. (2020) and Schweickle et al. (2017) utilised the same measure which involved participants ranking their confidence on a 10-point Likert scale from one ("not at all confident") to ten ("totally confident"), Carter et al. (2021) asked "How confident did you feel that you would achieve your goal?" on a 10-point Likert scale from one (not confident et all) to ten (fully confident). In the cognitive LNIT task individuals reported significant differences between goal type and perceived confidence, with lower perceptions of confidence under the specific goal condition compared to the open and DYB goals. Additionally, Schweickle et al. (2017) reported an interaction effect between goal type and attempt, where perceived confidence increased in the open and DYB at each attempt (Schweickle et al., 2017). As no differences were reported between the vaguer goal types, open and DYB, it would suggest that over time these goals are equally sufficient for perceived confidence in a cognitive task.

The effect of different goal types on perceived confidence was also found to be significant in a PA 6MWT (Carter et al., 2021, Hawkins et al., 2020). Perceived confidence was higher in the open (Carter et al., 2021; Hawkins et al., 2020), DYB (Hawkins et al., 2020), learning (Carter et al., 2021), and control (Carter et al., 2021) conditions when compared to SMART goals. Perceived confidence was also higher in the 6MWT in the control condition compared to the learning condition which could be a result of individuals not perceiving themselves to have the sufficient capabilities to identify and/or implement a strategy for goal pursuit, which for an insufficiently active adult could mean that PA goal pursuit may be avoided and not result in any PA changes. Additionally, although no differences between goals were reported on perceived confidence in an active population, insufficiently active individuals perceived confidence in the 6MWT to be higher in the open and DYB goal condition compared to the SMART goal condition; again, reiterating findings found in a cognitive task by Schweickle et al. (2017). As confidence can be a key moderator in goal commitment and perceived attainment (Seijts & Latham, 2001; Lunenberg, 2011), it could be hypothesised that if trialled in a longitudinal PA study that open goals would be more enduring, and individuals would have greater belief in their capabilities to achieve the goal of becoming physically active.

2.2.2.2.1.4 Perceived Challenge. Individual's perceptions of challenge were measured with a single-item measure in a cognitive (Schweickle et al., 2017) and a PA task (Hawkins et al., 2020).

Both studies reported the same measure where participants were asked to score perceptions of challenge on a 10-point Likert scale from one ("not at all challenged") to ten ("much too challenged"). In the cognitive LNIT participants reported significantly higher perceived challenge in the specific goal condition compared to the open and DYB goal, which was mirrored by the effects of goals in the 6MWT where participants reported higher perceived challenge in the SMART goal compared to the open goal condition (Hawkins et al., 2020). Additionally, in the 6MWT, participants also reported higher perceived challenge in all goal conditions compared to the control, but this diminished with the more attempts had (Hawkins et al., 2020). Futhermore, a qualitative exploration of participants experiences during Hawkins et al. (2020) study found that for insufficiently active individuals the increased challenge led to doubts in their capabilities and in some cases resulted in threat appraisal when faced with a specific goal (Hawkins et al., 2024). Schweickle et al. (2017) reported a significant goal x attempt interaction effect for open and DYB goals in the LNIT, suggesting that no matter how many times a novel task such as the LNIT is completed, a vaguer goal, such as the open or DYB goal, is perceived to be less challenging than a specific goal. GST suggests that for new tasks, challenging, specific goals are not the most optimal goal to pursue, and learning goals may be better suited (Seijts & Latham, 2001; Latham & Locke, 2007). Although Schweickle et al. (2017) did not include learning goals, and so it cannot be determined if learning goals would be better suited, open and DYB goals show promising initial results at lowering perceived challenge of a goal, which could result in increased PA engagement if employed in this context for those who may perceive the specific PA promotion goals (e.g., "complete 150-minutes of moderate activity", WHO, 2020) as too challenging.

2.2.2.2.1.5 Goal Perceptions. Goal perceptions, namely how realistic and achievable a goal was perceived to be reported in two studies (Carter et al., 2021, Swann et al., 2022). Both variables were measured using a single-item measure on a 10-point Likert scale from one ("not at all") to ten ("very much so"). Of the goals tested (SMART, open and DYB [Swann et al., 2022]; SMART, open and learning [Carter et al., 2021]) perceived achievability was higher in the control, open, and learning goals compared to the SMART goal (Carter et al., 2021). At the third attempt individuals also reported higher perceived achievability in the open, AWAP and control conditions compared to the SMART goal, and the goal was also perceived to be more realistic in the open and control conditions compared to the SMART goal (Swann et al., 2022). Overall, these findings would suggest that although the acronym for SMART states these goals should be 'realistic' and 'achievable' (Doran, 1981), these studies actually found vaguer goals were perceived to be more realistic and achievable in the 6MWT. Although both studies report the activity level of participants, they do not distinguish between them in the analysis and so no comment can be made regarding the context of baseline activity for this finding.

2.2.2.2.1.6 Post-Exercise Perceptions. One study examining the effects of goal types, SMART, open and DYB, in a 6MWT reported post-exercise perceptions. Questions were asked in relation to exercise for perceived motivation ("how motivated do you feel to exercise following this experience?"), perceived confidence ("how confident do you feel in exercising following this experience?"), and perceived intentions ("how likely would you be to engage in exercise again following this experience?") and scored on a Likert scale from zero ("not at all") to ten ("very much"). Goals reportedly affected all three exercise perceptions, with higher perceived motivation, confidence and intentions to exercise after the open and DYB goal compared to the control condition, higher perceived confidence in exercising after the open, DYB, and control condition compared to the SMART goal condition, and higher perceived intentions to exercise after the open compared to the SMART goal condition (Hawkins et al., 2020). Active individuals reported higher perceived motivation to exercise after the SMART and control conditions compared to insufficiently active individuals which could be explained by active individuals having sufficient knowledge and skillset to strive for a specific, SMART, goal in a PA task (Locke & Latham 1990), where insufficiently active individuals do not. Additionally, higher perceived intentions to exercise were reported by active individuals in the SMART, open, and control conditions compared to those currently deemed insufficiently active. During this study the stages of an individual's behaviour change were not recorded (e.g., pre-contemplation, contemplation, action; Prochaska & DiClemente, 1983), and if for example an insufficiently active individual was in the pre-contemplation stage they may be unwilling and unmotivated to become more active (Raihan & Cogburn, 2020) and so a 6MWT would not have changed this.

2.2.2.2.2 Affect and Enjoyment. Three studies that were conducted in a PA context using the 6MWT to assess the effects of different goal types on affect experienced during the task (Carter et al., 2021; Hawkins et al., 2020; Swann et al., 2020), which is a key moderator in GST (Locke & Latham, 1990). Two of the studies (Carter et al., 2021; Hawkins et al., 2020) report affect using the single-item Feeling Scale (Hardy & Rejeski, 1989) which asks participants to respond using the 11-point Likert scale ranging from '-5' (very bad) to '+5' (very good). The other study used three subscales (psychological well-being, psychological distress, and fatigue) of the Subjective Exercise Experiences Scale (McAuley & Courneya, 1994). Participants scored the 12-items on a seven-point Likert scale from one ("not at all") to seven ("very much so"). Overall findings were conflicting, SMART, learning, open and DYB goals did not influence affect (Carter et al., 2021; Swann et al., 2020). However, Hawkins et al. (2020) reported all goal types resulted in greater positive affect (i.e., pleasure) compared to the control suggesting that PA is more pleasurable when a goal is being pursued.

Hawkins et al. (2020) reported findings in relation to baseline activity level as this contextual factor could be important for goal setting for PA (Swann & Rosenbaum, 2018). Findings show that active individuals reported higher affective experiences in the SMART, open and DYB compared to no goal, but no goal produced significantly different affective experiences than another. In contrast, only open and DYB goals were reported to increase affective experiences compared to the control in the insufficiently active group. Not only were SMART goals not beneficial for increasing affective experiences in insufficiently active adults, they also specifically report significantly lower affect in the SMART goal condition compared to active individuals. Therefore, suggesting that for pleasurable experiences, any goal can be set for active individuals, but consideration of vaguer goals could be more beneficial at inciting pleasurable experiences that could contribute to repeated engagement in those who are not currently active (Rhodes & Kates, 2015).

The Physical Activity Enjoyment Scale (Kendzierski & DeCarlo, 1991) was used in its complete form (Hawkins et al., 2020; Swann et al., 2020) and short form (Carter et al., 2021) to measure enjoyment, both of which required participants to respond to bipolar statements on a seven-point scale (e.g., one "I dislike it" to seven "I like it"). Findings showed goals to have a mixed effect.

as no effect of learning, SMART or open goals were found (Carter et al., 2021). Conversely, individuals reported higher levels of enjoyment in the SMART, open and DYB condition compared to a control (Hawkins et al., 2020; Swann et al., 2020). Specifically, active individuals reported higher levels of enjoyment compared to insufficiently active individuals in the SMART goal condition, and insufficiently active individuals reported higher levels of enjoyment in the open goal condition compared to active adults. As enjoyment is both a predictor and outcome of PA (e.g., Schwaneberg et al., 2017), it is highly important to increase this as much as possible for insufficiently active adults to promote continual participation, and if open goals are preliminarily showing to be more enjoyable in this population, they could be beneficial for PA adherence.

2.2.2.2.3 Future Interests. In a PA context, using the 6MWT, three studies reported the effects of goal types on future interests, including: future exercise goal intentions ("How likely would you be to use this type of goal setting when undertaking your own exercise?") rated on a Likert scale from one ("not at all likely") to ten ("extremely likely") and interest in using the goal rated on a Likert scale from one ("no interest") to five ("definitely interested"; Carter et al., 2021); future interest in re-engaging in the programme based on the goal ("To what extent would you be interested in following a program based on the goals you were set in this session?") rated on a Likert scale from zero ("not at all") to ten ('very interested"; Swann et al., 2022); and future interest in repeating the session ("Based on your experience of the 6-min walking tests, how likely, out of 10, would you be to come back knowing that you wouldn't get an incentive next time?" [Swann et al., 2020]; "To what extent would you be interested in having another session like this?" [Swann et al., 2022]).

There were no differences between goal types (SMART, open and learning) on interest in using the goals again (Carter et al., 2021). However, there were differences between goal types on intention to use the exercise goals in the future, with learning goals showing to be the most likely goal to be used for PA in the future compared to open and SMART goals. As suggested by recent literature, learning goals may be better for new exercisers where the focus is less so on goal performance and more about the task, especially compared to specific goals (e.g., Locke & Latham, 2013) as they aid new exercisers in identifying skills and knowledge to work towards goals.

Therefore, if early findings are reporting learning goals as the most preferred goal type there is further justification that these goals require further attention in a longitudinal PA setting.

Significant differences of goal type on future interest in repeating the 6MWT session showed open goals resulted in higher interest in repeating the session compared to the control condition (Swann et al., 2020; 2022). There were no differences between the other goal types. In terms of participants interest in re-engaging, Swann et al. (2022) reported that, again, open goals resulted in higher interest in re-engaging compared to the control condition. Collectively, these findings would suggest that open goals could be beneficial for repeated engagement and adherence, however these findings are only significant compared to when no goal is set and are also only tested at one time point. Additionally, although these studies report baseline activity level, they fail to distinguish between activity level in the analysis and so cannot directly respond to questions over the efficacy of specific goals in an insufficiently active population (e.g., Swann & Rosenbaum, 2018).

2.2.2.2.4 Arousal. The Felt Arousal Scale (Svebak & Murgatroyd, 1985) was used by Carter et al. (2021) and Hawkins et al. (2020) to measure the effects of different goal types on arousal in the 6MWT. Although there were no reported differences in learning, open and SMART goals on arousal (Carter et al., 2021), higher levels of arousal were reported in the SMART, DYB and open goal condition compared to the control condition (Hawkins et al., 2020). Furthermore, in the second and third attempt at the 6MWT, insufficiently active individuals reported higher levels of arousal in the open and DYB goal condition compared to active individuals (Hawkins et al., 2020). As arousal can be linked to feelings of pleasure (Costa et al., 2010), it should be explored in the context of goal setting for PA, particularly for insufficiently active individuals, to understand how different goals may be influencing an individual's arousal response, and indirectly, pleasure; as the more pleasurable an experience, the higher likelihood of repeated engagement (e.g., Ekkekakis & Brand, 2019). These initial experimental findings, although mixed, seem to support the use of vague goal types for arousal in a PA task for insufficiently active individuals.

2.2.2.2.5 Motivation. The effect of different goal types on motivation was measured by two studies, both during the 6MWT. Carter et al. (2021) measured the effect of SMART, open and learning goals on a single-item question ("How motivated did you feel to achieve your goal") which was scored from one ("not motivated at all") to ten ("very motivated") but found no effect. The second study (Swann et al., 2020) used three, researcher selected, subscales of the Intrinsic Motivation Inventory (Competence, Pressure/tension, Effort/importance [McAuley et al., 1989]) to measure the effect of SMART, open and DYB goals on motivation in the 6MWT. No differences were found between goal types on competence scores; however, individuals did report higher scores of pressure/tension in the SMART goal condition compared to the open goal and control. Additionally, individuals also reported greater effort/importance in all goals conditions compared to the control condition, specifically open goals resulted in greater effort/importance during the 6MWT than SMART goals. Fundamentally, goal setting is a motivational tool (Locke & Latham, 2013). Knowing how to best set goals to increase an individual's motivations would maximise the potential for behaviours, however the evidence presented is inconclusive and more research is required.

2.2.2.2.6 Optimal Psychological States. The optimal psychological states of flow and clutch are states underpinning excellent performances. It was suggested that specific goals were associated with inciting clutch states, whilst open goals resulted in flow states (Swann et al., 2017), which was then confirmed by participants taking part in the LNIT pursuing specific-challenging, open and DYB goals. The occurrence of flow and clutch was measured using the Dichotomous Flow-Clutch Scale developed by Schweickle et al. (2017) as no prior measure existed. The study found that in a cognitive task individuals reported higher levels of flow in the open and DYB goal compared to the specific goal condition. Although both states result in optimal performances, where performance is not a key outcome of PA it is less so important than simply doing more. Therefore, the more positive experience of flow could be more beneficial in this context for new exercisers to promote increased pleasure and decreased displeasure which may be experienced under a clutch state.

2.2.2.2.7 Goal Commitment. Pre-task goal commitment was measured before participants undertook the LNIT cognitive task in one study (Pilcher et al., 2022). It was measured using the 5-item Goal Commitment Scale (Klein et al., 2001), which involved participants responding on a Likert scale from one ("strongly disagree") to five ("strongly agree") that then resulted in an overall goal commitment score. Goal commitment was found to be lower under the specific-unrealistic goals compared all other goal types (specific-easy, specific-challenging, open and DYB) and baseline

(Pilcher et al., 2022), which could be a sign that under the pursuit of specific-unrealistic goals individuals may be more likely to disengage, which for PA has poor health consequences from reduced activity level.

2.2.2.2.8 Goal Preferences & Autonomy. Goal preferences were explicitly measured by one study in a PA context (Carter et al., 2021). Participants took part in the 6MWT under three goal conditions, open, learning, and SMART. Afterwards participants were asked questions developed for the study: (1) to rank the goal conditions from least to most preferred; (2) of the three goals which would be most likely to apply to PA; and (3) their interest in using the three goals for PA. Learning goals were most preferred, and SMART the least, by individuals as they allowed for autonomy in goal pursuit, were deemed to be interesting, challenging and enjoyable, felt individualised and were mentally stimulating. All of which are positive experiences that could be associated with pleasure, and pleasure can increase likelihood of engagement (e.g., Ekkekakis & Brand, 2019). As highlighted by participants in Carter et al.'s (2021) study, participants preferred goals that allowed for autonomy. Autonomy was measured by Swann et al. (2022), finding that participants in the open goal condition reported increased autonomy. As autonomy is beneficial for long-term adherence to behaviours and instilling persistence, particularly for challenging goals (Deci & Ryan, 2008; Sheldon & Elliot, 1998), promotion of open and learning goals in a PA context for those starting to become more active could prove promising.

2.2.2.3 Summary of Experimental Evidence

In summary, there are six empirical studies that collectively assess the effect of specific-challenging, specific, SMART, learning, open, DYB and AWAP goals against a control or baseline or no goal on a range of PA, task performance, and psychological variables. Four of these studies were conducted in a PA context and employed the 6MWT (Carter et al., 2021; Hawkins et al., 2020; Swann et al., 2020; 2022), and the other two were conducted in a cognitive task using the LNIT (Pilcher et al., 2022; Schweickle et al., 2017). Overall, there is no conclusive evidence that promotes a single goal type over another, however there is ample evidence to suggest that goal types other than specific, challenging goals are beneficial and require further attention. It should be noted that there are a few overarching limitations of the studies discussed above. First, they are all experimental studies that use a single task and so the generalisability of these findings to PA adherence is not possible and future research should look to test these initial findings over a period of time to allow for better comparison to a 'real-world' PA context. Additionally, contextual factors, such as activity level for PA, have been noted to be key considerations for goal setting (e.g., Locke & Latham 1990; 2002; 2013). Hawkins et al. (2020) reported findings comparing the effects between active and insufficiently active individuals, thus allowing for differences in goal types between the two populations to be compared. Although other studies reported baseline activity level, they failed to report findings that distinguished between the level of activity and so these comparisons were not able to be made. To conclude, these six studies provide initial insights into the differences between specific and vague goal types in single time-point studies, but there is need to assess these effects in a more ecologically valid context.

2.3 Goal Motives

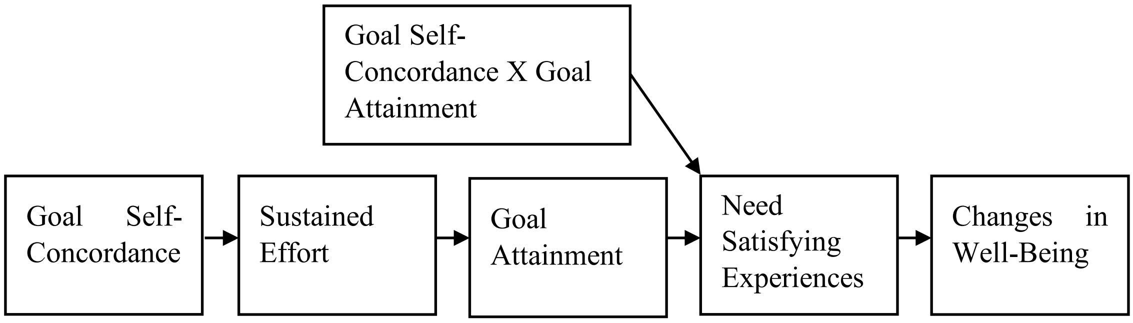
As discussed so far, different goal types are affecting PA and psychological variables differently, yet no research has considered the influence of *why* an individual may pursue a particular type of goal, thus building on previous work (e.g., McEwan et al., 2022) exploring BCTs including goal setting effectiveness without consideration of the *why*. Goal motives are the foundations for goal pursuit for behaviour change (Sheldon & Elliot, 1999). There are two overarching forms of motivation; broadly these are defined as autonomous and controlled motives (Ryan & Deci, 2024). Both forms of motivation are influential for initiating goal pursuit (Deci & Ryan, 2008), however controlled motives may be less enduring (Sheldon & Elliot, 1998). To optimise goal pursuit in populations where behaviour change has vast consequences for health, such as PA, the reasons why, i.e., the motives, could help to explain the efficacy of different goal types and offer a more comprehensive picture of how these goals are 'working'.

2.3.1 Self-Concordance Model

The Self-Concordance Model (SCM; Sheldon & Elliot, 1999) is founded from Self-Determination Theory (SDT; Deci & Ryan, 1985) and states that the more self-concordant an individual's motives are, the more closely their reasons for goal pursuit aligns with their personal interests and core values (Sheldon & Elliot, 1998). The model (Figure 2) links the degree to which a goal is self-concordant with goal attainment which then satisfies one's needs and influences well-being; with more self-concordant motives resulting in increased goal attainment and well-being (Sheldon & Elliot, 1999).

Figure 2

The Self-Concordance Model (Sheldon & Elliot, 1999)



SCM offers distinct comparison between autonomous, otherwise referred to as self-concordant, motives and controlled motives for goal pursuit. It is proposed that, generally, autonomous motives result in changes in behaviour for PA, increasing efforts towards attainment, thus satisfying one's basic psychological needs and influencing their perceived mental well-being (Gunnell et al., 2014). The basic principle of goal motives literature is that an individual can have autonomous *and* controlled motivations towards a goal or behaviour (Ryan et al., 2009; Figure 3). Behaviours are autonomously motivated when an individual engages in goals and activities out of enjoyment (Deci, 1985) and can lead to environments that foster high quality learning and creativity (Ryan & Deci, 2000a). In comparison, behaviours that are pursued through controlled motivations are engaged with to achieve an outcome other than enjoyment (Ryan & Deci, 2000a). The umbrella of extrinsic motivation includes four forms of regulation: external regulation, introjected regulation, identified regulation, and integrated regulation. External regulations are behaviours engaged with to satisfy external pressures/demands and may result in a tangible reward (Ryan & Deci, 2000a). Introjected regulations are behaviours driven by guilt, shame or punishment avoidance and although are internal to oneself, are not accepted as the 'true' self (Ryan & Deci, 2000a). Identified regulation underpins behaviours that a person engages with as they value the importance of the behaviour's outcome (Ryan & Deci, 2000a). Integrated regulations have been fully internalised by an individual and are engaged with because an individual

Figure 3

Continuum of motivational regulations (Deci & Ryan, 1985b; 2000)

Controlled **Autonomous**

Type of Motivation	Amotivation	Extrinsic Motivation				Intrinsic Motivation
Form of Regulation	No-Regulation	External Regulation (e.g., "I am only doing more activity because I have been told to")	Introjected Regulation (e.g., "I have to go for a walk otherwise I will feel guilty")	Identified Regulation (e.g., "I am being more active to get fitter")	Integrated Regulation (e.g., "I am active because it is important to me"	Intrinsic Regulation (e.g., "I go for a walk daily because I enjoy it"
Source of Motivation	Impersonal	External	(Somewhat External)	(Somewhat Internal)	(Internal)	(Internal)

values the importance of the behaviour (Ryan & Deci, 2000a), whereas intrinsic regulations are drivers in the form of enjoyment and satisfaction. Last, amotivation refers to behaviours that have no regulation, therefore lack any intention to take action (Ryan & Deci, 2000a). These forms of regulation can be grouped into the two overarching forms; autonomous motivations, include identified regulation, integrated regulation and intrinsic regulation and controlled motivations include introjected and external regulations.

The model details that the degree to which a goal is pursued with self-concordant autonomous motives, with more autonomous motives being preferred, can improve the likelihood of efforts being sustained over time. These more autonomous motives that increase, and sustain efforts then result in an increased likelihood of goal attainment. The model then goes further to explain that, as suggested in SDT (Deci & Ryan, 2008), attainment can result in basic psychological needs satisfaction, and that by satisfying the needs of autonomy, competence, and relatedness, changes in well-being can occur (Sheldon & Elliot, 1999). *Autonomy* relates to feeling free and in control of one's actions in reference to an internal locus of control (Kilpatrick et al., 2013). The more orientated an individual is to perform or engage in a behaviour out of internal interests relative to one's values, the greater the feeling of autonomy (Deci & Ryan, 2024). However, the promise of monetary, extrinsic rewards, threat of punishment and increases in perceived competition can all impede one's autonomy (Deci & Ryan, 2012) and reduction in the feeling of autonomy may result in lower levels of motivation. *Competence* relates to feeling of mastering a skill or task and being is relative to one's sense of proficiency (Kilpatrick et al., 2013). Together with intrinsic motivations, positive feedback can promote feelings of competency in a task (Deci & Ryan, 2012). Finally, *relatedness* associates with a sense of feeling connected with the social context of the behaviour (Kilpatrick et al., 2013). SDT (Deci & Ryan, 2000) postulates motivation on a continuum from amotivation, not self-determined, to intrinsic motivation, self-determined (Figure 3) where somebody who is intrinsically motivated is satisfying all three psychological needs.

2.3.2 Application of Self-Concordance Model for Physical Activity

Research has generally supported the theoretical assumptions of SCM. When initially founded, Sheldon and Elliot (1999) reported separately the elements of goal striving and goal attainment as well as findings that support the model as a whole. In explicit support of the SCM, two literature reviews have reported evidence to suggest that the model in Figure 2 is an accurate depiction of goal attainment. First, a meta-analysis reported that seven studies collectively found that more self-concordant goals resulted in increased efforts towards a goal progress (Koestner et al., 2002). Furthermore, the same review by Koestner and colleagues (2002) found that a large positive effect was found in the nine studies that reported on goal progress on changes in well-being. Additionally, in a second review (Gaudreau et al., 2012), self-concordant, autonomous motives were indirectly related to goal progress through effort and action planning. Collectively these review papers demonstrate support for the SCM in explaining the role of motives for goal pursuit.

SCM has been widely applied to other contexts including business and sport. In a sport setting, greater self-concordant motives have resulted in predicted efforts and perceptions of goal attainment which influenced an individual's satisfaction of basic psychological needs and related to athlete's well-being (Smith et al., 2007, 2011). Findings have also supported the promotion of self-concordant motives for the workplace, whereby self-concordant motives were directly positively correlated with perceived alignment to the organisation and role, and further indirectly related to goal attainment and job satisfaction (Downes et al., 2016).

The application of SCM in PA contexts is limited however a few studies have reported effects. Specifically, the level to which an individual pursued self-concordant motives was unchanged over time, and the extent to which an individual pursued self-concordance motives was reported to have a large effect on exercise behaviour maintenance (Fuchs et al., 2012). Additionally, in SCM the satisfaction of basic psychological needs in goal pursuit is stated for well-being, a review of 66 studies found that research has focused less on the effects on how motives may be influencing these needs (Teixeira et al., 2012). Although predominantly concerned with the effects of motivations, this review offers insight into theoretical propositions that have been discussed in this section. Autonomy (n = 4) and relatedness (n = 4) were the least reported and showed minimal effects. However perceived competence was the most frequently reported in relation to exercise (n = 8). The review findings show that 92% of studies reported a positive relationship between higher competence and exercise (Teixeira et al., 2012). Overall, the review was in support of SDT and SCM, and reported that, in an exercise context, autonomous, self-concordant motivations were positive correlated, and controlled, less self-concordant motivations were negatively correlated (Teixeira et al., 2012). Therefore, it would suggest that irrespective of goal type, the motive for which is underpinning goal pursuit is extremely relevant in a PA context. Although the studies included in Teixeira et al.'s (2012) review were predominantly short-term, findings show promise that autonomous, self-concordant motives, are beneficial for PA goal pursuit.

It is clear that the SCM is applicable for goal pursuit in a range of contexts including PA, however it is still uncertain how different goal types could have a role. More specifically it is unknown if different goals could be employed to promote greater self-concordance and move away from controlled motives that do not benefit psychological needs (Hagger et al., 2014) or perceived mental well-being (Briki, 2016; Ng et al., 2012). Sheldon (2014) discusses the idea that self-concordant motives could be promoted by "self-attunement", by asking individuals to proceed and make judgements on goal pursuit based on gut instincts as opposed to the conscious mind response. Goal types that could facilitate this theory more so are open goals as they require less mental response to a specific target and allow for flexibility in goal pursuit; yet this is still to be tested.

2.3.3 Measuring Goal Motives

In order to understand how motives are influencing outcomes of interest, a long standing four item measure of motives (Sheldon & Elliot, 1999) has been commonly reported. The four items, divided into two subscales, represent the two overarching motives: autonomous goal motives relate to the importance and enjoyment of the goal, and controlled goal motives relate to the internal or external pressures that may be experienced. As the measure only contained two items per sub-scale it has been critiqued and its internal consistency questioned. Additionally, the four items did not capture the entire essence of SDT proposed motivations and did not offer insight into all of the motivational regulations. Sheldon et al. (2017) recommended including both positive and negative introjected items, suggesting that positive introjected regulations should be included in the autonomous sub-scale. In response, Riddell et al. (2022) incorporated these suggestions and adapted the items resulting in an updated 10-item measure of autonomous and controlled motives. However, given the wider literature including introjected forms of regulation as controlled motivations, Riddell et al. (2022) decided against including positive introjected regulations in the autonomous subscale. As a result, the updated questionnaire of goal motives reports better internal consistency (a = .80 and a = .75, respectively [Riddell et al., 2022]) and offers a more comprehensive measure of motives.

2.3.4 Need to Consider Goal Motives Alongside Goal Setting

PA is a continual behaviour that requires repeated and sustained engagement for a person to be considered active. Yet, the relationship between *how* and *why* individuals set goals has not been considered collectively in a PA context. However, there are many overlapping theoretical assumptions suggesting that there is a direct association affecting the outcome of goal pursuit. For instance, both make reference to an individual's need to feel confident in their abilities (Deci & Ryan, 1985a; Locke & Latham, 1990; Sheldon & Elliot, 1999). There is evidence to suggest that successful goal attainment promotes increased competence, and satisfies individuals needs which in turn increases well-being (Koestner et al., 2002; Sheldon & Elliot, 1999), and so identifying the most attainable goal for insufficiently active individuals would increase feelings of competence and potentially overall perceived well-being. Furthermore, as discussed previously, the SCM goes further than simply goal pursuit and considers well-being a key outcome. Similarly, this thesis looks to not only address the objective PA outcomes of goals, but also seeks to explore the effect had on psychological variables that could be influencing participation and long-term adherence, particularly for those considered to be insufficiently active and most at risk of low PA related health conditions. Additionally, Locke & Latham (2019) state that goals should be valued by individuals pursuing them, and the same could be said for those pursuing autonomous, self-concordant motives as these relate to one’s innate interest and values. However, for those pursuing a goal for more controlled or less-self-concordant motives and doing so because of internal or external pressures, they may be less affected by goal types. This could have positive and negative associations with overall PA and well-being; however, this is yet to be determined. Furthermore, progress and goal attainment results in increased perceived well-being, which then promotes future goal pursuit with autonomous motives (Sheldon & Houser-Marko, 2001). Thus, identifying the best goal type for goal attainment in an insufficiently active population could result in greater attainment, more autonomous motives, and higher rates of adherence and behaviour change and reduction in health risks.

2.4 Summary of Literature Review

In this section the underpinning elements of this thesis are discussed and reviewed in detail. This literature review discussed GST more broadly, and in a PA context. The current evidence comparing different goal types was also presented and the effects on PA and psychological outcomes were discussed and critically evaluated. Overall, the current evidence of different goal types generally reports findings of mixed populations (Carter et al., 2021; Swann et al., 2020; 2022), but as identified by Hawkins and colleagues (2020) there are key differences in goal response between active and insufficiently active individuals and so further examination of the goal types is required in more specified populations. In addition, the current application of goal motives for PA and psychological outcomes were also summarised highlighting the need to explore the relationship between the *how* and *why* of goal setting for PA. This literature review identifies the gaps in the current literature which are addressed in this thesis, namely the lack of understanding of how different goal types influence physical and psychological outcomes over time in insufficiently active individuals, and how these goals impact goal motives for PA. The aim of this thesis is to contribute to the growing understanding of different goal types in a PA context offering implications for research and applied practice.

CHAPTER 3: WHAT EFFECTS DO GOAL-SETTING INTERVENTIONS HAVE ON PHYSICAL ACTIVITY AND PSYCHOLOGICAL OUTCOMES IN INSUFFICIENTLY ACTIVE ADULTS? A SYSTEMATIC REVIEW AND META-ANALYSIS[14]

Background: Goal setting is commonly used for promoting PA among insufficiently active individuals. Previous reviews have analysed the effects of goal setting on PA, but the purpose of this systematic review was to examine the concurrent effects of goal setting on PA and psychological outcomes in insufficiently active individuals to support interventions aiming to produce sustained PA behaviour change.

Methods: In this review (PROSPERO: CRD42021243970), we identified 13 studies with 1208 insufficiently active adults that reported the effects of goal-setting interventions (range 3-24 weeks) on both PA and psychological outcomes (e.g., self-efficacy, motivation, affect). We used meta-analysis and narrative synthesis to analyse these effects.

Results: All goals used in the included studies were specific goals. Setting specific goals had a large, positive effect on PA (g [SMD] = 1.11 [$p < .001$], 95% CI 0.74-1.47), but only a small, positive effect on the combined psychological outcomes (g [SMD] = 0.25 [$p < .001$], 95% CI 0.10-0.40). Moderator analyses revealed that interventions that did not reward participants had a significantly greater effect on PA than interventions that did provide rewards (g = 1.30 vs. 0.60 respectively, $p \leq .003$). No other significant moderators were found.

Conclusion: Our review offers initial insight into the long-term effects of specific goals on PA and psychological outcomes in insufficiently active adults. Further research that examines the PA and psychological effects of goal-setting interventions and investigates a wider range of goal types could develop a stronger evidence base to inform intervention for insufficiently active individuals.

Keywords: Exercise, sedentary behaviour, motivation

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3.1 Introduction

The physical, mental and social benefits of PA (i.e., any bodily movement that substantially increases energy expenditure; Caspersen et al., 1985) are widely documented (Cekin, 2015). Nevertheless, prevalence data indicates that one-third of adults globally are not meeting the WHO PA guidelines of $\geq$ 150 minutes of moderate-vigorous PA per week (Guthold et al., 2018; WHO, 2020), with some even labelling this issue a 'global pandemic' (Flint et al., 2014). If levels of physical inactivity remain unchanged, it is predicted that 499.2 million new cases of preventable non-communicable diseases will occur by 2030 (Santos et al., 2023). Consequently, the development and implementation of behaviour change strategies that help to address physical inactivity would be valuable to PA providers, healthcare organisations, exercise practitioners, and researchers.

Goal setting is one of the most frequently used strategies for promoting PA behaviours, particularly among those who are less active (Howlett et al., 2019; Howlett et al., 2021). A goal is defined as the objective of one's actions directed towards a desired achievement or end state (Lee et al., 1989; Locke et al., 1981). Under the right conditions, a goal can influence an individual's motivations and behaviours (Lunenburg, 2011), such as increasing PA. A meta-analysis of 52 interventions (N = 5912), of mostly insufficiently active adults, indicated that goal setting can have a significant, moderate effect on PA in adults (d = 0.55, 95% CI = 0.43-0.67; McEwan et al., 2016). However, contrary to previous goal-setting theory-based research (e.g., Locke & Latham, 2002) and the widespread use of specific goals in PA interventions, specific goals (d = 0.589, p < .001), both in absolute (e.g., "to walk 10,000 steps per day") and relative (e.g., "to be 20% more active compared to baseline") forms, did not produce significantly different levels of PA compared to nonspecific goals (e.g., "to be more active" - d = 0.511, p < .001; McEwan et al., 2016).

Although the review by McEwan et al. (2016) established that goal setting had a positive effect on PA behaviour, researchers have also assessed the effects of goal setting on a range of psychological outcomes in insufficiently active adults. For instance, evidence has emerged on the effects of goal setting in PA on self-efficacy (Stovitz et al., 2005), motivation (Prestwich et al., 2017), and quality of life (Vetrovsky et al., 2017). Given that psychological responses in PA (e.g., affective response) can predict long-term PA engagement (e.g., Rhodes & Kates, 2015) and that goal setting can elicit different psychological responses in active compared to insufficiently active adults (Hawkins et al., 2020), a synthesis of evidence on the effects of goal setting on PA *and* psychological outcomes in insufficiently active adults is warranted. By doing so, this could provide a more complete picture of the impact of goal-setting interventions, which could help to inform future PA interventions that involve goal setting.

Although McEwan et al. (2016) found no evidence of a significant difference between goals that differed in specificity (i.e., specific vs. vague goals), differences between specific and non-specific goals have been found in recent studies involving exercising tasks. Specifically, findings from a series of lab-based walking studies have suggested that the types of goal used within interventions may influence psychological outcomes (Hawkins et al., 2020; Swann et al., 2020; Swann et al., 2022). Despite initial experimental evidence suggesting that qualitatively different goals may elicit distinct psychological responses, even in the absence of any significant differences in performance, the effects of different goal types on psychological outcomes in interventions over longer timeframes have yet to be synthesised. By synthesising the effects of goals on psychological outcomes in PA interventions in insufficiently active adults and analysing the moderating effect of goal type, better understanding of the longer-term effects of different goal types on PA levels could be provided.

The aim of this systematic review and meta-analysis was to identify, synthesise, and appraise literature on the effects of goal-setting interventions on PA and psychological outcomes (e.g., motivation, self-efficacy) in insufficiently active adults. Through addressing these aims, the current review builds upon previous literature (e.g., McEwan et al., 2016) by examining the effects of goals on PA *and* psychological outcomes in PA interventions specifically in insufficiently active adults. By doing so, the findings could offer a more comprehensive understanding of the effects of goal setting interventions in PA. In turn, this could help to inform the development of goal-setting recommendations for insufficiently active adults.

3.2 Method

3.2.1 Protocol and Pre-registration

This systematic review was pre-registered (PROSPERO: CRD42021243970; Appendix A.1) and reported in accordance with the Preferred Reporting Items for Systematic-Reviews and Meta-Analysis (PRISMA; Page et al., 2021; Appendix A.4) guidelines and the APA's Meta-Analysis Reporting Methods (MARS; Appendix A.3). The narrative synthesis is reported following the Synthesis Without Meta-Analysis (SWiM; Campbell et al., 2020) guidelines (Appendix A.2).

3.2.2 Eligibility Criteria

Eligibility criteria were set in line with the PICO framework (Population, Intervention, Comparison, and Outcome). Studies were included if they: (a) used goal setting as the primary intervention to promote PA, which could have been in relation to outcomes (e.g., to spend less time sitting in the day), events (e.g., to complete a 5 km run), or processes (e.g., to increase PA levels; Swann et al., 2020); (b) recruited sedentary (i.e. MET value < 2; Salmon et al., 2003) or insufficiently active (< 150 minutes of moderate-to-vigorous activity per week; WHO, 2020) adults aged between 18 and 64 years old; (c) examined the effects of the intervention on at least one PA measure and at least one psychological outcome; (d) included a control or baseline measure; (e) measured the effects of the intervention over a minimum of a 1-week period; (f) reported original empirical data; and (g) were published as a full text in the English language. We defined a goal as "the objective or aim of an individual's actions" (Locke et al., 1981, pp. 126). Where insufficiently active adults were combined with ineligible participants (e.g., sufficiently active adults, children), a study was only included if data for eligible participants were presented separately and could be extracted.

3.2.3 Search Strategy

Electronic database searches were conducted on three occasions from March 2021 to the final search conducted in February 2023. Five electronic databases were searched: Academic Search Complete; APA PsycINFO; MEDLINE; PubMed; and SPORTDiscus. Table 6 lists the search terms and fields used for each search block (see Appendix A.5 for full search information for each database). To ensure that studies including step-count instructions that did not explicitly refer to the term "goal" were identified, we included the term "step*" in block 1. In relation to block 4, we chose to focus on broad psychological terms rather than specific constructs due to the exploratory nature of this element of the review. In addition to the electronic database searches, manual searches were undertaken of the reference lists of five reviews that focused on goal setting or improving PA (Allen et al., 2019; Howlett et al., 2019; McEwan et al., 2016; Swann et al., 2021; Whatnall et al., 2021). All returned records were exported to Zotero 6.0. Duplicates were manually removed before articles were screened independently by the first and fifth authors. The records were screened first at title level, before being screened at the abstract level, and with the full-text screening constituting the third and final stage. After each stage of screening, the first and fifth authors met to discuss their decisions, resolve discrepancies, and, in the case of articles excluded at full text, agree reasons for exclusion (see Appendix A.6 for list of excluded texts and reasons). The inter-rater reliability coefficient indicated "almost perfect" agreement on screening decisions (κ = .93).

Table 6

Search terms used to identify relevant research

Block	Search Terms	Search Field
1	goal* OR step*	Title/Abstract
2	"phys* activ*" OR exer* OR fitness OR activ* OR walk* OR "phys* train*"	Full Text
3	"seden* adult*" OR "seden* older* adult*" OR "inactiv* adult*" OR "inactiv* older* adult*" OR "seden* individual*" OR "inactiv* individual*" OR "insufficient* activ* adult*" OR "insufficient* activ* older* adult*" OR "insufficient* activ* individual*"	Full Text
4	psych* OR wellbeing OR well-being OR "well being" OR "mental health"	Full Text

(*) were used to broaden the search and to retrieve all variations of the word

("") were used to search multiple words as one phrase

3.2.4 Data Analysis

3.2.4.1 Data Extraction

The following contextual information were extracted by the first author: design; sample; goal; PA measure; psychological variable measure; and number of effect sizes calculated. The authors of 16 studies were contacted for further information as insufficient data were presented in the original articles to satisfy the requirements of a meta-analysis. Six authors replied and provided the necessary data to be included. Two further studies were included, but only some of the variables could be used in the analysis. No replies were received for the remaining eight studies, leading to the exclusion of these articles. The fifth author reviewed and verified all extracted data.

3.2.4.2 Risk of Bias

Risk of bias was conducted by the first author and assessed using the Cochrane Risk-of-Bias Tool for Randomised Trials (RoB 2; Sterne et al., 2019) and the Risk of Bias in Non-Randomised Studies – of Interventions (ROBINS-I; Sterne et al., 216). The risk of bias determined by the first author for each study was reviewed by the fifth author and agreement was reached (see Appendix A.7).

3.2.4.3 GRADE Assessment

The Grading of Recommendations, Assessment, Development, and Evaluation levels of certainty framework (GRADE; Guyatt et al., 2008) was employed to assess the certainty of the evidence included in the review (see Appendix A.8). The first author assessed GRADE using GRADEpro (2021), with additional guidance on level and considerations for each sub-group provided using the checklist proposed by Meader et al. (2014).

3.2.4.4 Meta-analysis

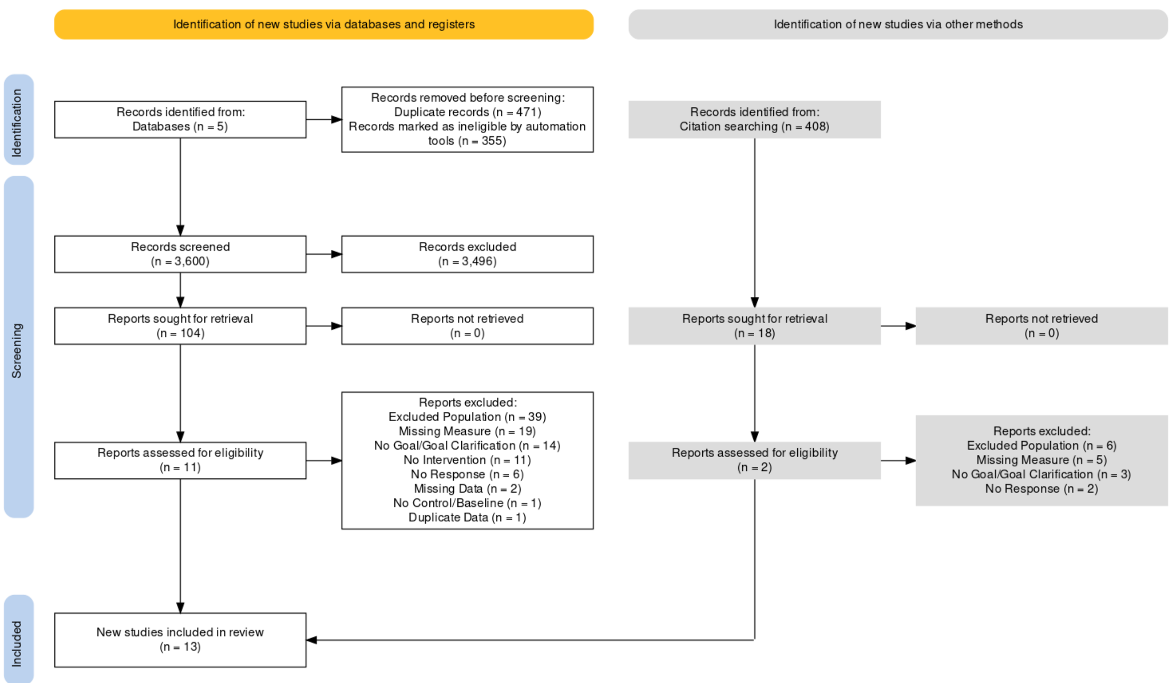
A quantitative aggregate data synthesis was conducted with Review Manager (RevMan) version 5.4 software (The Cochrane Collaboration, 2020), using a random effects meta-analysis, with standard mean difference (SMD) effect sizes ($g \leq 0.2$ – small effect, $0.2 < g \leq 0.5$ – moderate effect, $g \geq 0.8$ – large effect; Hedges, 1981), and 95% confidence intervals (CI). Heterogeneity of studies was assessed from visual inspection of forest plots and assessment of the I^2 statistic, where an I^2 statistic of 50% or greater indicated a substantial grade of heterogeneity (Deeks et al., 2019). Additionally, publication bias was reduced by including grey literature (Hopewell et al., 2005), although no grey literature met the eligibility criteria. Due to the low number of included studies and diverse range of outcomes and scales presented, moderator analyses could not be undertaken for all intended subgroups (PROSPERO: CRD42021243970). Guided by groupings in the moderator analysis of a previous review (McEwan et al., 2016), the following subgroups were analysed: study characteristics (mode of intervention, PA intensity, PA measure, and follow-up); sample characteristics (sex); goals (goal type and time frame of goal); and additional behaviour change techniques (reward and educational component). Effect size (SMD), standard error, 95% CI, *Z*-value, and *Q*-value with *p*-value were calculated for each of the 11 moderators for PA. Where possible, PA subgroup analyses were conducted. Due to the high level of heterogeneity in the psychological outcomes assessed and measures used, a narrative synthesis approach was used to analyse evidence concerning the effects of goals on psychological outcomes. Effect sizes and standard mean differences (*g*) were computed to enable comparison across studies. Scores for variables that were negatively framed (e.g., lower scores for negative affect, anxiety, or depression are regarded as more positive outcomes) were reversed to ensure the overall effect-size direction was consistent.

3.3 Results

4,834 records were identified through our searches (Figure 4; Haddaway et al., 2022). Of the 122 articles screened at full-text level, 13 were included in the final review. The most common reason for exclusion was that baseline activity levels of the samples were not reported (*n* = 17; see Appendix A.8).

Figure 4

Literature search PRISMA flow diagram



3.3.1 Contextual Information

The 13 included studies included RCT (*k* = 10) and non-randomised trials (*k* = 3), with intervention durations ranging from three to 24 weeks. Table 7 provides an overview of study characteristics. In total, 1,208 participants took part in the included studies (studies with mixed gender samples *n* = 11; studies with female-only samples *n* = 2). All participants were deemed not to be meeting WHO (2020) PA guidelines (mixed inactivity levels: *k* = 1; insufficiently active: *k* = 2; low active: *k* = 1; inactive: *k* = 3; sedentary: *k* = 6). Based on the contents of the goals, the experimental conditions in all studies used specific, specific-relative (i.e., goals set relative to an individual's current PA levels, e.g., 3,000 steps above baseline; *k* = 5) or specific-absolute (goals set in relation to an absolute level of PA, e.g., 30-minutes of activity ≥ 5 days a week; *k* = 8) goals. No study compared specific-relative to specific-absolute goals. No other goal types were employed in any of the reviewed studies. A range of PA measures (steps *k* = 10; minutes of PA *k* = 1; recall [any form of participant perceived PA] *k* = 3) and psychological outcomes (self-efficacy *k* = 10; quality of life *k* = 3; enjoyment *k* = 2; anxiety-depression *k* = 1; motivation *k* = 1; mood *k* = 1; well-being *k* = 1) were utilise.

Table 7

Summary of included studies

Study	Design	Sample	Specific goal	Physical activity measure	Psychological variable measure	Number of effect sizes (ES) calculated	Overall RoB judgment
Chae et al. (2015)	8-week intervention	Sedentary male and female office workers (*N* = 39, M_{age}: 39.31 ± 8.46)	Relative: + 3,000 steps above baseline everyday	Pedometer step count	Exercise Self-Efficacy: Exercise Self-Efficacy scale (EXES; Bandura., 1997)	2 ES: differences between baseline and 8-weeks post-intervention of steps and exercise self-efficacy	Moderate
Dallow and Anderson (2003)	24-week RCT (2 experimental conditions)	Sedentary obese females (*N* = 58, M_{age}: 46.7)	Absolute: 30-minutes of moderate-vigorous activity ≥ 4 days/week	Physical Activity Readiness Questionnaire (PAR-Q ; Thomas et al., 1992)	Self-Efficacy (Marcus et al., 1992)	3 ES: differences between combined experimental conditions at baseline and 24-weeks post-intervention of daily energy expenditure and self-efficacy, and baseline and 48-weeks post-intervention daily energy expenditure	High
Fitzsimons et al. (2012)	12-week randomised trial (1 experimental condition, 1 control)	Low active Scottish male and female adults (*N* = 59, M_{age}: 49.2 ± 8.8)	Relative: + 3,000 steps above baseline, ≥ 5 days/week	Pedometer step count	Quality of Life: Euroqol (EQ-5D; Group, 1990) Mood: Positive and Negative Affect	5 ES: differences between group 1 and group 2 at 12-weeks post-intervention of steps, EQ-5D, PANAS (+ve), and PANAS (-ve), and group 1 baseline and 48-	High

					Schedule (PANAS; Watson et al., 1988)	weeks post-intervention steps	
Lewis et al. (2013)	6-month RCT (1 experimental condition, 1 control)	Sedentary male and female adults (*N* = 386, M_{age}: 42.65)	Absolute: 30-minutes of moderate activity ≥ 5 days/week	Diary & Interview: Minutes of Physical Activity	Self-Efficacy: Self-Efficacy for Physical Activity (Marcus et al., 1992)	3 ES: differences between experimental and control conditions at 6-months of minutes of PA and self-efficacy, and at 12-months of PA	Some concern
Mansi et al. (2015)	12-week RCT (1 experimental condition, 1 control)	Insufficiently active male and female adults in New Zealand (*N* = 58, Experimental: M_{age}: 43 ± 14.9; Control: M_{age}: 40 ± 12.2)	Absolute: Increase steps by 5% each week until 10,000 steps a day is reached	Pedometer step count 7-day recall: International Physical Activity Questionnaire Short-Form (IPAQ-SF; Craig et al., 2003)	Quality of Life: Short Form 36 Version 2 Mental Component Score (SF-36 MCS; Ware & Sherbourne, 1992) Self-Efficacy	6 ES: differences between experimental and control conditions at 12-weeks of steps, IPAQ, self-efficacy, and MCS of SF-36, and at 24-weeks of steps and IPAQ	Some concern
Miragall et al. (2018)	3-week RCT (2 experimental conditions, 1 control)	Sedentary or low active male and female students (*N* = 71, M_{age}: 22.18 ± 3.71)	Relative: Individually set daily step count	Pedometer step count	Enjoyment: Physical Activity Enjoyment Scale – Short Version (sPACES; Kendzierski & DeCarlo, 1991) Self-Efficacy: Self-Efficacy Questionnaire	4 ES: difference between IMI+Ped condition and control of steps, enjoyment, and self-efficacy, and at 12-weeks post intervention of steps	Some concern

					(SEQ ; Marcus et al., 1992)		
Monroe et al. (2017)	12-week RCT (1 experimental condition, 1 control)	Insufficiently active male and female adults (N = 63, M_{age}: 48.2 ± 10.40)	Relative: + 3,000 steps above baseline, ≥ 5 days/week	Pedometer step count	Self-Efficacy: Barrier Self-Efficacy Scale (McAuley, 1992)	2 ES: differences between combined experimental condition at 12-weeks and baseline of step and barrier self-efficacy	High
Prestwich et al. (2017)	4-week RCT (2 experimental conditions, 1 control)	Physically inactive male and female adults (N = 263, Competition: M_{age} 23.94 ± 9.16; Self-monitoring: M_{age}: 21.98 ± 5.97; Control: M_{age}: 23.09 ± 6.96)	Absolute: ≥10,000 steps per day	Pedometer step count	Motivation: Behavioural Regulation in Exercise Questionnaire (BREQ-2; Markland & Tobin, 2004) Self-Efficacy	7 ES: differences between combined experimental condition and baseline of step, self-efficacy, and the five subscales of (BREQ-2) motivation	High
Rovniak et al. (2005)	12-week RCT (2 experimental conditions)	Sedentary females (N = 50, M_{age}: 40.21 ± 9.14)	Absolute: Walk for 30-minutes, 3 x times/week	Self-reported walking: National Health Interview Survey (NHIS; Centres for Disease Control and Prevention, 1990)	Self-Efficacy for Exercise Behaviour Scale (Sallis et al., 1988) Physical Activity Enjoyment Scale (PACES; Kendzierski & DeCarlo, 1991)	4 ES: differences between combined experimental condition and baseline of minutes walked, self-efficacy for exercise, and PA enjoyment, and 1-year post intervention of minutes walked	High

Steeves et al. (2016)	6-month randomised trial (2 experimental conditions)	Sedentary overweight male and female adults (*N* = 58, TV: M_{age}: 53.8 ± 6.8; Walking: M_{age}: 50.2 ± 9.8)	Absolute: All: increase to at least 150-minutes PA per week 1: walk briskly during TV commercials for ≥90 minutes a day, ≥5 days per week 2: walk briskly for ≥30-minutes, ≥5 days per week	Pedometer step count	Self-Efficacy: Barriers Specific Self-Efficacy Scale (McAuley, 1992)	2 ES: differences between combined experimental condition and baseline of step and barrier self-efficacy	High
Stovitz et al. (2005)	9-week RCT (1 experimental condition, 1 control)	Inactive male and female patients (*N* = 94, Intervention: M_{age}: 38 ± 12.4; Control: M_{age}: 44.3 ± 13.8)	Relative: Intervention: increase daily average step count by 400 steps each week Control: walk an extra 10% more steps each week	Pedometer step count	Self-Efficacy: Exercise Self-Efficacy (Marcus et al., 1992)	2 ES: differences between experimental condition post-intervention and baseline of step and exercise self-efficacy	High
Vetrovsky et al. (2017)	12-week intervention (2 experimental conditions)	Physically inactive male and female adult patients (*N* = 23, M_{age}: 41 ± 10)	Absolute: Gradually increase daily steps to 10,000 steps per day	Pedometer step count	Quality of Life: Short Form 36 (SF-36 mental health scale; Ware & Sherbourne, 1992)	4 ES: differences between experimental condition post-intervention and baseline of steps, anxiety, depression, and mental health	Low

					Anxiety & Depression: 14-item Hospital Anxiety and Depression scale (HADS; Zigmond & Snaith, 1983)		
Yuenyong-chaiwat (2016)	12-week intervention (1 experimental condition with baseline)	Sedentary overweight male and female individual's ($N = 30$, M_{age}: 49.67 ± 6.51	Absolute: Walk ≥10,000 steps per day	Pedometer step count	Psychological well-being: Profile of Mood States (POMS; Curran et al., 1995)	2 ES: differences between experimental condition post-intervention and baseline of step and psychological well-being	Low

PA = physical activity

+ve = positive

-ve = negative

3.3.2 Risk of Bias

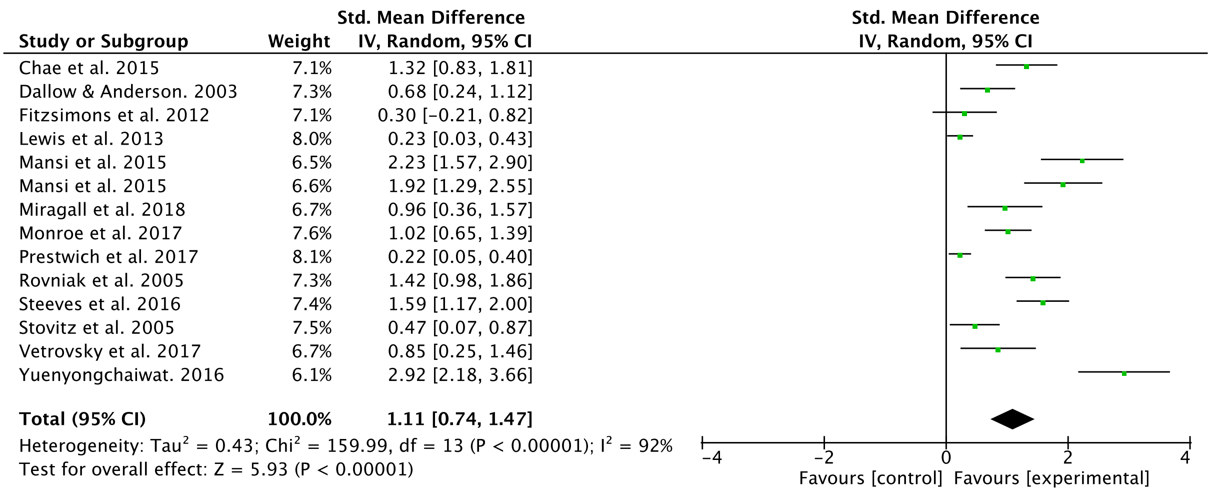
Seven of the 10 studies that involved a randomised controlled trial (RCT) were judged as having a high risk of bias using the RoB-2 tool (see Appendix A.7), with the remaining three classified as having some concerns. Two of the three non-randomised trials were judged as having low risk of bias, with the remaining study appraised as having moderate risk of bias (see Appendix A.7).

3.3.3 Physical Activity Outcomes

Across the 13 included studies, PA was measured using: daily step count; or self-report measures of recalled minutes of PA, such as the PAR-Q (Thomas et al., 1992). Overall, specific goals had a large, positive effect on PA behaviour in insufficiently active individuals (g: [SMD = 1.11, 95% CI 0.74-1.47]; Figure 5). There was, however, large heterogeneity amongst the studies (Q = 159.99, df = 13 [p < .001], I^2 = 92%), and the certainty of evidence was rated as low using the GRADE criteria.

Figure 5

Overall effect size of included studies on physical activity



Daily step-count was the only PA measure with sufficient data (k = 10) to conduct a subgroup analysis. Pooled analysis showed a large, positive effect of specific goals on increasing daily step-count in insufficiently active adults (g: [SMD = 1.12, 95% CI 0.66-1.59]). There was, however, very high heterogeneity amongst the studies (Q = 109.01, df = 9 [p < .001], I^2 = 92%), and the certainty of evidence was judged to be low using the GRADE criteria.

Similar to the effect of specific goals on daily step count, the three studies that collected information on PA via participant recall found specific goals had a positive effect (g = 0.68 – Dallow & Anderson [2003]; g = 0.23 – Lewis et al. [2013]; g = 1.42 – Rovniak et al. [2005]) (Figure 5). However, the large variance should be noted, and no subgroup analysis was conducted due to the lack of consistency between study measurements and limited data (k = 3).

3.3.4 Moderator Analysis for Physical Activity

Moderator analyses were carried out for four subgroups, each with multiple potential moderating variables to account for any potential influencing factors (Table 8; Appendix A.9).

3.3.4.1 Study Characteristics

No significant difference (p = .24) was found between interventions that used remote (g = 0.81, p = .006, GRADE: low) and multiple (g = 1.21, p < .001; GRADE: low) methods of delivery. The effects of goals did not differ significantly depending on the intensity of PA (i.e., moderate or not specified), with both presenting large, positive effects on PA ($g \geq 1.06$, $p \leq .001$; GRADE: very low and low, respectively). There were no significant differences for the effects of goals based on the measure of PA (p = .97), with significant effects found when PA was assessed using objective means (i.e., via pedometer; g = 1.12, p < .001; GRADE: moderate) and self-report methods (i.e., through questionnaires; g = 1.10, p = .008; GRADE: very low). Follow-up periods were reported at 12 weeks (k = 1), 24 weeks (k = 1), and 48 weeks (k = 4), with seven studies not including follow-up information. There was no significant difference in PA (p = .66) between studies with (g = 0.98, p < .001) and without (g = 1.15, p < .001) follow up measures. The GRADE certainty of evidence was low and moderate, respectively.

3.3.4.2 Sample Characteristics

Of the 13 included studies, 11 studies measured specific-goal effects on PA behaviour in mixed-gender samples, and two reported the effect for female-only samples. Both reported large effects ($g \geq 1.05$), yet no significant difference was found between groups (p = .87) and there was high heterogeneity within each subgroup (Female-only: $Q = 5.50$, $df = 1$ [$p = .02$], $I^2 = 82\%$; GRADE: low; Mixed gender: $Q = 147.38$, $df = 11$ [$p < .001$], $I^2 = 93\%$; GRADE: very low).

3.3.4.3 Goal Content

Specific-absolute ($g = 1.29$, $p < .001$) and specific-relative goals ($g = 0.81$, $p < .001$) and the timeframe of the goal (i.e., set daily or weekly), had a large, positive effect on PA ($g \geq 0.89$, $p < .001$), but no significant differences were revealed between these comparator groups. The certainty of evidence for both was graded as moderate-to-very low based on the GRADE criteria.

3.3.4.4 Intervention Related Behaviour Change Techniques

Four studies provided a monetary reward or a gift to participants for taking part. Studies with no reward had a significantly greater effect on PA ($g = 1.30$, $p < .001$) versus studies that rewarded participants ($g = 0.60$, $p = .003$), although the quality of evidence was judged to be very low and low, respectively. When educational components (e.g., information leaflets) were included in studies, the effect on PA was positive ($g = 0.97$; $p < .001$; GRADE: low), yet the effect was not significantly different when an educational component was not used ($g = 1.37$, $p < .002$; GRADE: low).

Table 8

Moderator analysis for physical activity outcomes (overall effect on physical activity; g = 1.11)

Moderator	k	Effect size (SE)	95% CI	*Z*-value	*p*-value	*Q* value (*df*), *p*-value	GRADE Rating
Study characteristics							
Mode of intervention						1.40 (1), *p* = .24	
Remote	4	0.81 (0.30)	0.23-1.39	2.75	.006		Low
Multiple methods	9	1.21 (0.17)	0.88-1.54	7.26	< .001		Low
PA intensity						0.07 (1), *p* = .79	
Moderate	6	1.17 (0.31)	0.57-1.77	3.81	< .001		Very low
Not specified	7	1.06 (0.27)	0.52-1.59	3.87	< .001		Low
PA measure						0.00 (1), *p* = .97	
Technology (pedometer)	10	1.12 (0.24)	0.66-1.59	4.71	< .001		Moderate
Self-report	4	1.10 (0.41)	0.29-1.91	2.67	.008		Very low
Follow-up						0.19 (1), *p* = .66	
Yes	6	0.98 (0.26)	0.47-1.50	3.73	< .001		Low
No	7	1.15 (0.29)	0.58-1.73	3.94	< .001		Moderate
Sample characteristics							
Sex						0.03 (1), *p* = .87	
Female	2	1.05 (0.37)	0.32-1.78	2.83	.005		Low
Mixed sex	11	1.12 (0.21)	0.71-1.53	5.38	< .001		Very low
Goal content							
Goal type						2.17 (1), *p* = .14	
Specific							
Relative	5	0.81 (0.18)	0.45-1.17	4.39	< .001		Moderate
Absolute	8	1.29 (0.27)	0.77-1.81	4.83	< .001		Very low
Goal timeframe						1.25 (1), *p* = .26	
Daily	7	1.33 (0.32)	0.69-1.96	4.12	< .001		Low
Weekly	6	0.87 (0.25)	0.37-1.36	3.43	< .001		Very low
Additional BCTs							

Reward						5.39 (1), p = .02	
Yes	4	0.60 (0.20)	0.20-1.00	2.94	.003		Low
No	9	1.30 (0.22)	0.86-1.74	5.82	< .001		Very low
Educational component						0.64 (1), p = .42	
Yes	8	0.97 (0.21)	0.56-1.39	4.58	< .001		Low
No	5	1.37 (0.44)	0.50-2.24	3.08	.002		Low

BCTs = Behaviour Change Techniques

3.3.5 Psychological Outcomes

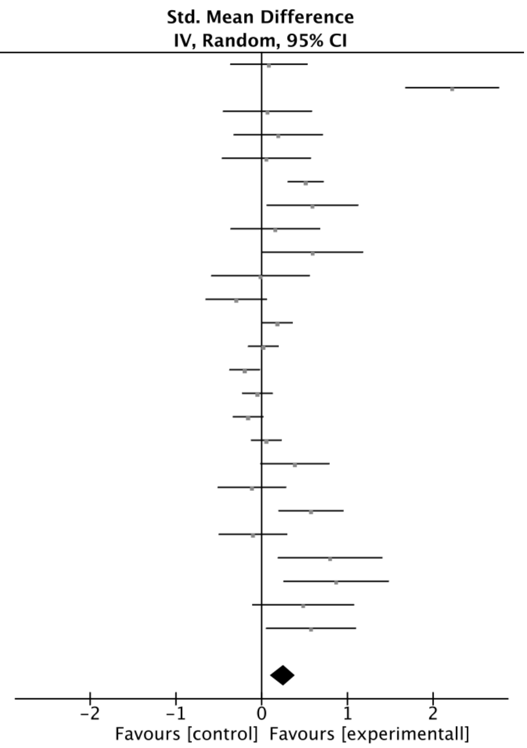
The overall effect of goal-setting interventions for PA in insufficiently active adults on the presented psychological variables was small-to-moderate (*g*: [SMD = 0.25, 95% CI 0.10-0.40]; Figure 6). Notably, some outcomes (e.g., self-efficacy) were negatively affected by specific goals. However, using the GRADE assessment criteria, the quality of evidence was rated as very low, with the primary concern being the inconsistency of evidence. Due to the wide range of psychological variables assessed (i.e., 8 outcomes), high heterogeneity (Q = 138.67, df = 24, p = .001, I^2 = 83%), low number of studies assessing outcomes, and lack of consistency in measurement tools, it was not possible to conduct subgroup analyses for psychological outcomes. The following sub-sections present our narrative synthesis of findings. Where possible, the differences between specific-absolute and specific-relative goals have been stated.

Figure 6

Overall effect size of included studies on psychological variables

Study or Subgroup	Weight	Std. Mean Difference IV, Random, 95% CI
Chae et al. 2015	3.8%	0.08 [−0.36, 0.53]
Dallow & Anderson. 2003	3.3%	2.22 [1.68, 2.76]
Fitzsimons et al. 2012	3.4%	0.07 [−0.44, 0.58]
Fitzsimons et al. 2012	3.4%	0.19 [−0.32, 0.71]
Fitzsimons et al. 2012	3.4%	0.05 [−0.46, 0.57]
Lewis et al. 2013	5.1%	0.51 [0.31, 0.72]
Mansi et al. 2015	3.3%	0.59 [0.07, 1.12]
Mansi et al. 2015	3.4%	0.16 [−0.36, 0.67]
Miragall et al. 2018	3.1%	0.59 [0.01, 1.18]
Miragall et al. 2018	3.1%	−0.01 [−0.58, 0.55]
Monroe et al. 2017	4.3%	−0.30 [−0.65, 0.05]
Prestwich et al. 2017	5.3%	0.18 [0.01, 0.35]
Prestwich et al. 2017	5.3%	0.02 [−0.15, 0.19]
Prestwich et al. 2017	5.3%	−0.20 [−0.37, −0.03]
Prestwich et al. 2017	5.3%	−0.05 [−0.22, 0.12]
Prestwich et al. 2017	5.3%	−0.16 [−0.33, 0.01]
Prestwich et al. 2017	5.3%	0.05 [−0.12, 0.23]
Rovniak et al. 2005	4.1%	0.39 [−0.01, 0.78]
Rovniak et al. 2005	4.1%	−0.11 [−0.51, 0.28]
Steeves et al. 2016	4.2%	0.58 [0.20, 0.95]
Stovitz et al. 2005	4.1%	−0.10 [−0.49, 0.29]
Vetrovsky et al. 2017	3.0%	0.80 [0.20, 1.40]
Vetrovsky et al. 2017	2.9%	0.87 [0.26, 1.48]
Vetrovsky et al. 2017	3.0%	0.48 [−0.10, 1.07]
Yuenyongchaiwat. 2016	3.4%	0.58 [0.06, 1.09]
Total (95% CI)	**100.0%**	**0.25 [0.10, 0.40]**

Heterogeneity: $Tau^2 = 0.11$; $Chi^2 = 138.67$, df = 24 (P < 0.00001); $I^2 = 83\%$
Test for overall effect: Z = 3.25 (P = 0.001)



3.3.5.1 Self-efficacy

Self-efficacy was measured using multiple scales across three domains: exercise self-efficacy (i.e., belief in one's abilities to take part in regular exercise [Everett et al., 2009]); barrier self-efficacy (i.e., one's belief in own abilities to cope with barriers [Cramp & Bray, 2009]); and overall self-efficacy (i.e., self-perception of one's abilities and belief to complete a task [Bandura, 1986]). Four studies assessed 'exercise self-efficacy' or self-efficacy for PA, with one study reporting a positive, moderate effect of specific goals (g = 0.51 – Lewis et al. [2013]), and three reporting negligible, non-significant effects (g = 0.08 – Chae et al. [2015]; g = -0.11 – Rovniak et al. [2005]; g = -0.10 – Stovitz et al. [2005]). Barrier self-efficacy also produced mixed results; Monroe et al. (2017) reported a moderate, negative effect of specific-relative goals on barrier self-efficacy (g = -0.30), thus suggesting participants felt less capable of coping with barriers, whereas Steeves et al. (2016) reported a large, positive effect of specific-absolute goals on barrier self-efficacy (g = 0.58). Self-efficacy was measured more generally by the remaining four studies, although there was no consistency in the measurement tool employed. Overall, the results were mixed, with two studies reporting positive effects of specific-absolute goals (g = 2.22 – Dallow & Anderson [2003]; g = 0.59 – Mansi et al. [2015]) and two others displaying negligible effects (specific-relative: g = -0.01 – Miragall et al. [2018]; specific-absolute: g = -0.20 – Prestwich et al. [2017]). Based on the synthesised evidence, it is difficult to offer a firm conclusion on the overall effect of specific goals on self-efficacy in PA interventions for insufficiently active adults.

3.3.5.2 Psychological Well-being and Mental Health

This category encompassed three studies that examined the effects of goals on indicators of psychological well-being and mental health. Overall, due to the heterogeneity of measures and variables assessed, it was difficult to draw any firm conclusions. Yuenyongchaiwat (2016) and Vetrovsky et al. (2017) both reported moderate-to-large, positive effect on psychological well-being (g = 0.58) and mental health (g = 0.48) when a specific goal was pursued. However, specific goals produced negligible changes in general quality of life (g = 0.07 – Fitzsimons et al. [2012]) and in mental health subscale scores in a single study (g = 0.16 – Mansi et al. [2015]). Finally, Vetrovsky et al. (2017) found that a specific-absolute goal produced large reduction in anxiety (g = 0.80) and a large reduction in depression (g = 0.87) in a 12-week intervention in a mixed-gender sample.

3.3.5.3 Enjoyment and Affect

Two studies examined enjoyment (Miragall et al. [2018]; Rovniak et al. [2005]), albeit using different measurement tools. Overall, enjoyment in PA resulted moderately improved following 12 weeks of using a specific-absolute (g = 0.39 – Rovniak et al. [2005]) and 3 weeks of using a specific-relative goal (g = 0.59 – Miragall et al. [2018]). Fitzsimons et al. (2012) used the PANAS (Watson et al., 1988) as a measure of mood and reported a small change in positive and negative subscales as a result of setting a specific-relative goal for PA (g = 0.19 and g = 0.05, respectively).

3.3.5.4 Motivation

Only one study assessed participants' motivation when setting specific goals for PA (Prestwich et al., 2017). Prestwich et al. (2017) used the BREQ-2 (Markland & Tobin, 2004) to assess five types of motivation regulations for exercise (external, introjected, identified, intrinsic, and amotivation) and found that setting a specific goal of walking more than 10,000 steps per day resulted in negligible differences in the five motivation subscales ($g \leq 0.18$).

3.4 Discussion

This systematic review and meta-analysis aimed to identify, synthesise, and appraise published evidence on the effects of goal setting interventions on PA and psychological outcomes (e.g., motivation, self-efficacy) in insufficiently active adults. Only 13 studies met inclusion criteria, thus suggesting that a relatively small number of goal-setting studies on PA in insufficiently active adults considered the effects of goal-setting on both PA *and* psychological outcomes concurrently. Such a trend is somewhat surprising given how important psychological outcomes can be for long-term PA engagement (e.g., Rhodes & Kates, 2015). Nevertheless, this systematic review and meta-analysis provides important findings related to goal-setting interventions lasting 3-24 weeks in insufficiently active adults. First, specific, relative and absolute, goals were effective for increasing PA compared to no goal or a baseline; second, not rewarding or incentivising participants appeared to be more beneficial for PA than providing rewards; third, specific-relative and specific-absolute goals had small, non-significant, effects on psychological outcomes.

3.4.1 Physical Activity Outcomes

Specific goals were found to have a large, positive effect on PA. This effect was greater than that found by McEwan et al. (2016) and reinforces the utility of goal setting for increasing PA in insufficiently active adults. A comparison of the effects of specific goals to other goal types was not possible as only specific goals were used, although a comparison of specific-relative and specific-absolute goals was possible. While our findings might suggest specific-absolute goals should be recommended for insufficiently active adults to increase PA, our meta-analytical evidence supports previous work (McEwan et al., 2016) in suggesting that there is a paucity of evidence to demonstrate that these goals are better than other goal types. That is, based on our moderator analyses, we can only conclude at this point that specific goals are better than no goals at all for PA outcomes and maintained PA behaviour when pursued by insufficiently active adults, but it remains unknown as to how they compare to other, non-specific goal types. Although the use of non-specific goals (e.g., open) have been suggested for insufficiently active individual's (Swann et al., 2021; Swann & Rosenbaum, 2018), no longer-term intervention has examined the effects of non-specific goals on both PA and psychological outcomes. Future research using a range of goal types within interventions for insufficiently active adults may yield more insight on the impact that goal type can have on both PA and psychological outcomes.

Although not significantly different, results of the present meta-analysis indicated that specific-absolute goals had larger effects on PA in comparison to specific-relative goals. As absolute goals, and most commonly daily step-count, had a greater effect on PA, this somewhat contradicts previous work which argued that health behaviour change interventions are most effective when individualised (Kahn et al., 2002). The popularity of daily step-count as a PA measure is understandable due to its high validity and reliability, cost-effectiveness, and ease of implementation, with evidence suggesting that 6000-8000 steps per day is associated with lower mortality risk (Paluch et al., 2022). However, daily step count alone cannot be used to assess the attainment of WHO (2020) guidelines, which are published in minutes of activity per day. Based on these findings, we suggest that future PA guidelines could incorporate step goals into their recommendations (e.g., minimum 30-minutes of brisk walking of 3-4000 steps per week; Tudor-Locke et al., 2011), with the aim to increase acceptability of guidelines.

In contrast to McEwan et al. (2016), who found that daily or combined daily-and-weekly goals work best in populations of mixed-activity level (i.e., active and insufficiently active groups), the current review found that insufficiently active populations benefited from either daily or weekly goals for PA, with no significant difference revealed between these goal timeframes. It should be noted, however, that the effect was greater for those pursuing daily goals. The findings therefore support McEwan and colleagues' suggestion that recommendations for PA-promotion guidance should not only advise people to set weekly goals for PA, but to also set daily PA goals. Nevertheless, further research is warranted given that the findings presented in the current review are drawn from a smaller sample than the previous review (McEwan et al., 2016) of goal setting in PA.

Feedback and reward are two variables deemed important for successful goal setting (Latham & Locke, 1991). Moderator analysis indicated that all but one study utilised feedback and the effect on PA was significantly greater when no reward was provided in comparison to studies that provided rewards, of which most were monetary. This finding suggests that rewards were not required in the included goal-setting interventions to improve PA. Although somewhat speculative, a possible explanation is that the financial rewards offered may not have been viewed, or accepted, as a sufficient reward by some participants. Alternatively, it is also possible that the rewards may have undermined autonomous motivation for PA (Ryan & Deci, 2000b), resulting in lower commitment to the goal and, as a result, less goal progress (Klein et al., 1999). When providing rewards, accounting for personality and behavioural characteristics may aid the use of rewards as a moderator for goal achievement (Munson & Consolvo, 2012). The moderator analyses also found educational components did not significantly moderate the effect of the goal-setting interventions on PA. However, knowing the benefits of PA could incite autonomous motives to be physically active, which are more effective at predicting health behaviours (Hagger et al., 2014), such as PA adherence. In addition, current activity level may inform the type of goal most beneficial for increasing activity, so that the most effective strategy for long term PA engagement is utilised (Swann et al., 2021).

3.4.2 Psychological Outcomes

Although specific goals had a large, positive effect on PA, only small effects were found for the combined psychological outcomes. The psychological outcomes were assessed through a variety of measures, resulting in high heterogeneity and preventing a statistical synthesis of findings for specific variables. Self-efficacy was the most widely examined psychological outcome, yet the effects of the specific goals used varied widely. This variation could be a result of the duration of the intervention as they ranged 3 – 24 weeks with the longer, 24-week interventions reporting moderate-large improvements in self-efficacy (Dallow & Anderson, 2003; Lewis et al., 2013; Steeves et al., 2016), compared to the shorter interventions. Given the important role of self-efficacy for PA (Ashford et al., 2010), further research on goal setting and self-efficacy in PA is warranted, including in relation to the effects of goal setting on multiple types of self-efficacy depending on the stage of a goal-setting intervention (e.g., initiation and maintenance; Conner, 2008).

As goal setting is a strategy for increasing motivation (Lunenburg, 2011), it was surprising that the one study reporting motivation reported negligible, non-significant effects of specific goals on five types of motivation (Prestwich et al., 2017). Future studies should compare the level of motivation that could be provided from different goal types to explore the relationship between goal content and motivation further. Enjoyment of PA can facilitate continued participation and adherence (Wankel, 1993), and the two studies that examined the effects of specific goals on enjoyment (Miragall et al. [2018]; Rovniak et al. [2005]) showed moderate increases in enjoyment. As enjoyment could result in maintained behaviours (Wankel, 1993), there is tentative evidence suggesting that specific goals produce greater enjoyment of PA over time versus no goal. However, based on the small amount and low quality of evidence available, further research that examines the effects of specific goals and other goal types on enjoyment, as well as other affective outcomes (e.g., affective response), is needed.

Overall, the findings of this review show that specific goals may bring about changes in PA, yet minimal changes in psychological outcomes. This is both concerning, given the high use of specific goals within the papers reviewed and popularity of these goal types more generally, and important, because if individuals using goals to enhance PA have a positive psychological experience, there may be benefits for adherence to interventions and long-term behaviour change. Therefore, this review provides the impetus for future research to compare how other goal types (e.g., nonspecific goals) impact on psychological outcomes such as self-efficacy, motivation, well-being, and enjoyment. Such lines of inquiry would offer a more holistic understanding of the effects of goal setting for PA behaviour change in insufficiently active adults.

3.4.3 Strengths and Limitations

This review has made a valuable contribution to knowledge of goal setting for insufficiently active adults and has several strengths. To the best of our knowledge, this review is the first to synthesise the literature on goal setting for PA and psychological outcomes specifically in a population of insufficiently active adults. While it could be claimed this limits the generalisability of the findings, we consider this to be a strength as there have been calls to shift away from one-size-fits-all approaches to goal setting in PA (e.g., McEwan et al., 2016; Swann & Rosenbaum, 2018; Swann et al., 2022). Therefore, the focussed nature of the review on insufficiently active populations means our findings may be useful to inform future practice, recommendations, and research by highlighting the benefits, or lack thereof, for specific-goal-setting interventions for PA and psychological outcomes specifically within this population. Additionally, by examining both PA and psychological outcomes concurrently, our review extends the current literature and may be useful in highlighting ways in which future research can promote both initial engagement in PA interventions *and* long-term PA adherence.

Despite these strengths, there were some limitations. First, when interpreting the results of the review, it important to acknowledge problems within the included studies, including heterogeneity in the measures used. Second, alongside high heterogeneity, the risk of bias was judged to be high overall for the RCTs, and moderate for non-randomised trials. Together, high heterogeneity and high risk of bias raise doubts about the quality of evidence, thus highlighting the importance of further, high-quality studies in this area. Third, the number of included studies may be too low to provide significantly, distinguishable differences in the outcomes of interest. Fourth, unlike McEwan et al. (2016), it was not possible to make comparisons between goal types (i.e., specific vs. vague) given that specific goals were only compared to no goal or baseline. Future studies should look to compare specific goals alongside other goal types in insufficiently active adults. Lastly, the authors acknowledge there may be many factors external to the goal that influence psychological outcomes over a period of time (e.g., social, economic or environmental hardship; WHO, 2022). Although this review has attempted to isolate the effects of the intervention on psychological outcomes, the findings are only as certain as those reported in the included studies.

3.4.4 Conclusion

In conclusion, this systematic review and meta-analysis offers new insights into the effects of goal setting on PA and psychological outcomes in insufficiently active adults. While doing so, it highlights a range of directions for future research. The benefits of goal setting and, more precisely, specific goals for insufficiently active individuals for improving PA versus no goals are evident. However, this review indicates a lack of evidence to suggest that specific goals produce increases in PA *and* adaptive psychological outcomes, which raises important questions about the use of this goal type to promote long-term PA adherence. A range of goal types, and individual goal preferences should be included in future interventions to provide information regarding the most beneficial goal type for insufficiently active adults PA and allow for the effects of specific and other goal types on PA and psychological outcomes to be compared over time.

CHAPTER 4: THE ASSOCIATION BETWEEN PHYSICAL ACTIVITY GOAL-SETTING PRACTICES OF ADULTS ON PHYSICAL ACTIVITY AND MENTAL WELL-BEING: A CROSS-SECTIONAL EXAMINATION[15]

Goal Setting Theory is widely used across many contexts (e.g., business and sport). However**,** the applicability and efficacy of this theory, and its moderators, is still to be tested in a PA context. A cross-sectional survey assessing the relationship between goal-setting practices in line with Goal Setting Theory, PA, and mental well-being was completed by adults aged 18-64 years old ($N = 309$; $n_{\mathrm{Male}} = 130$; $n_{\mathrm{Female}} = 179$). Regression analysis showed that MVPA ($F[11,297] = 3.43$, $p < .001$; $\Delta R^2 = .08$) was positively predicted by complexity of the task ($\beta = .16$, $p = .02$), but no other variables. Mental well-being ($F[11,297] = 2.63$, $p = .003$; $\Delta R^2 = .06$) was positively predicted by challenge/difficulty of the goal ($\beta = .16$, $p = .04$) and by receiving feedback on the goal ($\beta = .17$, $p = .02$), but negatively predicted by the complexity of the goal ($\beta = -.14$, $p = .04$). This study questions the efficacy of the proposals within Goal Setting Theory when pursuing PA goals.

Keywords

Well-being, self-efficacy, active, inactive, motivation

[15] This chapter has been written in the format for publication in the Journal of Sport Sciences.

4.1 Introduction

PA can benefit both physical and mental health (see reviews by Mahindru et al., 2023 and Warburton et al., 2006). Yet over one-third of the global population are considered to be insufficiently active and are not completing the recommended amount of PA (Guthold et al., 2018) of 150-minutes of moderate activity or 75-minutes of vigorous activity per week (WHO, 2020). If current inactivity levels do not decrease, the prevalence of preventable non-communicable diseases are anticipated to rise by 499.2 million cases by 2030 (Santos et al., 2023). As current strategies to improve PA are clearly not sufficient (Brannan et al., 2019), we need to develop greater understanding of how behaviour change strategies and tools can be employed to target insufficiently active populations.

One of the most popular behaviour change tools for PA promotion is goal setting (Howlett et al., 2019), where goals are defined as the target or objective of an individual's actions (Locke et al., 1981). GST (Locke & Latham, 1990a) is a theory of motivation, widely used across many contexts, including business (Locke & Latham, 1990a), sport (e.g., Jeong et al., 2023), and health (e.g., Strecher et al., 1995), with over 1,000 studies based upon it (Mitchell & Daniels, 2003). Within GST, Locke and Latham (1990a) proposed that a linear relationship exists between specific, challenging goals and performance; thus, the more challenging and specific a goal is, the better the performance. However, it is also suggested that these types of goals should be avoided by individuals without prior knowledge and skill to achieve them (Seijts et al., 2013), such as insufficiently active individuals initiating PA behaviours.

GST (Locke & Latham, 1990a) proposes that goals work in four ways, otherwise referred to as the mechanisms of goal pursuit. First, goals aid pursuit of an outcome by improving attentional focus and directing attention to appropriate goal related stimuli. Second, goals stimulate an individual's efforts towards a desired aim or objective, which can contribute to higher success. Third, goals provide the means for an individual to persist at goal pursuit for longer and through adversities. Finally, goals allow an individual to identify and implement relevant strategies, founded on the prior knowledge and skill an individual possesses.

For the aforementioned mechanisms of GST to be activated, there are proposed to be several moderators that must be satisfied for a goal to be achieved. Accordingly, within GST, ability, feedback, commitment, complexity and affect are postulated as moderating variables of goals. First, ability can influence the goal chosen for pursuit (Locke & Latham, 1990a). An individual can only pursue a goal where their perceived ability matches the knowledge and skill required to achieve it (Locke & Latham, 2013). Not only must an individual possess the appropriate ability for goal pursuit, but they must also have belief that achieving the goal is within their capabilities (i.e., self-efficacy; Locke & Latham, 2013). A second moderator is feedback (Locke & Latham, 1990a), which enables individuals to track progress towards goal pursuit and adjust efforts and strategies appropriately, which then allows goals to better regulate performance (Latham, 2016). Commitment to a goal is a third moderator, whereby if an individual is not adequately committed to a goal, one's actions for goal pursuit will not be affected (Latham, 2016). Commitment is particularly important in the pursuit of behaviours such as becoming physically active as it is a behaviour requiring repeated engagement as opposed to a one-time task. A final moderator is task complexity, for simpler tasks in which an individual possesses the adequate knowledge, ability and skill to be successful, it can result in better performance in goal pursuit than more complex tasks (Locke & Latham, 2013). Collectively, it is proposed that all moderators must be satisfied to lead to goal success (Locke & Latham, 1990a).

Although well established, there are several critiques of GST that limit the applicability of it for PA, particularly when those engaging in and using PA goals are new to the behaviour. Firstly, for PA there have shown to be no differences in outcomes, such as walking, when a specific goal is set compared to a vague goal (McEwan et al., 2016), therefore questioning the need for specific goals in this population. Secondly, as specific, challenging goals are suggested to guide attentional focus towards a desired outcome, this could narrow attentions to the extreme, such that those new to a behaviour become too focused on a specific outcome and do not acquire relevant knowledge and skills that can contribute to long-term behaviours, which in the early stages are important (Trumpower et al., 2004). In this instance, the theory suggests replacing specific, challenging goals with learning goals (e.g., focussing on strategy development), although these are sparsely tested in PA research. Additionally, setting specific, challenging goals when an individual does not have sufficient levels of ability required for goal pursuit can be detrimental to performance and should be avoided (Williams, 2013), which could be the case for those new to PA behaviours. In addition to the moderator of ability, task complexity is also an area that has been critiqued as PA is high in component, coordination, and dynamic complexity and so specific goals could be detrimental for those new to PA (Swann & Rosenbaum, 2018). In relation to GST, specific goals may not be preferable, providing further reasons as to why such goals might not be the most appropriate for new exercisers. To conclude, when considered theoretically in a PA context, the efficacy of GST is debatable. As such, there is a need to test the practicality of the theory for individuals in regard to their PA level, to identify the suitability and benefits for those at different engagement levels.

Although specific goals have been widely tested in PA contexts (see reviews by Garstang et al., 2024 & McEwan et al., 2016), research has predominantly focused on setting specific goals for physical objective outcomes and has failed to consider the effects had on an individual's mental well-being during goal pursuit (Garstang et al., 2024). As mental well-being is strongly correlated with higher rates of adherence to PA (Salmon et al., 2019), there is value in understanding how different goal components might impact mental well-being, alongside PA, to inform future participation and long-term adherence. Further, how an individual perceives a goal can affect not only goal-related performance, but also well-being (Ntoumanis et al., 2014b), which could in turn directly and indirectly effect re-engagement in PA behaviours. Given the importance of mental well-being, to date, few studies have actually tested elements of GST, particularly for PA and psychological outcomes like well-being (Swann et al., 2023). Therefore, further research is needed to establish to what extent GST is applicable in this context.

Therefore, the aim of this study was to examine the relationship between goal setting practices in relation to the moderators, mechanisms and propositions as outlined in GST (Locke & Latham, 1990a; 2002) and their PA and mental well-being. Specifically, we sought to answer the following two research questions: (1) is there a relationship between an individual’s goal-setting practices (i.e., preferences, how they set goals) and PA levels?; and (2) is there a relationship between an individual’s goal-setting practices (i.e., preferences, how they set goals) and perceived mental well-being? Based on the literature, we anticipated that we could find support for one of two competing sets of hypotheses. On the one hand, based on GST, we hypothesised that (H1): the more an individual's use of goal setting aligns with GST moderators, mechanisms and propositions, the higher an individual's PA levels will be; (H2): the more an individual's practices align with GST moderators, mechanisms, and propositions, the higher an individual's perceived mental well-being will be. On the other hand, given the heavy critique of GST for PA goals, we equally expected that we may find support for the null hypotheses and that there would be no relationship between GST's moderators, mechanisms and propositions and PA levels and perceived mental well-being.

4.2 Methods

4.2.1 Participants

Following ethical approval (Nottingham Trent University Non-invasive Human Ethics Committee, ref: 20/21-97), data were collected via an online survey open to adults aged 18-64 years old in the UK. The survey was distributed via social media, researcher contacts and university platforms. In total, 368 responses were recorded between June 2021 and February 2023.

4.2.2 Procedure

After receiving ethical approval, a JISC online survey was distributed through social media, posters, and word of mouth. After reading the information sheet and providing informed consent, respondents were asked to complete sets of questions in the following order: demographics, current PA levels, mental well-being, affective exercise experiences, motivation, self-efficacy, goal setting practices and goal motives. The average duration to complete the survey was 30.14 minutes, and respondents did not receive any compensation for participating. This paper is the first of two, with the variables presented in this paper being PA levels, mental well-being and goal setting practices; the remaining data will be presented in Chapter 5.

4.2.3 Measures

4.2.3.1 International Physical Activity Questionnaire Short Form (IPAQ-short form)

The IPAQ-short form (Craig et al., 2017) was used as a valid measure to calculate total moderate-vigorous PA time (MVPA), with very good internal consistency ($\alpha = .80$). Questions were asked in relation to days per week of moderate and vigorous activity, and average minutes on a single day spent doing this level of activity. The total minutes of moderate and vigorous activity were then scored independently and summed to provide a total minutes of MVPA score.

4.2.3.2 Short Warwick-Edinburgh Mental Wellbeing Scale (SWEMWBS)

The SWEMWBS (Tennant et al., 2007) was used to collect perceptions of mental well-being as it is a valid measure for use in the general population (Ng Fat et al., 2017), with very good internal consistency ($\alpha = .89$; Stewart-Brown et al., 2011); permission was sought prior to data collection for the use of the measure. The measure consists of seven statements relating to the respondents' thoughts and feelings over the past two weeks. Participants were asked to score each statement on a 5-point Likert scale (*1 = None of the time; 2 = Rarely; 3 = Some of the time; 4 = Often;* and *5 = All of the time*). The sum of the items was totalled and converted, with higher scores interpreted as indicative of higher positive mental well-being.

4.2.3.3 Goal Setting Practices

As there is no standardised measure of goal-setting practices related to GST, 11 single items were developed (Table 9) to assess participants' goal setting practices in line with the proposed goal content, moderators and mechanisms in GST (Locke & Latham, 1990a; 2002). Participants were asked to score these on a 5-point Likert scale (*1 = Disagree, 2 = Somewhat disagree, 3 = Neither agree nor disagree, 4 = Somewhat agree,* and *5 = Agree*).

Table 9

Items Measuring the Goal Content, Mechanisms and Moderators of Goal Setting Theory

Goal Setting Practices	Item
Goal Content	
Clear/Specific	"I like to have clear, specific goals when taking part in physical activity"
Challenge/Difficulty	"I like to set myself challenging/difficult goals for physical activity"
Mechanisms	
Direction	"Goals give me direction when taking part in physical activity"
Effort	"Goals increase my effort when taking part in physical activity"
Persistence	"Goals give me greater persistence during physical activity"
Strategy	"I use goal setting as a strategy to be more physically active"
Moderators	
Commitment	"I am more physically active when I am committed to the goal"
Importance	"I am more physically active when the goal is important to me"
Belief	"I have greater belief that I can be physically active when I set goals"
Feedback	"I like to receive feedback on my physical activity goals"
Complexity	"My physical activity goals are made up of complex tasks"

4.2.4 Analysis strategy

SPSS Version 28 was used for data analysis. The survey responses were first screened for missing data, poor responses, and ineligible respondents, before being screened for univariate and multivariate outliers using SPSS. Descriptive statistics including participant gender and age were presented prior to statistical analysis. To analyse data, two hierarchical regressions were performed, one for MVPA and one for mental well-being. For both hierarchical regressions, step 1 included the goal content items (1-2), step 2 included the mechanisms of GST (3-6), and step 3 included the GST moderators (7-11). An R^2 was reported to test for model fit and was reported between 0 and 1. Values closer to '1' were considered more indicative of an ideal model fit (Hagquist & Stenbeck, 1998).

4.3 Results

Of the 368 responses, 59 were excluded through the screening process. The remaining 309 were used in the analysis (Male = 130, M_{age} = 31.61 ± 13.03; Female = 179, M_{age} = 33.11 ± 13.19; Table 10).

Table 10

Descriptive statistics of included variables

	Score	
	Range	Mean (SD)
Clear/Specific	1-5	3.67 (0.98)
Challenge/Difficulty	1-5	3.49 (1.01)
Direction	1-5	3.73 (1.02)
Effort	1-5	3.84 (1.02)
Persistence	1-5	3.83 (1.01)
Strategy	1-5	3.51 (1.11)
Commitment	1-5	3.96 (0.93)
Importance	1-5	4.20 (0.79)
Belief	1-5	3.82 (0.93)
Feedback	1-5	3.30 (1.24)
Complexity	1-5	2.58 (1.10)
Physical Activity (MVPA; minutes)	-	264.49 (316.24)
Mental Well-being (SWEMWBS)	7-35	22.09 (3.50)

Note. MVPA = Moderate Vigorous Physical Activity; SWEMWBS = Short Warwick-Edinburgh Mental Wellbeing Scale

4.3.1 Moderate-Vigorous Physical Activity

Results for the hierarchical multiple regression analyses of the relationship between the goal content, mechanisms and then moderators of GST (Locke & Latham, 1990a; 2002) and PA are presented in Table 11.

Table 11

Hierarchical Multiple Regression Model Fit for the Association of MVPA and Goal Setting Theory

	MVPA					
	Model 1		Model 2		Model 3	
Variable	*B*	β	*B*	β	*B*	β
Constant	-58.23		-103.40		-231.19*	
Clear/Specific	38.18	.12	26.56	.08	17.80	.06
Challenge/Difficulty	52.30*	.17*	42.86	.14	24.83	.08
Direction			-9.34	-.03	-21.66	-.07
Effort			71.32*	.23*	50.34	.16
Persistence			0.45	.00	1.16	.00
Strategy			-34.02	-.12	-46.93	-.16
Commitment					28.31	.08
Importance					53.40	.13
Belief					-12.96	-.04
Feedback					-3.65	-.01
Complexity					45.51*	.16*
R^2_{adj}	.06		.08		.11	
F_{adj}	10.14**		4.64**		3.43**	
ΔR^2	.06		.07		.08	
ΔF	10.14**		1.84		1.90	

Note. N = 309. *p < .05, **p < .001; B = Unstandardised Regression Coefficient; β = Standardised Coefficient; F = Variation of Dependent Variable; F = Change in Variation of Dependent Variable; R^2 = Coefficient of Determination; ΔR^2 = Adjusted R^2.

The full model (Model 3; Table 11) was a better fit than the first two models, and was statistically significant, R^2 = .113, $F(11,297)$ = 3.43, p < .001; adjusted R^2 of .08; Durbin Watson = 1.87.

Complexity was the only predictor in model 3 that was significantly related to MVPA (β = .16, p = .02; Table 11). Although MVPA was positively related to the challenge/difficulty of goals in model one (β = .17, p = .01) and MVPA was positively related to the perception that goals result in greater efforts for MVPA in model two (β = .23, p = .045), this finding was not consistent when all three levels of independent variables were accounted for in model three. Overall, model 3 explained 11% of the variance in MVPA.

4.3.2 Mental Well-being

Results for the hierarchical multiple regression analyses of the relationship between the goal content, mechanisms and then moderators of GST (Locke & Latham, 1990a; 2002) and mental well-being are presented in Table 12.

Table 12

Hierarchical Multiple Regression Model Fit for the Association of Mental Well-being and Goal Setting Theory

	Mental Well-being					
	Model 1		Model 2		Model 3	
Variable	*B*	β	*B*	β	*B*	β
Constant	20.21**		19.71**		19.76**	
Clear/Specific	-0.20	-.06	-0.35	-.10	-0.42	-.12
Challenge/Difficulty	0.75*	.22*	0.62*	.18*	0.56*	.16*
Direction			-0.05	-.02	-0.27	-.08
Effort			0.75	.22	0.66	.19
Persistence			-0.14	-.04	-0.19	-.06
Strategy			-0.18	-.06	-0.17	-.05
Commitment					0.13	.03
Importance					-0.34	-.08
Belief					0.57	.15
Feedback					0.48*	.17*
Complexity					-0.45*	-.14*
R^2_{adj}	.04		.05		.09	
F_{adj}	5.90*		2.85*		2.64*	
ΔR^2	.03		.04		.06	
ΔF	5.90*		1.31		2.31*	

Note. N = 309. *$p < .05$, **$p < .001$; B = Unstandardised Regression Coefficient; β = Standardised Coefficient; F = Variation of Dependent Variable; ΔF = Change in Variation of Dependent Variable; R^2 = Coefficient of Determination; ΔR^2 = Adjusted R^2.

The full model (Model 3) significantly explained the variance in well-being, $F(11,297)$ = 2.64, p = .003; adjusted R^2 of .06; Durbin Watson = 1.90. Mental well-being was related to three variables (see Table 12); mental well-being was positively related to the challenge/difficulty of the goal (β = 16, p = .04) and by receiving feedback on the goal (β = .17, p = .02), but negatively related to the complexity of the goal (β = -.14, p = .05). Overall, model 3 explained 9% of the variance in mental well-being.

4.4 Discussion

This is the first study to examine the relationship between goal setting practices (i.e., preferences, how they set goals) in relation to the moderators, mechanisms and propositions as outlined in GST (Locke & Latham, 1990a; 2002) and their PA and mental well-being to answer if: (1) there is a relationship between an individual's goal-setting practices and PA levels?; and (2) there is a relationship between an individual's goal-setting practices and perceived mental well-being?. It was hypothesised that the more an individual's practices (i.e., preferences, how they set goals) align with GST moderators, mechanisms and propositions, the higher an individual's (H1) PA levels and (H2) perceived well-being will be. Regression analysis, which used MVPA and mental well-being as the outcome variables, found that only three elements of GST were associated with measured outcomes, rejecting the hypotheses. Thus, the findings of this study largely support recent queries over the applicability of GST in PA contexts (Swann & Rosenbaum, 2018; Swann et al., 2021), particularly in regard to PA and mental well-being outcomes measured in this study.

For both the MVPA and mental well-being models, the GST variables were categorised into three groups of independent variables (Goal Content, Mechanisms and Moderators). Although still small, the model fit increased from the first and second model accounting for 11% of the variance for MVPA, and 9% for perceived mental well-being questioning the support of GST for PA goal pursuit. MVPA was positively related to task complexity, and mental well-being was negatively related to task complexity, and positively related to feedback and the challenge/difficulty of the goal.

Overall, H1 was not accepted as only task complexity, where individuals reported that their "PA goals are made up of complex tasks", was related to MVPA. In other words, the more complex an individual's PA goal, the more total MVPA minutes reported. Swann and Rosenbaum (2018) assessed PA to be a complex task due to its high degree of component (amount of stimuli to attend to at once), coordination (sequencing and coordination of said stimuli) and dynamic complexity (need to alter strategies; Drach-Zahavy & Erez, 2002). In addition, Locke & Latham's GST states that only those with sufficient capabilities should pursue complex tasks (2013). In line with these propositions, the findings of this study may suggest that complex goals are only set for PA by those who are more active thus supporting theorised assumptions, and those with lower MVPA levels avoid them.

Greater support was found for the second model as three of the 11 GST (Locke & Latham, 1990a) variables were related to mental well-being. Similar to MVPA, complexity of the task was significantly related to well-being. However, contrastingly, greater perceived task complexity was negatively associated with mental well-being. In other words, the more PA goals are made up of complex tasks, the lower an individual perceived their mental well-being to be. Although this relationship needs further exploration in future research, this finding could be explained by the increased mental toll of complex tasks, especially in regard to dynamic complexity where an individual is required to alter strategies even if there is a negative consequence such as increased anxiety (Drach-Zahavy & Erez, 2002). Furthermore, in an education (e.g., Barbayannis et al., 2022) and business context (e.g., Priya et al., 2023), stress has shown to be significantly negatively correlated with mental well-being, however it should be noted that task complexity was not considered in these studies. Therefore, it is plausible that the higher levels of stress that may be experienced during a complex PA task could result in poorer mental well-being outcomes as shown in this study.

In addition to the complexity of a task, this study also showed that mental well-being was significantly and positively related to preferring to receive feedback on goal pursuit, and to preferring to set challenging, difficult goals It is suggested in GST that challenging, specific goals may be detrimental for performance if set during newer behaviours (Latham & Locke, 1991), but not all respondents in this study reported having low MVPA. Individuals may enjoy the pursuit of more challenging goals as it could increase satisfaction when achieved (Locke & Latham, 1990b). This increased satisfaction could contribute to one's overall needs satisfaction, which when satisfied, can result in an individual being more autonomously driven for a behaviour (Deci & Ryan, 1985; Sheldon & Elliot, 1999), which is linked to mental well-being (Hortop et al., 2013).

Interestingly, individuals did not prefer to set specific goals as this showed to have no relationship with either MVPA or mental well-being. Specific goals have been shown to be effective for PA, but alternative goal types are underexplored (see reviews by Garstang et al., 2024 and

McEwan et al., 2016). Furthermore, the current study found no relationship between MVPA and the best practice goal type (Swann et al., 2023), thus questioning the relevance of specific goals to those pursuing PA goals. In addition, there was no relationship between the four mechanisms proposed in GST and our outcomes of MVPA and mental well-being. Items representing these mechanisms were generalised to goal setting and not to specific, challenging goals, yet goals providing direction, increasing efforts and persistence, and enabling the use of appropriate strategies for PA behaviours as suggested in GST (Locke & Latham, 2013) was not significantly important for MVPA or mental well-being. Therefore, suggesting that goals for PA may not work in the same way as proposed in GST.

4.4.1 Limitations and Future Directions

There are limitations that should be considered when interpreting the findings of this study. First, this study was open for a period of 22-months from the end of a COVID-19 lockdown period through to a time of no COVID-19 restrictions. During this timeframe individuals may have engaged in varying levels of activity compared to their 'norm' and so findings may differ as a result. Second, as no validated measure was available to test propositions within GST, single-item questions were used to capture individual components of the theory, however they have not been validated. Future research should focus on testing these individual components using more comprehensive measures (e.g., General Self-Efficacy Scale [Schwarzer & Jerusalem, 1995]) to explore these in more detail. Thirdly, the study design was cross-sectional, so causal relationships cannot be established. Thus, further investigations using more advanced research designs are needed to enable inferences about causality. Lastly, the questions reference PA, which has different outcomes (e.g., participation and adherence) compared to business and sport (e.g., performance and targets). Thus, providing context specific evidence for the relevance of GST in PA contexts which has previously been suggested but not tested (Swann et al., 2021). Therefore, the generalisability of these findings is limited to a PA context. It would be of interest to examine elements of GST in different contexts to assess its efficacy and applicability considering its wide use.

4.4.2 Conclusion

This is the first study that the researchers are aware of that has tested how the propositions, moderators, and mechanisms of GST are used in practice by individuals and the relationship with PA levels and mental well-being. Specific, challenging goals were not significantly associated with higher levels of PA as GST would suggest. Further research is warranted to compare alternative types of goals that could help individuals to become more active. In conclusion, goal setting practices of individuals for PA do not seem to align with GST, and further research into the individual components in a PA context could extend our understanding further.

CHAPTER 5: PSYCHOLOGICAL MEDIATORS OF THE RELATIONS BETWEEN GOAL MOTIVES, PHYSICAL ACTIVITY AND WELL-BEING: TESTING A MODEL OF PATH ANALYSIS[16]

The autonomous and controlled motivations underpinning goal pursuit directly impact PA and mental well-being and are important for healthy behaviour adherence. Psychological variables can also affect PA and mental well-being. This study tested the association between goal motives, psychological variables, PA, and mental well-being using structural equation modelling. Adults[17] (*N* = 323; M_{age} = 32.46 ± 13.12y) completed a cross-sectional survey measuring goal motives, motivation, affective experiences, self-efficacy, PA, and mental well-being. Our analysis showed support for the proposed model fit: ($\chi 2$ (6) = 14.16, p = .028, RMSEA = .07, CFI = .99, TLI = .97). In contrast to controlled goal motives, autonomous goal motives were positively related to the psychological variables associated with PA and mental well-being. Motivation and affective experiences were positively associated with PA. Self-efficacy was positively associated with mental well-being. Intricacies of the associations between goal motives, psychological variables, PA, and mental well-being are discussed.

Keywords

Motivation, exercise, self-efficacy, affect, well-being, goal pursuit

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[17] *Note.* This study reports findings from the same sample population reported in Chapter 4, however different variables are included and presented.

5.1 Introduction

Higher levels of sedentary behaviour and lower levels of PA are associated with increased risks of health issues and mortality (Hechanova et al., 2017). When aiming to increase an individual's long-term engagement in PA, it is also important to consider relationships with mental well-being, defined as a combination of feeling good and functioning effectively (Stewart-Brown et al., 2009). Greater mental well-being can predict repeated, continuous PA behaviours (Rector et al., 2019) and is considered fundamental for optimal physical health (Biddle and Mutrie, 2007). When seeking to promote mental well-being, health and exercise practitioners are usually encouraged to help individuals set PA goals (e.g., Cooper, 2020). Goal setting is a widely used and effective technique for increasing PA (Howlett et al., 2019; McEwan et al., 2016). Although goals people set are underpinned by motives (Sheldon and Elliot, 1999), many goal-setting interventions fail to consider the underlying reasons for engaging in specific behaviours, the psychological variables that may influence these, and relationships with mental well-being. Therefore, this study examined how motives underpinning goal pursuit were associated with PA and mental well-being.

In the self-concordance model (SCM), Sheldon and Elliot (1999) proposed well-being as the main outcome of goal striving. Within the SCM, two overarching goal motives are proposed: autonomous goal motives (i.e., motives that hold intrinsic value and are of personal interest to the individual); and controlled goal motives (i.e., an individual feels compelled to do something due to internal or external pressures). Both goal motives can be powerful drivers of goal striving, but the long-term impacts of these goal motives can vary. Controlled motives may initially change behaviours yet are unlikely to result in long-term behaviour change as the effort invested in goal pursuit can fade over time (Sheldon and Elliot, 1998). Furthermore, controlled motives are negatively related to perceived mental well-being (Briki, 2016; Ng et al., 2012) and unrelated to moderate-intensity PA (Standage et al., 2008) and the maintenance of healthy behaviours (Ng et al., 2012).

In contrast, goals pursued with autonomous motives have not only been linked to achievement of desired outcomes, but also to improved well-being (Ntoumanis et al., 2014) and more generally to psychological health (Deci and Ryan, 2008). Furthermore, all forms of autonomous regulation can predict exercise and PA participation (Teixeira et al., 2012), highlighting the potential benefits of more self-concordant and autonomous goals for long-term PA adherence. While researchers have assessed the direct effects of goal motives on exercise and PA (Teixeira et al., 2012), there is limited understanding of how the effects of goal motives on PA and mental well-being might be mediated via other psychological variables. Thus, further research is needed to better understand how different psychological variables relate to individuals' goal motives for PA, and the subsequent impacts upon long-term PA adherence and overall mental well-being.

One of the most important correlates of PA behaviour is self-efficacy (Bauman et al., 2012). In the context of PA promotion, researchers have found that self-efficacy is positively associated with increased vigorous-intensity PA (Sallis et al., 1989), decreased sedentary behaviour (Szczuka et al., 2021), and is a strong predictor of exercise behaviours for those in the initial stages of starting to be physically active (McAuley and Blissmer, 2000). In turn, this suggests that self-efficacy could play a vital role in one's intent and pursuit of long-term PA behaviours. Despite suggestions that individuals who pursue more self-concordant goals are more likely to feel more competent and effective (Sheldon and Elliot, 1999), research is needed to empirically examine the relationship between goal motives and self-efficacy in the context of PA.

Motivation is another psychological variable that has been shown to be a direct determinant of behaviour (Knittle et al., 2018), including prolonged PA (≥10 weeks; Wilson and Rogers, 2007). While there are many types of motivation (Ryan and Deci, 2017), it is generally accepted that more self-determined motivation is more likely to lead to behavioural adoption and maintenance (Weman-Josefsso et al., 2015). In terms of PA behaviour, research shows that autonomous motivation, and more specifically integrated motivation, is particularly influential for promoting PA (Sevil et al., 2015). These findings suggest that autonomous forms of motivation are key for PA behaviours, but further research is needed to understand how goal motives are related to motivation for PA, and the subsequent influence on mental well-being.

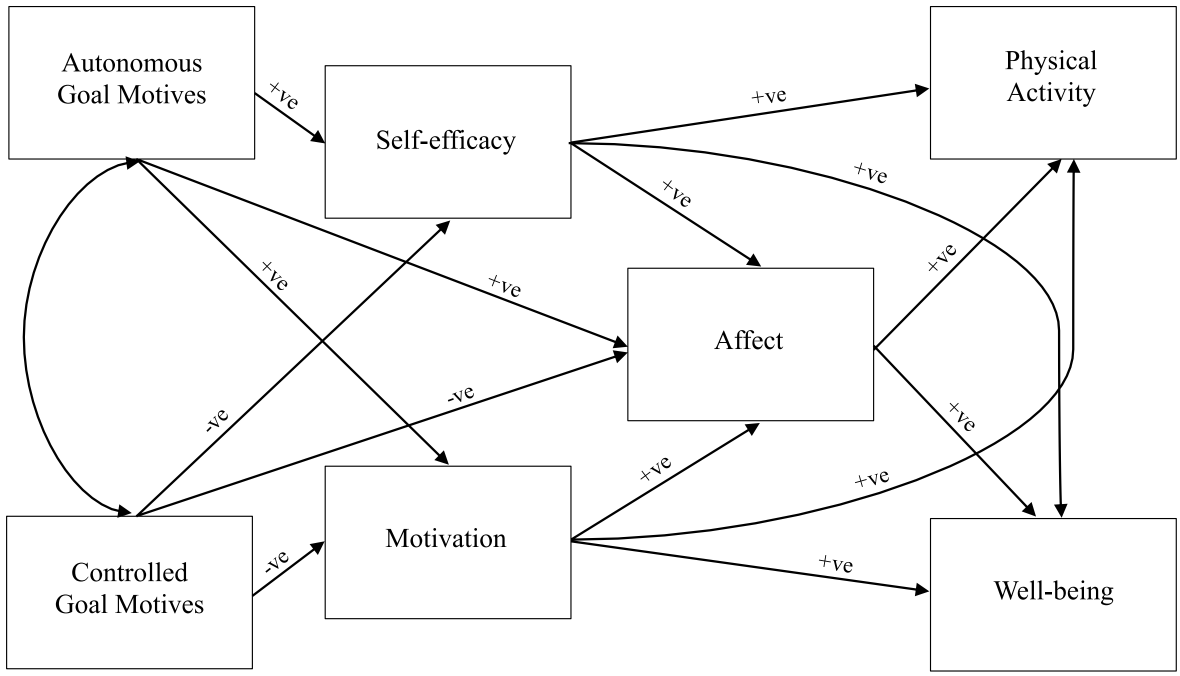
Finally, in recent years, there has been increased recognition of the importance of affective experiences in promoting PA (Ekkekakis and Zenko, 2016). When individuals experience more pleasure in PA, they are more likely to approach this behaviour again in future, whereas unpleasant experiences are more likely to lead to avoidance behaviours (Ekkekakis and Brand, 2019). Therefore, it is proposed that if an individual has an unpleasant affective experience with PA, this could lessen the likelihood of them engaging in PA (Ekkekakis et al., 2021) and thus negatively impact their perceived mental well-being. While evidence continues to accumulate on the relationship between affective experience and PA behaviours, further research is needed to examine whether different goal motives for PA elicit different affective experiences in PA, and how these experiences might subsequently be related to PA behaviours and mental well-being.

In this study, we aimed to enhance understanding of the influence goal motives have on psychological variables associated with PA (i.e., self-efficacy, motivation, and affect), PA, and mental well-being in adults, and examine the relationships between these variables. In addressing this aim, we sought to answer the following questions: (a) are psychological variables (self-efficacy, motivation, and affect) associated with increased PA and improved mental well-being linked to one's motives for pursuing PA goals?; (b) how do self-efficacy, motivation, and affective exercise experiences link to PA and mental well-being?; and (c) how do these psychological variables (self-efficacy, motivation, and affect) mediate the relationship between motives for PA and both PA and mental well-being?

We hypothesised that: (H1) goal motives would be directly associated with self-efficacy, motivation, and affective exercise experiences, and expected autonomous motives to show positive associations, and controlled motives to have negative associations; (H2) self-efficacy, motivation, and affective exercise experiences would be directly, positively associated with PA and mental well-being; and (H3) goal motives would be indirectly associated with PA and mental well-being via self-efficacy, motivation and affective exercise experiences. Therefore, in our proposed model (Figure 7), we suggested that the motives underpinning PA goals would not be directly related to PA and well-being; instead, we hypothesised that one's belief in their ability to achieve the goal, the quality of motivation one has striving for the goal, and their affective exercise experiences should be considered, in addition to goal motives, when examining factors related to PA and perceived well-being. The effect of these autonomous and controlled motives on self-efficacy, motivation, and affective exercise experience, in turn, was posited to influence PA behaviours and perceived mental well-being. By considering how goal motives might be related to both PA and mental well-being together, we sought to develop evidence that could provide a platform to enhance goal-setting interventions in future.

Figure 7

Conceptual model of the associations between goal motives, psychological variables, physical activity and well-being



Note. +ve predicted a positive association; -ve predicted a negative association.

5.2 Methods

5.2.1 Participants

A total of 368 individuals completed an online survey on a single occasion. This sample size was accepted based on the *N*:q ratio, minimum recommendation of 20:1 (participants:parameter), suggestive that a minimum sample of 140 participants was required to perform the analysis (Kline, 2016; Kyriazos, 2018). Individuals were all living in the United Kingdom at the time of completing the survey. Responses were recorded between June 2021 and February 2023.

5.2.2 Procedure

After receiving ethical approval (ID: 20/21-97), a JISC online survey was distributed through social media, posters, and word of mouth. After reading the information sheet and providing informed consent, respondents were asked to complete sets of questions in the following order: demographics, current PA levels, mental well-being, affective exercise experiences, motivation, self-efficacy, and goal motives. The average duration to complete the survey was 30.14 minutes, and respondents did not receive any compensation for participating.

5.2.3 Measures

5.2.3.1 Goal Motives

To measure goal motives, we utilised a 4-item questionnaire that has been used in prior research (Sheldon and Elliot, 1999). Participants were asked to identify a PA goal (e.g., "to stay healthy and fit" or "to feel mentally sharp") and to rate the extent to which the four items represented their motives for goal pursuit on a 7-point Likert scale ranging from 1 (*Not at all*) to 7 (*Very much so*). The four items were divided into two subscales, representing the two overarching motives: autonomous goal motives ("*Because you personally believe it's an important goal to have*" and "*Because of the fun and enjoyment the goal provides you*") and controlled goal motives ("*Because someone else wants you to*" "*Because you would feel ashamed, guilty, or anxious if you didn't*"). Autonomous and controlled motives were scored by taking an average of the two responses relating to that subscale; the reliability of the subscales were very good ($\rho = .79$) and fair ($\rho = .36$) respectively.

5.2.3.2 Affective Exercise Experiences (AFFEXX)

Affective exercise experiences were measured using the AFFEXX questionnaire (Ekkekakis et al., 2021). For the purpose of this study, the single scale of 'antipathy-attraction' was used to represent affective experiences and one's desire to complete PA as it is ultimately influenced collectively by the antecedent and core variables of affective experiences that are stated in the measure. The scale is comprised of five items, where questions are phrased as pairs of opposites on a 7-point scale (e.g., *"Exercise is an uninviting activity" = 1 versus "Exercise is a tempting activity" = 7*). Higher scores corresponded with attraction, and lower scores corresponded to antipathy. These subscales were previously reported to correlate with self-reported moderate and vigorous PA and have demonstrated very good internal consistency scores (α = .92; Ekkekakis et al., 2022). In the current study, internal consistency of the antipathy-attraction subscale was very good (α = .88).

5.2.3.3 Behavioural Regulation in Exercise Questionnaire 3

Motivation regulations were measured using the BREQ-3 (Markland and Tobin, 2004; Wilson et al., 2006). The BREQ-3 is a multidimensional measure based on SDT literature offering scores for six subscales (‘amotivation’, ‘external regulation’, ‘introjected regulation’, ‘identified regulation’, ‘integrated regulation’, and ‘intrinsic regulation’) and a relative autonomy index (RAI) of self-determination. Each of the 24 items was scored on a 5-point Likert scale ranging from 0 to 4 (*0 = Not true for me; 1, 2 = Sometime true for me; 3, 4 = Very true for me*). An average score is calculated for each subscale, and then multiplied by its predisposed weighting, before summing the total weighted scores to provide a RAI score. The higher the score, the greater one’s autonomous motivation. The RAI score was used due to its practicality and ability to predict outcomes (Ryan and Deci, 2017). Various versions of the BREQ scale are consistently used in exercise contexts (Teixeira et al., 2012). The BREQ-3 captures a broader scope of subscales than the previous versions of the scale that compromise an overall scale of motivation and has displayed good internal consistency in adult populations (.66 ≤ α ≤ .75; Vancampfort et al., 2018). In the current study, internal consistency values for the BREQ-3 subscales were very good (.82 ≤ α ≤ .89).

5.2.3.4 Generalised Self-Efficacy Scale (GSE)

Self-efficacy was measured using the GSE (Schwarzer et al., 1995), which contained 10 items (e.g., “*I can always manage to solve difficult problems if I try hard enough*”) scored on a 4-point Likert scale (*1 = Not at all true; 2 = Hardly true; 3 = Moderately true; 4 = Exactly true)*. Self-efficacy was determined by a sum of all items; the higher the score, the higher an individual’s self-efficacy. The GSE has previously displayed very good internal consistency (α = .86; Sherer et al., 1982). In the current study, internal consistency of the GSE was very good (α = .88).

5.2.3.5 Short Warwick-Edinburgh Mental Wellbeing Scale (SWEMWBS)

Perceived mental well-being was captured using the SWEMWBS (Tennant et al., 2007). The SWEMWBS is made up of seven statements about the respondents’ feelings and thoughts over the past two weeks. Permission for use of the measure was sought prior to data collection. Respondents reported their answers on a 5-point Likert scale (*1 = None of the time; 2 = Rarely; 3 = Some of the time; 4 = Often; and 5 = All of the time*). The sum of the items is then scored and converted, with higher scores indicative of higher positive mental well-being. The SWEMWBS was selected due to its validity for use with the general population (Ng Fat et al., 2017) and its very good internal consistency (α = .89; Stewart-Brown et al., 2011). In the current study, internal consistency of the SWEMWBS was very good (α = .84).

5.2.3.6 International Physical Activity Questionnaire Short Form (IPAQ-short form)

Moderate-to-vigorous PA (MVPA) was captured using the IPAQ-short form (Craig et al., 2017). The IPAQ-short form was selected as total moderate and total vigorous activity time is scored in isolation to other types of activity and it has been shown to have a very good internal consistency (α = .80; Craig et al., 2017). Total minutes of moderate and vigorous activity was scored separately and summed to provide one minutes of MVPA score.

5.2.4 Data Analysis

SPSS Version 29 was used to screen the data for univariate and multivariate outliers and to produce descriptive statistics. Correlations were performed between all variables. To assess the co-variances between goal motives, the associated psychological variables, PA and well-being, structural equation model path analysis was performed using Amos Version 26 software (Arbuckle, 2019). Associations were characterised as follows: small, $\beta \leq 0.29$; moderate: $0.30 \leq \beta \leq 0.49$; and large $\beta \geq 0.50$ (Cohen, 1998; Fey et al., 2023). Absolute fit indices were used to determine the best model fit for the data. Hu and Bentler (1999) determined a model to be of good fit if chi-square (χ^2) was found to be non-significant, the absolute fit measure root mean squared error of approximation (RMSEA; Steiger, 1990) value was below .06, and relative fit measures of the Comparative Fit Index (CFI; Bentler, 1990) and the Tucker-Lewis Index (TLI; Tucker and Lewis, 1973) were $\geq$ .95 (Hu and Bentler, 1999). However, these indices are considered a guide, and not absolute values (Hu and Bentler, 1999). Gender was not controlled for as previous goal motive research found no gender differences (Ntoumanis et al., 2014; Sheldon and Elliot, 1999).

5.3 Results

5.3.1 Descriptive Statistics

Data were screened for partially completed and ineligible participant responses before being screened for outliers using univariate and multivariate screening. This resulted in data for 323 participants being used for analysis (M_{age} = 32.46 ± 13.12 years; n_{male} = 135, n_{female} = 188; Caucasian = 240, Black = 50 Asian = 17, Other = 11, Other = 16 ; Area: Suburban = 107, Urban = 127, Rural = 85, Other = 4; Occupation: Student = 129, Office/Desk role = 96, Teacher/Educator = 39, Other = 37, Unemployed = 7, Labourer = 7, Fitness Instructor/Coach = 6, Driver = 2). The means, standard deviations, and correlations between the variables stated in the model are presented in Table 13.

Table 13

Model variables means, standard deviations, correlations (r)

Variable	1.	2.	3.	4.	5.	6.	7.
1. Autonomous goal motives	-	-	-	-	-	-	-
2. Controlled goal motives	-.03	-	-	-	-	-	-
3. Self-efficacy	.32**	-.17**	-	-	-	-	-
4. Motivation	.69**	-.13*	.32**	-	-	-	-
5. Affect	.64**	.00	.26**	.82**	-	-	-
6. Physical activity (minutes of MVPA)	.21**	.06	.13*	.36**	.37**	-	-
7. Mental well-being	.23**	-.17**	.59**	.28**	.25**	.09	-
M	5.28	2.80	31.13	9.79	4.73	264.40	22.11
SD	1.51	1.37	4.56	7.10	1.40	311.38	3.53

Note. N = 323; *p < .05; **p < .01, two-tailed; MVPA: Moderate-Vigorous Physical Activity.

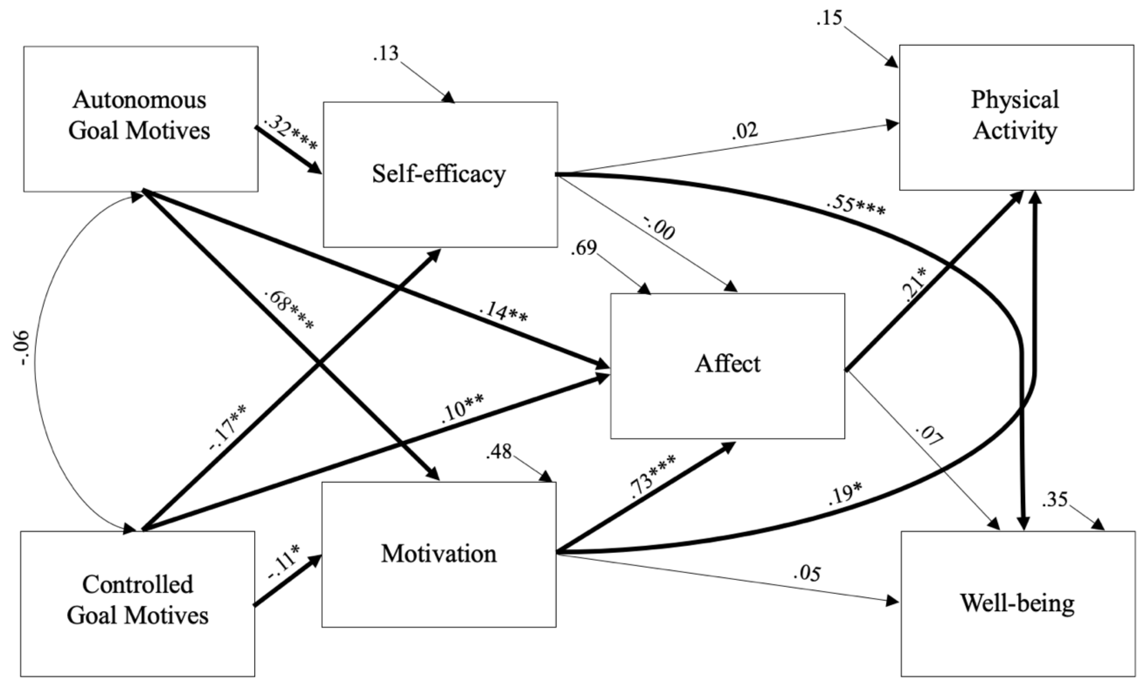
As shown in Table 13, autonomous goal motives were significantly associated with higher reported self-efficacy, greater quality of motivation, greater positive affective experiences, higher levels of reported MVPA, and greater perceived mental well-being. In contrast, controlled goal motives were found to be significantly associated with lower self-efficacy, poorer-quality motivation, and poorer perceived mental well-being.

5.3.2 Structural Equation Model Path Analysis

The data demonstrated good fit to the proposed model: $\chi 2$ (6) = 14.162, p = .028, RMSEA = .065, CFI = .990, TLI = .965 (Hu & Bentler, 1999). Direct and indirect associations of the proposed model are presented in Figure 8.

Figure 8

Model showing the associations between goal motives, psychological variables, physical activity and well-being



Note. **p* < .05; ***p* < .01, ****p* < .001.

5.3.2.1 Goal Motives

5.3.2.1.1 Autonomous Goal Motives. (H1) Autonomous goal motives had a significant, positive, small-to-large association with greater self-efficacy (β = 0.32, 95% CI [0.21, 0.42], *p* = .001), positive affective experiences (β = 0.14, 95% CI [0.05, 0.24], *p* = .003), and quality of motivation (β = 0.68, 95% CI [0.61, 0.74], *p* = .001). (H3) Autonomous goal motives also showed small significant, indirect, positive associations with greater perceived mental well-being, via self-efficacy (β = 0.41, 95% CI [0.26, 0.58], *p* = .001) and higher reported MVPA via motivation (β =

26.27, 95% CI [3.84, 52.58], *p* = .02), affect (β = 6.28, 95% CI [0.95, 15.34], *p* = .02), and through motivation and affect (β = 21.60, 95% CI [1.56, 41.52], *p* = .04).

5.3.2.1.2 Controlled Goal Motives. (H1) When goals were underpinned by controlled motives, the model showed a significant, direct association with lower reported self-efficacy (β = -0.17, 95% CI [-0.27, -0.06] *p* = .004) and poorer quality of motivation (β = -0.11, 95% CI [-0.20, -0.02] *p* = .02), both with small effect sizes. Controlled motives had a significant, small positive association with positive affective experiences (β = 0.10, 95% CI [0.03, 0.16] *p* = .002). (H3) Indirectly, the pursuit of goals with controlled motives was found to have small significant associations with poorer perceived mental well-being through self-efficacy (β = -0.23, 95% CI [-0.40, -0.08], *p* = .003). Controlled motives were also reportedly, indirectly associated with lower minutes of MVPA via motivation (β = -4.51, 95% CI [-12.44, -0.60], *p* = .02), and motivation and affect (β = -3.71, 95% CI [-10.19, -0.28], *p* = .03); but were indirectly associated with higher MVPA via affect (β = 4.68, 95% CI [0.45, 11.48], *p* = .03).

5.3.2.2 Psychological Variables

5.3.2.2.1 Self-efficacy. (H2) In the final model, perceived self-efficacy was significantly, largely, and directly associated with greater perceived mental well-being (β = 0.55, 95% CI [0.47, 0.62], *p* = .001). Conversely, self-efficacy was not directly associated with greater positive affective experiences (β = -0.00, 95% CI [-.07, 0.08], *p* = .99), nor was it directly associated with reported MVPA (β = 0.02, 95% CI [-0.10, 0.14], *p* = .75). Additionally, self-efficacy was not found to be indirectly associated, via affect, with reported MVPA (β = -.02, 95% CI [-1.15, 1.26], *p* = .92) or perceived mental well-being (β = 0.00, 95% CI [-0.01, 0.01], *p* = .84).

5.3.2.2.2 Motivation. (H2) The quality of one's motivation was directly and significantly, largely associated with greater positive affective experiences (β = 0.73, 95% CI [0.65, 0.80], *p* = .001) and showed small associations with higher reported MVPA (β = 0.19, 95% CI [0.02, 0.36], *p* = .03), yet was not directly associated with perceived mental well-being (β = 0.05, 95% CI [-0.11, 0.21], *p* = .51). Furthermore, quality of motivation was significantly, associated, through affect, with higher reported MVPA indirectly (β = 6.74, 95% CI [0.31, 12.64], p = .04), but not indirectly associated with perceived mental well-being (β = 0.02, 95% CI [-0.03, 0.08], p = .40).

5.3.2.2.3 Affect. (H2) Greater positive affective experiences appeared in the model to have a small direct significant associated with greater reported MVPA (β = 0.21, 95% CI [0.02, 0.39], p = .03), but affective experiences were not directly associated with perceived mental well-being (β = 0.07, 95% CI [-0.08, 0.23], p = .39).

5.4 Discussion

This study aimed to enhance understanding of the association between goal motives and psychological outcomes (motivation, self-efficacy and affect), PA, and mental well-being by answering the following questions: (1) are psychological variables (motivation, self-efficacy and affect) associated with improved PA and well-being linked to one's motives for pursuing PA goals?; (2) how do psychological variables (motivation, self-efficacy and affect) link to PA and well-being?; (3) what are the indirect effects of one's motives for PA on PA and well-being? Overall, our findings supported our hypotheses. First, H1 was accepted as both autonomous and controlled motives were significantly associated, positively or negatively respectively, with all psychological variables. Second, H2 was partially accepted as significant associations were observed between both motivation and affect and PA, and between self-efficacy and mental well-being but not between all three psychological variables and PA and mental well-being. Lastly, H3 was partially accepted as significant indirect associations were found between autonomous motives and PA and mental well-being, and controlled motives and mental well-being, but not between controlled motives and PA. The findings of the present study emphasise the importance of measuring PA and well-being simultaneously when assessing long-term adherence.

Considering autonomous and controlled motives are described broadly in SDT as the motives for behaviour (Deci and Ryan, 1985) and that SDT proposes the continuum of motivation types that are then categorised into the two broad motives (Ryan and Deci, 2017), the finding that controlled motives and quality of motivation were not significantly associated with each other was in line with these propositions. Further, more self-regulated motivation, which can lead to an increased likelihood of adoption and maintenance of new behaviours (Teixeira et al., 2012, was positively associated with increased belief in one's ability to complete the desired behaviour. Blom et al. (2021) suggested that although it takes time to change PA behaviours, initially improving autonomous motives and self-efficacy could be beneficial and are suggested to be the first stages in changing long-term behaviours. These findings also suggest that when an individual's autonomy for the activity is greater, they should have higher quality of motivation (i.e., intrinsic and identified motivation; Ryan and Deci, 2017) and positive affective experiences, specifically attraction to the activity. As a result, being attracted to activities that increase moderate-vigorous activity could lead to increased adoption of healthy PA behaviours (Ekkekakis and Brand, 2019). This idea is supported by both the direct and indirect association between motivation and PA in this study.

As hypothesised (H1), controlled motives were associated with significantly lower self-efficacy and quality of motivation. If controlled motives result in lower confidence in one's ability to complete a goal/be more active, pursuing goals with higher controlled motives could have adverse effects on PA adoption and maintenance; as lower self-efficacy can influence the time and effort invested to achieve a goal, thus reducing the likelihood of goal attainment (Bandura, 2001). In addition, lower RAI scores correspond with more introjected and extrinsic motivation (Ryan and Deci, 2017) or, more simply, controlled motives. Thus, our findings further demonstrate the negative associations between these controlled goal motives, motivation and self-efficacy, the latter two of which have been linked to poor long-term PA adherence. In contrast to self-efficacy and motivation, controlled motives were positively associated with positive affective experiences (Sheldon and Elliot, 1998). When PA is perceived to be pleasurable, individuals are more likely to maintain it (Schmid and Reimann, 2019). However, given the findings of this data report a snapshot in time, and as controlled motives are not considered to be enduring over an extended period (Emm-Collinson et al., 2020), these relationships may prove different over time; the temporal nature of these relationships require further investigation in future research.

Although hypothesised that all psychological variables would be positively associated with PA and mental well-being (H2), this was not found to be the case. Self-efficacy has been suggested to be the best mediator of PA (Bauman, 2012; Sallis et al., 1989), yet the present study found no significant association between the two variables in this population. However, a significant positive association was found between one's belief and confidence in their abilities to complete the task and perceived well-being. As well-being and PA are essential variables for consideration when addressing long-term behaviour change (Kates and Rhodes, 2015; Schmid and Reimann, 2019), these findings emphasise the need to assess psychological outcomes and PA simultaneously when evaluating the effects of PA interventions, something that is currently lacking (Garstang et al., 2024). Previously, however, positive experiences have been shown to be more important than self-efficacy at predicting PA behaviours (Lewis et al., 2016). Consequently, the current study supports those previous findings as alongside quality of motivation, positive affective experiences were positively associated with higher levels of PA. The findings of the current study thus reinforce the importance of considering multiple psychological variables in the pursuit of positive health behaviours and the role each may have in long-term behaviour change.

In line with the goal motives literature (Deci and Ryan, 2008; Emm-Collinson et al., 2020; Maltby and Day, 2001; Sheldon and Elliot, 1998), higher autonomous motives for goal pursuit were significantly associated with greater perceived mental well-being and higher levels of PA. In contrast, in this study, we found controlled motives were significantly and indirectly related to poorer mental well-being, which is somewhat consistent with past research that found controlled motives were directly related to poorer mental well-being (Briki, 2016; Maltby and Day, 2001; Ng et al., 2012). Previous findings in relation to exercise also support this (e.g., Standage et al., 2008), by suggesting that controlled motives are not associated with PA. As such, these current findings provide further evidence to support promoting autonomous motives and limiting controlled motives for PA goals, as they do not fulfil one's psychological needs (Hagger et al., 2014). Furthermore, as the association between PA and well-being is bidirectional, perceived mental well-being and psychological variables (e.g., self-efficacy and motivation) can impact upon maintained PA behaviours (Kim et al., 2020) and should be considered in future studies.

5.4.1 Implications

Based on the findings of this study, we suggest a number of implications. First, autonomous motives offered greater benefits to psychological variables associated with repeated and sustained engagement in PA, and well-being compared to controlled motives. Therefore, individuals, researchers and practitioners should seek to underpin future goal pursuits with autonomous motives to avoid potential detrimental effects that could lead to disengagement, and in the case of PA, sustained inactivity. Further, it is important for future goal-setting research to consider goal motives for goal pursuit as one's quality of motivation could have significant impacts on PA behaviour in the long-term, as often the focus is only on the type of goal set. Second, and relatedly, the findings underscore the importance of considering motives in the process of goal setting (e.g., Bird et al., 2024). Consequently, we suggest that guidance surrounding goal setting for PA should emphasise the importance of understanding the motives that underpin goal pursuit and thus go beyond solely focusing on the content of a goal (e.g., how specific, measurable, or challenging is it?). Third, our findings demonstrate the importance of considering psychological outcomes that can contribute to the outcomes of PA behaviour rather than solely focusing on PA alone. Consideration of these psychological factors is important when seeking to understand goal setting and PA in future as this will allow for a more holistic approach to setting goals with different motives.

5.4.2 Limitations and Future Directions

This study is the first to offer insight into the association between goal motives, psychological variables influencing, and the outcomes of, PA and well-being; yet is not without limitation. Firstly, data reported in this study are cross-sectional and represent a single time point, and it should be noted, although PA was not restricted by COVID-19 during the data collection period, the pandemic did alter attitudes, intentions and behaviours. Subsequently, causality cannot be inferred nor firm conclusions about the mechanisms between these variables offered. Nevertheless, we still, offer initial insight into the associations between key psychological variables in relation to the pursuit of PA goals. We also note that the high correlation between affect and motivation should be considered when interpreting these results as any changes could be a result of the effect have on the other. Future research may aim to examine these variables using a longitudinal approach, with objective measures of PA, to gain a better understanding of their interactions over time. Secondly, this study recruited a UK sample, therefore potentially limiting the applicability of these findings globally. Future research may look to recruit individuals from multiple countries to account for any geographical and cultural differences. Furthermore, few studies have sought to integrate concepts from goal motives (e.g., SCM; Sheldon and Elliot, 1998) and goal setting (e.g., goal-setting theory; Locke and Latham, 2002). Future research may look to explore this, which could better our current understanding of health behaviours. Lastly, it should be noted that this study reported the global score of RAI of the BREQ-3. In doing so, the global measure score could be assessed in relation to the other included variables in the model, however using the global RAI score means that the independent sub-scales were not assessed in isolation. Further, this may be why no association was observed between motivation (RAI) and mental well-being. Motivation (RAI) is not dichotomous and so the weighted score of the sub-scales may have resulted in any associations with well-being being masked. Future research may wish to explore the associations between one's motives, the independent sub-scales of the BREQ-3 and PA and well-being to understand how different levels of motivation contribute to PA behaviour and mental well-being.

5.5 Conclusion

The present study offers insight into the intricacies of how goal motives are associated with psychological variables linked to improved PA and well-being, in turn illustrating the importance of measuring PA and well-being simultaneously when assessing long-term adherence. Autonomous motives were found to be associated with higher levels of PA and greater well-being, whereas controlled motives were associated with poorer well-being, suggesting that the promotion of autonomous goal motives would be most advantageous for health behaviours. To summarise, goal motives were associated with psychological variables linked to PA and well-being, with the proposed model indicating that the relationship between goal motives, PA, and well-being was not direct, but was influenced by perceived self-efficacy, motivation, and affective experiences.

CHAPTER 6: DO THE 'HOW' AND 'WHY' OF GOAL SETTING MATTER FOR COMPLEX TASKS? FINDINGS IN A NOVEL WALKING TASK[18]

Both the type of goal being pursued (e.g., specific, learning, open) and goal motives underpinning them (e.g., autonomous/controlled) are important considerations for successful goal pursuit. However, no studies have examined how these factors may interact and affect performance outcomes and variables related to sustained engagement of desired behaviours. Additionally, despite suggestions that task complexity should be a key consideration when setting goals, particularly for new, challenging tasks, this is often overlooked in exercise psychology studies. Within this study, we examined goal types and goal motives concurrently and explored the subsequent effects on performance outcomes during a simple trial and a complex trial of a novel task. Using a between-within study design (pre-registered OSF), 90 participants (M_{age} = 23.62 ± 4.31) completed the Corsi Block Tapping test for familiarisation and baseline, before being randomly assigned to a goal type (specific, open, learning) for the Walking Corsi test (WalCT). For both the simple and complex WalCT trials, participants completed pre- and post-trial questionnaires. There were no differences in goal motives ($F[4,164] = 0.80$, $p = .53$, partial $\eta 2 = .02$) or WalCT performance ($F[2, 83] = 1.36$, $p = .26$, partial $\eta 2 = .03$) between goal types. Controlled motives positively predicted threat appraisal in both conditions: Simple: $\beta = .45$, 95% CI [0.20-0.56], $p < .001$; Complex: $\beta = .39$, 95% CI [0.17-0.55], $p < .001$. The findings question suggestions that goal types should be adjusted based on task complexity, whilst offering initial insight into the effect of goal types on goal motives.

Keywords

Goal setting, task complexity, self-concordance theory, goal motives, performance

[18] *Under Review: Psychology of Sport & Exercise.*

6.1 Introduction

Goal setting, where a goal is defined as a target or objective of one's actions (Locke et al., 1981), is one of the most utilised techniques for enhancing performance and changing behaviours (e.g., McEwan et al., 2016; Howlett et al., 2019). Goal-setting theory (GST; Locke & Latham, 1990) proposes that specific, challenging, performance goals are most beneficial for performance (e.g., walking 10,000 steps a day). For specific performance goals to be recommended, GST proposes five moderators, including: appropriate ability, i.e., skill and knowledge, to achieve the goal; receiving feedback, the commitment to achieve the goal; the necessary situational resources; and appropriate task complexity (Locke & Latham, 2013). In situations where the moderators are not satisfied, such as when a task is new and complex or the challenge of the task does not meet the ability of the individual (Seijts & Latham, 2001; Locke & Latham, 2019), the benefits of specific, performance goals may not be as strong. In these instances, the theoretical proposition of GST is that a specific, challenging, learning goal (e.g., to identify and implement strategies to walk 10,000 steps a day) may be more suitable than a specific, performance goal (e.g., to walk 10,000 steps per day) as it alters the focus instead from an outcome of performance to the processes required to be successful (Latham, 2016). Learning goals have been found to produce better academic and business performance compared to other goal types in complex tasks (Drach-Zahavy & Erez, 2002; Seijts & Latham, 2001), and have also been shown to increase reported self-efficacy for goal achievement (Winters & Latham 1996). However, few studies have been conducted on learning goals in PA and exercise (Carter et al., 2021) and no firm conclusion of the effect of this goal type compared to other goal types can yet be made in a PA context (Garstang et al., 2024; McEwan et al., 2016).

Despite the contention that specific goal types could confer greater performance benefits than non-specific goals, which are ambiguous in nature regarding the desired outcome (Wallace & Etkin, 2018), for PA behaviours a meta-analysis of intervention studies found no significant differences between specific and non-specific goals (McEwan et al., 2016). Alongside the performance outcomes of different goals, there are several performance-related psychological variables that have received attention in recent experimental studies. One non-specific goal that has received attention in PA and cognitive tasks in recent years is the open goal (e.g., Hawkins et al., 2020). Open goals are defined as a goal with no defined outcome, and are exploratory in nature, for example 'see how far you can walk' (Swann et al., 2016) and can result in greater perceived performance and levels of confidence in a task (Schweickle et al., 2017), higher levels of enjoyment in a PA task for insufficiently active individuals (Hawkins et al., 2020), and lead to interest in repeated engagement in a PA task (Swann et al., 2020). However, although perceptions of performance may be greater when pursuing an open goal, objectively-measured performance was actually found to be greater in a cognitive letter and number identification task when a specific goal was pursued (Schweickle et al., 2017). Conversely, Pilcher et al. (2022) found that in the same task where participants were asked to search rows for a specified amount of random letters/numbers (Hardy & Fazey, 1990), and in the walking tasks (Hawkins et al., 2020), open, and specific goals were found to be equally effective at producing accurate task performances. Researchers to date have highlighted the effect of goal types on performance and PA outcomes, yet the effect of learning goals remains relatively unknown in this context with only preliminary evidence available (see Carter et al., 2021). Furthermore, this work highlighted the need to evaluate different types of specific goals (i.e., specific and learning) alongside non-specific goals (i.e., open; Carter et al., 2021).

Although experimental studies comparing open to specific goals provide evidence for the use of goal types for PA outcomes, they fail to consider the why of goal pursuit. A key component of successful goal pursuit is the underpinning motive. Goal motives reflect a person's reasons for their behaviours and may vary in the extent to which they reflect their values and interests (Sheldon & Elliot, 1999). Motives are generally dichotomised into two overarching categories. First, autonomous motives (i.e., when one's reason for doing something is for enjoyment and/or because it reflects personally interests and values; Ryan & Deci, 2000b) are reflected in intrinsic and identified motivation regulations (Healy et al., 2015). Second, controlled motives, whereby they are indicative of internal or external pressures (Healy et al., 2015; i.e., when one feels compelled to do something by external or internal pressures; Ryan & Deci, 2000b). Although both autonomous and controlled goal motives have been shown to be influential drivers for initial changes in behaviours, the long-term effects can differ (Teixeria et al., 2012). Controlled motives may lead to reduced efforts for goal pursuit as time goes on, whereas when pursuing goals with autonomous motives, individuals are more likely to sustain and persist towards goal attainment (Ntoumanis et al., 2014; Sheldon & Elliot, 1998). It has been found that more autonomous goal motives can result in more positive outcomes, whilst curbing more negative outcomes compared to controlled motives (Deci & Ryan, 2000; Healy et al., 2014; Teixeria et al., 2012). In addition, there is further evidence suggesting that autonomous goal motives are preferable to controlled goal motives particularly when striving for challenging goals, due to associations autonomous motives have with greater persistence (Ntoumanis et al., 2014). Autonomous motives have also been linked to psychological benefits including improved well-being (Ntoumanis et al., 2014) and overall psychological health (Deci & Ryan, 2008). Therefore, it is important to promote autonomous motives and identify ways in which this type of motivation can be facilitated, so that future interest to engage and repeat positive behaviours is heightened.

There is an abundance of evidence surrounding the effects of goal types and goal motives in isolation in different contexts (see example evidence in reviews by Ng et al., 2012 and McEwan et al., 2016). However, as yet, there is no understanding of how the types of goals set may be influencing why an individual pursues a goal and the subsequent effect this has on desired outcomes. As such, it is unknown if autonomous motives, most desirable for sustained engagement (Deci & Ryan, 2000), can be elicited by a certain type of goal, and how this could not only effect performance, but also additional psychological variables associated with performance and engagement (e.g., challenge and threat). For instance, open goals have been found to result in lower perceived pressure in goal pursuit compared to specific goal types (Swann et al., 2020), and can allow for greater flexibility in goal success, particularly for insufficiently active individuals (Hawkins et al., 2024). Conceptually, there appear to be some links between certain goal types and autonomous motives. For instance, it is plausible to suggest that open goals could allow for greater autonomy over one's actions, and thus could be most beneficial for promoting autonomous motives. Additionally, learning goals may also prove advantageous for inciting autonomous motives, as a result of the increased autonomy in selecting one's own strategies for goal striving. To test these hypotheses, the current study seeks to evaluate the combined effect of goal types and goal motives to provide preliminary evidence for recommendations for applied practice that could be generalised to many contexts, including PA.

Consistent with the proposals in GST, researchers have highlighted the need to consider contextual factors, such as task complexity, when setting goals for PA (Swann & Rosenbaum 2017). According to Drach-Zahavy and Erez (2002), task complexity can be classified based on three dimensions: (a) component complexity: the number of dimensions a person must attend to at once (i.e., complex tasks require more actions or cues to attend to than simple tasks); (b) coordinating complexity: the sequencing and coordination of acts (i.e., simple tasks would require fewer acts to coordinate then complex tasks); and (c) dynamic complexity: the ability to adapt to changes (i.e., complex tasks require greater flexibility and capacity for change than in simple tasks). GST moderators such as task complexity are stated a necessary requirement for specific, challenging performance goals, with Locke and Latham (2016) suggesting that specific, challenging learning goals should replace them if the task is too complex, as success in a complex task reportedly requires individuals to develop effective strategies for pursuit (Kanfer & Ackerman, 1989). However, this suggestion is still to be examined in an exercise task, with previous studies only comparing the effects of specific (e.g., SMART and learning goals) and non-specific (e.g., open, do your best, as-well-as-possible) goals using a universal 6-minute walk test which does not account for differing task complexities (Carter et al., 2021; Hawkins et al., 2020; Swann et al., 2020, 2022). Although there is a body of evidence for the effect of goal types and the influence of goal motives individually, researchers have yet to explore how these two variables interact and subsequently affect behavioural outcomes (e.g., PA) and associated psychological outcomes in PA tasks involving differing task complexities.

Therefore, the aims of this study were twofold. Firstly, we sought to examine the effects of specific, learning and open goals on performance in simple and complex walking tasks. Secondly, we aimed to examine the effects of specific, learning and open goals on psychological outcomes (goal perceptions, challenge/threat appraisal and future interest). In line with our aims, we formed the following hypotheses: H1: specific goals will produce the best results (i.e., WalCT performance and positive task perceptions) in the simple trial; H2: learning goals will produce the best WalCT performance in the complex condition; H3: open goals will produce no difference in WalCT performance compared to the other goal conditions. In addition, an exploratory aim was to explore the effects of specific, learning and open goals on goal motives and task perceptions in a walking task. With respect to this exploratory aim, we sought to address two research questions: do different goal types elicit different goal motives?; and how do these motives interact with the goal type to influence our outcomes of interest?

6.2 Methods

6.2.1 Participants and Recruitment

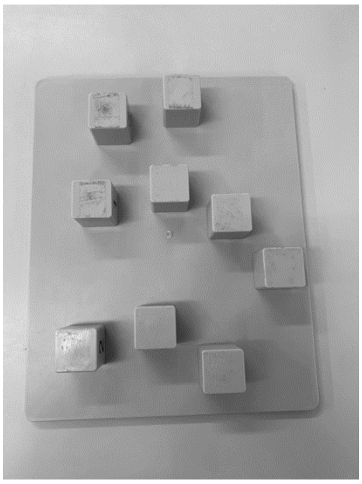
We adopted an experimental between-within groups design. Ethical approval was granted by the first author's University ethics committee (ref: 1605768). An a priori power analysis ($\alpha = .05$; 80% power; f =.25; correlation among repeated measures = 0.5) conducted using G*Power software (V3.1) indicated that a sample size of 81 participants was necessary. A total sample of 90 healthy adults, as determined by a health screening, aged 18-64 years old, were recruited to account for 10% attrition. All participants were recruited via convenience and snowball sampling via contacts of the research team and word of mouth. Participants completed informed consent and health screening forms prior to partaking; no incentives were provided to participants.

6.2.2 Procedure

Prior to commencing data collection in the lab, the study protocol was pre-registered (OSF). Participants completed both the Corsi block tapping task (CBTT; Corsi, 1972; Figure 9.a) and the Walking Corsi test (WalCT; Piccardi et al., 2013; Figure 9.b). The CBTT acted as a familiarisation of the task and provided a baseline score for the goal set in the WalCT. These tasks were selected for two reasons. First, using the CBTT and WalCT in combination allowed us to set individualised goals for each participant. Second, due to the two-part nature of the task, we compared performance in both a simple and complex trial of the same task. The same experienced practitioner (first author) provided instructions to each participant and conducted all trials for continuity.

Figure 9

(a) Corsi Block Tapping Task Board and Layout; (b) Walking Corsi Test Mat and Layout



(a)

(b)

6.2.2.1 CBTT

First, participants completed the CBTT (Corsi, 1972). The CBTT board is composed of nine square raised blocks (4.5 x 9 x 4.5 cm) distributed and positioned in a standardised layout on a 30 x 25 cm board (Figure 9a). The participant sat across from the experimenter, the first author, with the CBTT board in the middle of a table in a quiet room. The experimenter then proceeded to tap blocks, pausing for one second in sequences, starting from two block sequences and increasing in length by one block at a time until failure (Piccardi et al., 2008). The CBTT was completed twice, once by repeating the sequences in the same order (simple trial) and once in reverse order (complex trial); this order was randomised. Two scores were then recorded for the simple and complex trials, and the total score was the number of blocks in the last successfully performed sequence.

6.2.2.2 WalCT

After completing the CBTT participants then completed the WalCT. This consisted of a 3m x 9m x 2.5m, scale 1:10 version of the CBTT, with nine squares in positions identical to the CBTT. The first author and participant started the sequences from the same position on the mat. The first author then walked between the squares, pausing for two seconds on each square, and stood in the starting position to signal the end of the sequence. Similar to the CBTT, participants completed two trials of the WalCT in a randomised order: simple (i.e., repeating the sequence in the same order as shown), and complex (i.e., repeating the sequence in the reverse order to the sequence shown whilst remembering an 8-digit code). Before completing the WalCT, participants were randomly assigned using an online random generator to one of three goal conditions: specific ("successfully replicate *n** sequences"), open ("see how well you can do at successfully replicating the sequences"), and learning ("identify and implement one strategy to successfully replicate *n** sequences"). For the specific and learning goal, the *n* for each participant was equal to the number of sequences performed correctly in the CBTT. After receiving the goal and before starting the WalCT, participants completed pre-trial questionnaires to assess their goal motives and perceptions of the goal (see 6.2.3 Measures). Participants were reminded of their goal before commencing each trial. Post-trial questionnaires to assess challenge and threat appraisals and future interest were completed following each trial. Participants were observed by the experimenter who recorded successfully completed sequences to score.

6.2.3 Measures

6.2.3.1 Goal Motives

Goal motives were assessed pre-trial using a 10-item Goal Motivation questionnaire (Riddell et al., 2022; Sheldon & Elliot, 2017). Participants rated their reasons for pursuing the goal provided on a 10-point Likert scale, ranging from 1 (*Not at all*) to 7 (*Very much so*). The items were divided into two subscales, representing two overarching motives: four items for autonomous goal motives (i.e., identified and intrinsic motivation), and six items for controlled motives (i.e., extrinsic, positive introjected and negative introjected). The internal reliability of the autonomous motives and controlled motives were very good (a = .80) and good (a = .75), respectively (Riddell et al., 2022).

6.2.3.2 Goal Perceptions

Similar to previous research (Healy et al., 2015; Ntoumanis et al., 2014b), a 4-item questionnaire was used to assess perceived goal difficulty pre-trial ("*How challenging is your goal?*"), importance ("*How important is it to you that you achieve your goal*"), efficacy ("*How confident are you that you will achieve your goal?*"), and expected goal attainment ("*To what degree do you believe you are going to achieve your goal*"). Items were scored on a 7-point Likert scale, ranging from 1 (*Not at all*) to 7 (*Very much so*). These single item measures were deemed sufficient as the constructs being measured were unidimensional and quicker to complete (Wanous et al., 1997), thus allowing us to explore additional potential contributing variables (Allen et al., 2022).

6.2.3.3 Challenge/Threat Appraisal

Perceptions of challenge (e.g., "*I viewed the task as a positive challenge*") and threat (e.g., "*I viewed the task as a threat*") were measured post-trial using an 8-item questionnaire, four items for challenge and four items for threat, that previously reported very good internal consistency (.82 ≥ α ≥ .87; Riddell et al., 2022). The items were scored on a 7-point Likert scale, ranging from 1 (*Not at all*) to 7 (*Very much so*). The internal consistency of the measure in the current study was very good (.67 ≥ α ≥ .82).

6.2.3.4 Future Interest

A 3-item questionnaire was used to assess each participant's interest in participating in similar tasks in the future post-trial (Ntoumanis et al., 2014a). Each item (e.g., "*I would be interested in participating in this study again in the future*") was rated on a 7-point Likert scale from 1 (*Not at all*) to 7 (*Very much so*). The items were averaged for a final score.

6.2.4 Manipulation Check

A single-item measure of perceived complexity of each trial was taken as a manipulation check; "*How complex did you find that task to be?*". This was taken to assess the differing intended complexities of the trials and was scored on a 7-point Likert scale from 1 (*Not at all*) to 7 (*Very much so*).

6.2.5 Analysis Strategy

Before conducting statistical analyses, data were screened for univariate and multivariate outliers. Statistical analyses were then carried out using SPSS Version 29. A MANOVA analysis was performed to test the effect of goal types on goal motives in differing task complexities during the WalCT. Although we intended to perform a MANOVA to test for the effect of goal types on participant perceptions (i.e., challenge, importance, confidence, and expectancy) in differing task complexities during the WalCT, assumptions of normality and multicollinearity were violated, and so one-way between-within ANOVAs were performed for each variable instead. Although a MANOVA was intended to test if different goal types elicited different participant perceptions, the assumption of multicollinearity was violated. Therefore, ANOVAs were performed. One-way within-between ANOVAs were conducted to test for differences in participant perceptions, WalCT performance, challenge and threat appraisal, and future interest to take part between goal conditions and task complexities. Additionally, linear regression analyses were performed to identify the effect of goal motives on participant perceptions, WalCT, challenge and threat appraisal, and future interest.

6.3 Results

6.3.1 Descriptives Statistics

After univariate and multivariate outlier screening, a total sample of 86 adults was included (M_{age} = 23.62 ± 4.31; n_{female} = 47, n_{male} = 39). Means and standard deviations for all variables are presented in Table 14.

Table 14

Means and SD For All Tested Variables

	Simple[a,c,e,f]			Complex[a,c,e,f]		
	Specific[b,d] (*n* = 28)	Open[b,d] (*n* = 28)	Learning (*n* = 30)	Specific[b,d] (*n* = 28)	Open[b,d] (*n* = 28)	Learning (*n* = 30)
Goal Motives						
Autonomous	4.56±1.03	4.73±0.91	4.86±1.05	4.42±0.76	4.54±1.13	4.87±0.98
Controlled	4.33±0.87	4.27±1.11	4.57±1.20	4.26±1.01	4.13±1.09	4.40±1.08
Perceptions						
Challenge[a]	4.89±1.20	4.46±1.17	4.73±1.08	6.21±0.92	6.04±0.84	6.00±1.08
Importance	4.14±1.60	4.43±1.29	4.67±1.24	4.07±1.49	4.43±1.68	4.50±1.20
Confidence[b,c]	3.79±1.17	4.86±1.01	4.23±1.19	2.71±1.05	3.61±1.34	3.17±1.23
Expectancy[d,e]	3.82±1.28	5.00±0.98	4.30±1.18	2.75±1.27	3.50±1.32	3.30±1.37
WalCT performance	5.04±1.26	4.64±0.83	4.93±1.17	4.79±1.07	4.46±0.79	4.77±1.17
Challenge	5.21±0.85	5.11±0.77	5.39±0.83	5.04±1.19	5.33±0.95	5.45±0.82
Threat	1.97±0.92	2.23±0.88	2.17±0.84	2.02±1.01	2.26±1.03	2.17±0.87
Future interest[f]	6.35±0.79	6.10±0.98	6.54±0.67	6.36±0.76	6.18±0.94	6.61±0.61

Note. Main effect of trial complexity (complex > simple, p <.001)[a]; Main effect of goal condition (open > specific, p <.001)[b]; Main effect of trial complexity (simple > complex, p <.001)[c]; Main effect of goal condition (open > specific, p = .002)[d]; Main effect of trial complexity (simple > complex, p < .001)[e]; Main effect of trial complexity (complex > simple, p = .03)[f].

6.3.2 Manipulation Check

Individuals reported a significantly higher perceived complexity in the complex trial compared to the simple trial ($F[1,83] = 38.82$, $p < .001$, partial $\eta^2 = .32$).

6.3.3 Effect of Goal Types

6.3.3.1 Goal Motives

There was no main effect of goal condition ($F[4,164] = 0.80$, $p = .53$, partial $\eta^2 = .02$) or trial complexity ($F[2,82] = 2.30$, $p = .11$, partial $\eta^2 = .05$) on goal motives, and no interaction effect ($F[4,164] = 0.32$, $p = .87$, partial $\eta^2 = .01$).

6.3.3.2 Goal Perceptions

6.3.3.2.1 Perceived Challenge. No main effect of goal condition on perceived challenge was found ($F[2, 83] = 1.02$, $p = .36$, partial $\eta^2 = .02$). However, there was a significant main effect of trial complexity on perceived challenge ($F[1,83] = 82.58$, $p < .001$, partial $\eta^2 = .51$). Bonferroni post hoc analysis revealed challenge was perceived to be significantly greater in the complex trial compared to the simple trial ($MD = 1.39$, 95% CI [1.09-1.68], $p < .001$). No interaction effect was found between goal condition and trial complexity on perceived challenge ($F[2, 83] = 0.40$, $p = .67$, partial $\eta^2 = .01$). Additionally, autonomous and controlled goal motives did not significantly predict perceived challenge in the simple ($F[2, 83] = 0.82$, $p = .45$, $R^2 = .02$) nor complex ($F[2, 83] = 0.33$, $p = .72$, $R^2 = .01$) trials.

6.3.3.2.2 Perceived Importance. There was no main effect of goal condition ($F[2, 83] = 1.20$, $p = .31$, partial $\eta^2 = .03$) or trial complexity ($F[1, 83] = 0.36$, $p = .55$, partial $\eta^2 < .01$), and no interaction effect ($F[2, 83] = 0.14$, $p = .87$, partial $\eta^2 < .01$) on perceived importance. In the simple trial, goal motives showed to be significant predictors of perceived importance ($F[2, 83] = 18.03$, $p < .001$, $R^2 = .30$); both autonomous ($\beta = .37$, 95% CI [0.25-0.78], $p < .001$) and controlled ($\beta = .30$, 95% CI [0.14-0.65], $p < .01$) motives were positive predictors of perceived importance with a moderate effect size. In the complex trial, goal motives showed to be significant predictors of perceived importance ($F[2, 83] = 13.28$, $p < .001$, $R^2 = .24$); both autonomous ($\beta = .23$, 95% CI [0.04-

0.57], $p = .02$) and controlled ($\beta = .37$, 95% CI [0.20-0.69], $p < .001$) motives were positive predictors of perceived importance.

6.3.3.2.3 Perceived Confidence. A main effect of goal condition on perceived confidence was found (F[2, 83] = 7.41, $p = .001$, partial $\eta^2 = .15$). Bonferroni post hoc analysis showed confidence was perceived to be significantly greater in the open goal condition compared to the specific goal condition ($MD = 0.98$, 95% CI [0.36-1.61], $p < .001$). A significant main effect of trial complexity on perceived confidence was found (F[1,83] = 59.45, $p < .001$, partial $\eta^2 = .42$). Bonferroni post hoc analysis revealed confidence was perceived to be significantly greater in the simple trial compared to the complex trial ($MD = 1.13$, 95% CI [0.84-1.42], $p < .001$). No interaction effect was found between goal condition and trial complexity on perceived confidence (F[2, 83] = 0.17, $p = .85$, partial $\eta^2 < .01$). Additionally, autonomous and controlled goal motives did not significantly predict perceived confidence in the simple (F[2, 83] = 0.12, $p = .88$, $R^2 < .001$) or complex (F[2, 83] = 0.65, $p = .53$, $R^2 = .02$) trials.

6.3.3.2.4 Expected Goal Attainment. We found a significant main effect of goal condition on expected goal attainment (F[2, 83] = 6.20, $p = .003$, partial $\eta^2 = .13$); expected goal attainment was significantly higher in the open goal condition compared to the specific goal condition (MD = 0.96, 95% CI [0.30-1.63], $p = .002$). A significant main effect of trial complexity on expected goal attainment was found (F[1,83] = 62.82, $p < .001$, partial $\eta^2 = .43$). Bonferroni post hoc analysis revealed expected goal attainment was higher in the simple trial compared to the complex trial (MD = 1.19, 95% CI [0.89-1.49], $p < .001$). No interaction effect was found between goal condition and trial complexity on expected goal attainment (F[2, 83] = 1.08, $p = .35$, partial $\eta^2 = .03$). Additionally, autonomous and controlled goal motives did not significantly predict perceived confidence in the simple (F[2, 83] = 0.15, $p = .86$, $R^2 < .001$) or complex (F[2, 83] = 0.98, $p = .38$, $R^2 = .02$) trials.

6.3.4 Outcome Effects

6.3.4.1 WalCT

There were no significant main effects of goal condition ($F(2, 83) = 1.36$, $p = .26$, partial $\eta^2 = .03$) or trial complexity ($F(1, 83) = 2.24$, $p = .14$, partial $\eta^2 = .03$), and no significant interaction between these variables ($F(2, 83) = 0.04$, $p = .96$, partial $\eta^2 < .01$). Additionally, autonomous and controlled goal motives did not significantly predict performance in the simple ($F[2, 83] = 0.60$, $p = .55$, $R^2 = .01$) or complex ($F[2, 83] = 1.10$, $p = .34$, $R^2 = .03$) trials.

6.3.4.2 Challenge Appraisal

There were no main effects on challenge appraisals for goal condition ($F(2, 83) = 0.94$, $p = .40$, partial $\eta^2 = .02$) or trial complexity ($F(1, 83) = 0.22$, $p = .64$, partial $\eta^2 < .01$), and no interaction effect ($F(2, 83) = 2.03$, $p = .14$, partial $\eta^2 = .05$). In the simple trial, goal motives were a significant positive predictor of challenge appraisal ($F[2, 83] = 24.30$, $p < .001$, $R^2 = .37$); autonomous motives was a positive predictor of challenge appraisal ($\beta = .64$, 95% CI [0.37-0.67], $p < .001$), whereas the pathway from controlled motives was non-significant ($\beta = -.13$, 95% CI [-0.24-0.42], $p = .17$). In the complex trial, goal motives showed to be significant predictors of challenge appraisal ($F[2, 83] = 10.42$, $p < .001$, $R^2 = .20$); autonomous motives were a positive predictor of challenge appraisal ($\beta = .44$, 95% CI [0.24-0.66], $p < .001$), while there was a negative relation between controlled motives and challenge appraisal ($\beta = -.31$, 95% CI [-0.49 - -0.10], $p = .004$).

6.3.4.3 Threat Appraisal

There were no main effects of goal condition ($F(2, 83) = 0.59$, $p = .56$, partial $\eta^2 = .01$) or trial complexity ($F(1, 83) = 0.15$, $p = .70$, partial $\eta^2 < .01$), and no interaction ($F(2, 83) = .05$, $p = .96$, partial $\eta^2 < .01$). In the simple trial, goal motives showed to be significant predictors of threat appraisal ($F[2, 83] = 9.81$, $p < .001$, $R^2 = .19$); controlled motives positively predicted threat appraisals ($\beta = .45$, 95% CI [0.20-0.56], $p < .001$), while the pathway from autonomous motives was non-significant ($\beta = -.06$, 95% CI [-0.24-0.13], $p = .57$). In the complex trial, goal motives showed to be significant predictors of threat appraisal ($F[2, 83] = 9.61$, $p < .001$, $R^2 = .19$); controlled were a positive predictor of threat appraisal ($\beta = .39$, 95% CI [0.17-0.55], $p < .001$), whereas the pathway from autonomous motives was non-significant ($\beta = .10$, 95% CI [-0.11-0.30], $p = .35$).

6.3.4.4 Future Interest

No main effect of goal condition on future interest was found ($F(2, 83) = 2.25$, $p = .11$, partial $\eta^2 = .05$). A significant main effect of trial complexity on future interest was found ($F[1,83] = 4.79$,

p = .03, partial η^2 = .06). Bonferroni post hoc analysis revealed future interest was higher in the complex trial compared to the simple trial (MD = 0.05, 95% CI [0.01-0.10], p = .03). No interaction effect was found between goal condition and trial complexity on future interest (F(2, 83) = .75, p = .48, partial η^2 = .02). Goal motives did not predict future interest in the simple trial (F[2, 83] = 1.12, p = .33, R^2 = .03), but did show to be a significant predictor of future interest in the complex trial (F[2, 83] = 3.65, p = .03, R^2 = .08); autonomous motives were a positive predictor of future interest (β = .26, 95% CI [0.03-0.39], p = .02), whereas the pathway from controlled motives was non-significant (β = .07, 95% CI [-0.12-0.21], p = .56).

6.4 Discussion

This study is the first to examine how goal types and goal motives impact performance in simple and complex versions of a novel exercising task. Our first aim was to explore the effects of specific, learning, and open goals on goal motives and task perceptions (goal perceptions, challenge/threat appraisal and future interest) in a walking task; of which there was no effect. Additionally, this study sought to examine the effects of goal types (specific, learning, and open) on performance in simple and complex conditions of a walking task. Overall, no significant differences were found between specific and learning goals on the simple and complex tasks, thus rejecting H1 and H2. However, as hypothesised, there was no significant difference between performance produced in the open goal condition compared to the other conditions (in accordance with H3). Regarding the effect of specific, learning, and open goals on performance related outcomes, this study found that both expected attainment and confidence were significantly higher in the open goal compared to the specific goal condition. Overall, findings from this study offer preliminary evidence in an exercise context of the effects of different goal types and task complexity, whilst offering novel insight into the effect of 'how' (i.e., goal types) individual's set goals and the 'why' (i.e., goal motives).

The findings of this study suggest that goal motives during the tasks did not differ when participants were pursuing different goal types, as no significant effects of the goal condition on goal motives were found. This finding is surprising as it could be predicted that participants would have felt greater autonomy in the open and learning goals as a result of these goal types allowing for individual's input on what is deemed success in an open goal and the ability to apply own strategies in the learning goal condition. However, as both goal motives can be influential for initial behaviours (Sheldon & Elliot, 1998; Teixeria et al., 2012), this could suggest that in the early stages of new behaviours, particularly PA where any activity is better than none at all, any goal type is sufficient as there is no consequential impact on motives. It may be beneficial to assess the longer-term influence of different goal types on motives to assess whether these findings are enduring over time, as the positive effects of controlled motives can dwindle over time (Sheldon & Elliot, 1998), and with the enduring nature of autonomous motives known (Ntoumanis et al., 2014), these are more preferable for behaviour change.

Overall, goal types did not elicit differences in WalCT and psychological-related performance related outcomes. Additionally, goal types did not interact with trial complexity. Whilst goal types seemed to have no effect on the outcomes measured in this study, one's reasons for goal pursuit (i.e., goal motives) was shown to significantly influence several important psychological variables, specifically perceived importance, challenge appraisal, threat appraisal, and future interest. This is not to suggest that goal types are irrelevant, as previous research has shown their importance (e.g., Hawkins et al., 2020; Schweickle et al., 2017; Pilcher et al., 2022), but it may suggest that the effect goal motives have on performance-related variables is more complex than just goal type. Thus, this requires further attention, going beyond goal type and considering the 'why', to advance current understanding of the role of goal motives on successful, sustained performances and behaviours. In practical terms, it may be just as, if not more, important to focus on the reasons why a person is pursuing a goal (i.e., their goal motives) than the type of goals they are setting.

As previously mentioned, this study highlighted the need to consider goal motives when assessing the outcomes of goal pursuit. Overall, no matter the complexity of the task, autonomous and controlled motives led to increased perceptions of importance in the task, which is necessary for goal commitment (DeShon & Landis, 1997). However, when the task was complex in nature, the study suggests that autonomous motives were required for individuals to be interested in repeating the task, which is needed in a PA context to increase the likelihood of repeated, and sustained, engagement (Deci and Ryan, 2008; Sheldon and Elliot, 1998). In addition, no matter the task complexity, autonomous motives led to increased challenge appraisal, whilst controlled motives were negative predictors of challenge and positive predictors of threat appraisal. Together, these findings suggest that autonomous motives for goal pursuit, no matter the type of goal or complexity of the task, can result in favourable psychological outcomes that could further contribute to goal success and repeated positive behaviours.

Researchers have asked questions about the efficacy of different goal types in simple and complex trials, with predictions that other goals, e.g., learning goals, may be more beneficial than specific goal types for individuals new to learning a complex task (Swann & Rosenbaum, 2018). Although research suggests that in a complex trial learning goals would be most advantageous for performance compared to other goal types (Locke & Latham, 2013; Seijts & Latham, 2001; Drach-Zahavy & Erez, 2002), no significant differences were found between goal types in the simple or complex trial, contradictory to our hypotheses. This could be due to changes in individual's response to the complexity of the task as the goal condition was unchanged, or that the reason for completing the task was more influential than the goal type itself. Furthermore, the absence of a significant difference between open and specific goals supports existing literature that there are no differences between specific and non-specific goals on performance (McEwan et al., 2016; Swann et al., 2020). This study adds to this body of evidence with the addition of learning goals highlighting there are no significant differences between learning and open goals, and learning and specific goals. However, our results did show that across all goal conditions, performance in the walking task was best in the simple trial compared to the complex trial. This is to be expected as there are less stimuli to attend to during the simple trial (Drach-Zahavy & Erez, 2002), with the likelihood of participants ability to complete the task also higher (Locke & Latham, 2013). These findings suggest differing goal types for complexity in novel tasks has lesser impact than predicted, with all goal conditions sufficient for pursuit no matter the complexity of the task.

Unexpectedly, there was no main effect of trial complexity on WalCT performance, challenge or threat appraisal during the task. However, the interest in future activities was higher following the complex task than after the simple task. In contexts where repeated engagement is necessary for positive outcomes, such as PA for health (e.g., Posadski et al., 2020), there is a need to increase future interest to lead to long-term adherence and healthier behaviours. Additionally, whilst not a direct effect on performance, promoting future participation would also allow for skills to be tuned and improved resulting in improved performance. Therefore, although somewhat contradictory of other findings in this study, setting goals for individuals in more complex tasks may result in higher repeated engagements. This finding highlights again that the goal type is less important than the complexity of the task, and focus should shift to adapting task complexities accordingly for the desired outcomes.

GST proposes goals should be specific and challenging when an individual perceives the task achievable and that they have the necessary skills and knowledge to be competent in attaining the desired outcome (Locke & Latham, 1990; 2013). This study, involving a novel task, found that for goal attainment to be at its highest, no goal type seems to be more advantageous than another. These findings support early statements in GST that specific, challenging goals may not be as effective in novel tasks (Latham & Locke, 1991). Perhaps unsurprisingly, perceived goal attainment and perceived confidence were both significantly higher in the simple trial compared to the complex trial. With perceived confidence in one's abilities (i.e., self-efficacy; Bandura, 1997) resulting in higher commitment to goal attainment (Locke & Latham, 2002), it is important to facilitate higher levels of confidence. Although this did not translate into greater performance in the WalCT, individuals seemed to perceive they had the adequate knowledge and skills required, as stated is necessary in GST (Locke & Latham, 1990), to complete the task when the complexity was simpler. In turn, this suggests that when setting goals in novel tasks, novices should seek to set simple tasks to improve perceptions ahead of completing the task.

Previously, research found that open goals resulted in the greatest intentions to repeat a behaviour compared to SMART specific goals (e.g., Hawkins et al., 2020) however that past research did not examine learning goals. Additionally, when tasks that are not considered the 'norm' (e.g., PA for an insufficiently active individual), an individual may perceive the challenge of the task to be higher than for those who are accustomed to it (e.g., Hawkins et al., 2024). In the context of novel tasks, we could predict that perceived challenge/threat may be higher due to the unknown nature of it. However, when assessing the effects of goal types on performance-related outcomes (i.e., challenge-threat appraisal and future interest to take part), there were no significant differences between goal conditions on perceived challenge and threat appraisal or future interest, suggesting that in a novel task it did not matter the type of goal being pursued. Although not significant, this study showed that learning goals resulted in the highest future interest to participate. As learning goals elicited the highest levels of autonomous goal motives, it could be that individuals had the greatest autonomy over the task in the learning goal and so were more inclined to want to repeat the behaviour. Overall, learning goals seemed most promising for individuals repeating behaviours. If these findings were to be applied to PA, we would expect that learning goals may lead to repeated engagement if trends followed those of the current study.

6.4.1 Strengths, Limitations and Future Directions

This study sought to explore the effects of goal types in differing task complexities on performance. By following a definition of complexity (Drach-Zahavy & Erez, 2002; Swann & Rosenbaum, 2017), and the appropriate selection of a task, the two trials were deemed by participants to be significantly different in complexities. Although this study offers novel insight into the effect of specific, learning, and open goals in a simple and complex trial whilst also exploring potential effects on goal motives, there are limitations that should be considered when interpreting the findings. The WalCT is a walking *working memory* task, and so findings may have limited generalisability to other contexts. Additionally, the single-item questions were used where possible to reduce the load on participants during the trials. Although offering insight into the effects on variables such as confidence, future studies may use a validated, multi-item measures where appropriate for the variables of interest highlighted in this study (e.g., confidence). Finally, this study employed an experimental design with participants completing both tasks on a single day. Future studies would benefit from examining the effect of different goal conditions over time to observe how these goal's effects may differ as individuals become more competent. Furthermore, additional factors that could affect longer-term engagement, such as positive affect (Rhodes & Kates, 2015) and enjoyment (Kwan & Bryan, 2010), were not collected in this study but should be considered alongside these findings to inform future use of goal types for long term engagement. The findings of this study query suggestions that goal types should be adjusted for complexity of tasks. Alternatively, further research and practice may consider adjusting for task complexity instead: in other words, how can PA be made simpler for those individuals who are inactive.

6.4.2 Practical Implications

Although preliminary, the findings of this study do not promote a particular goal type over another for performance, with no differences between the goal types suggesting, for practice, setting a preferred goal type is sufficient. It is important however to consider the complexity of the task; setting PA goals for simpler tasks could result in greater confidence in one's ability to achieve the task which has been reported to be crucial for successful goal setting (Locke & Latham, 2013). In practice, adjusting an activity to better align with an individual's capabilities and functional capacities could result in increased vigorous intensity activity (Thøgersen-Ntoumani et al., 2023). Additionally, it may be beneficial to understand an individual's motives for being more active when setting PA goals. If practitioners can promote autonomous motives for PA goal-striving, it could lead to greater challenge appraisal and potentially greater persistence that could lead to long-term change.

6.5 Conclusion

To conclude, this is the first study to examine the effect of goal types on goal motives during a performance task. Additionally, it is the first study to explore performance in a task under different goal types in simple and complex trials in response to research suggesting task complexity is a crucial factor in goal efficacy (Locke & Latham, 2013; Swann & Rosenbaum, 2017). The findings of this study support previous research that found no significant differences between specific and non-specific goal types on performance in PA (McEwan et al. 2016; Swann et al., 2020), no matter the complexity of the task. Our findings suggest that there is no 'one size fits all' goal. As such, a whole-population approach (i.e., prescribing a particular type of goal to all people in a given context) should be avoided, and an individualised goal setting approach adopted based on the needs of the person pursuing the goal. Overall, in this task, goal types seemed less influential on variables of interest when compared to the effects had from goal motives. Therefore, attention should be focused less on how someone is setting goals, with efforts pivoted towards ways to improve autonomous motives in people to facilitate repeated engagement and adherence to positive behaviours such as PA.

CHAPTER 7: THE EFFECT OF SPECIFIC AND NON-SPECIFIC GOAL TYPES OVER TIME IN AN INSUFFICIENTLY ACTIVE POPULATION

This chapter is presented in two sub-sections. The first (7A: Design Considerations) presents the findings and learnings of a small-scale study (n = 6) that sought to identify elements of an intervention that required adaptations based on participants experiences which would be taken forward in the design of a seven-week intervention. The second chapter (7B: Intervention) presents the intervention study that was informed by the findings and learnings presented in chapter 7A.

CHAPTER 7A: DESIGN CONSIDERATIONS

7A.1 Rationale

Prior to conducting a longitudinal, goal-setting step-count intervention, there were several design considerations that needed to be addressed. The first of these related to goal difficulty. As highlighted in Chapter 3 of this thesis, the only goal type that has been assessed in relation to physical and psychological outcomes is a specific goal, which has been primarily set using absolute step count goals (e.g., "walk 10,000 steps a day"). To be considered active, a person must be completing 150-minutes of moderate-to-vigorous intensity activity per week (WHO, 2020). As such, the activity levels of those considered insufficiently active could range from zero minutes of activity through to completing 149 minutes of moderate PA per week and so the difficulty of an absolute goal could vary depending on current activity levels. Therefore, I chose to employ a relative goal (e.g., "walk X% more steps a day") and trial different increases from baseline to individualise the goal and to standardise the difficulty which had been omitted from previously experimental research (e.g., Pilcher et al., 2022; Schweickle et al., 2017).

The second consideration to be addressed was participant communication and feedback. In GST (Locke & Latham, 1990), feedback is considered a fundamental moderator of goal success and so I decided that this component of the intervention required tailoring for optimal results, both frequency, and the method of communication and feedback. A third consideration was the equipment: the equipment being used was new to me and so practice with the practicalities of the devices (e.g., participant acceptance, ease of use, battery life) and data reported were needed ahead of official data collection. Therefore, the aim of this study was to inform the design of the intervention study.

7A.2 Methods

Prior to data collection, ethical approval was granted by the University ethics committee (ref: 752). Insufficiently active adults, as assessed by participant's self-assessment ($M_{age} = 37.50 \pm 16.07$; $n_{female} = 3$; $n_{male} = 3$) were recruited via word of mouth and contacts of the candidate for a 3-week intervention (1-week baseline, 1-week intervention, 1-week post-intervention). Both wrist-worn Fitbit Inspire 2 devices (Fitbit Inc, San Francisco, California) and thigh-worn Fibion Research devices (Fibion Inc, Jyväskylä, Finland) were worn by participants for the entire 3-week duration, and the researcher met with participants to collect Fibion data and questionnaire measures on four occasions: (1) pre-baseline week; (2) pre-intervention week; (3) post-intervention week; and (4) post-3-week intervention. After completing the baseline week, activity level was screened for eligibility and step count during this period was then reviewed, and the highest step count on a single day was used to determine the goal. Three increases were trialled using a specific goal for standardisation: (1) 10% above highest baseline steps; (2) 15% above highest baseline steps; and (3) 20% above highest baseline steps. For the intervention week, participants were then provided with their individualised goal for the next 7-days. During the middle and end of the intervention week, participants were emailed a link to a diary entry using an online survey hosted on the JISC online platform, to provide further insight into their perceptions and experience of the goal and identify the number of strategies used in goal pursuit. Pre- and post-intervention measures were recorded using another online survey also hosted on JISC online and included measures of: PA (IPAQ; Craig et al., 2003), mental well-being (SWEMWBS; Tennant et al., 2007), affective exercise experiences (AFFEXX; Ekkekakis et al., 2021), general self-efficacy (GSE; Schwarzer & Jerusalem, 1995), and motivation (BREQ-3; Markland & Tobin, 2004; Wilson et al., 2006). The purpose of collecting these measures during the design study was less so for assessing differences from the goal conditions, but to test the acceptability and practicality of the content of the pre- and post-intervention questionnaire intended for use in the intervention. After completing the full three weeks, participants took part in a semi-structured interview to gain further insight into the design elements of the study. Upon completion, participants were offered a £10 gift card to compensate for their time.

7A.3 Findings and Learnings

There were five intervention elements that were highlighted during the design study that needed tailoring and implementing going forwards. Participants are referred to as [P] throughout followed by the percentage increase associated with the assigned goal condition (e.g., [P0, 10%]).

7A.3.1 Goal Difficulty

There were no observed differences between the increase in steps from baseline to post-intervention in the 10% increase goal condition (M_{diff} = 2031.50 ± 1474.32 steps) and the 20% increase goal condition (M_{diff} = 2023.00 ± 1401.49 steps), however the lowest effect was had by the

15% increase goal condition (M_{diff} = 1072.00 ± 448.31 steps). Therefore, it was decided that goals set at 20% increase from baseline would be acceptable for the specific and learning goal conditions. However, in the interviews, it was discussed by P5 [15%] that "after your first week, it [step goal] probably should be an average of that week" rather than an increase from the highest daily step count. This was supported by other participants; for instance, when the highest step count was recorded on a weekend day, they mentioned having more "free time for activity" [P6, 20%] on weekends. Thus, having a step-count goal based on the highest step count from a weekend day may not be feasible on a day-to-day basis. As a result, the baseline increases for the specific and learning goal were changed from increasing from highest day of steps to average steps of the week.

7A.3.2 Strategies

On average, 1.5 strategies were implemented by participants over the intervention week in the design study as reported in diary entries. Several participants spoke about making walks part of their daily routine by "Going for a walk every morning and evening" [P1, 10%] and "I did do extra dog walks when I could to make the steps" [P2, 15%]. Therefore, it was determined that in the learning goal condition, participants would only be asked to implement one strategy (e.g., "Identify and implement *one* strategy to walk 20% more steps").

7A.3.3 Devices

The Fitbit was widely accepted by all participants. However, participants found the Fibion device more problematic. As one participant commented "[it] isn't the easiest [to wear] ... rubbing on my clothing making it uncomfortable to wear all the time" [P1, 10%] and participants suggested only wearing it for shorter periods of time would be possible "because of the inconvenience" [P1, 10%]. To avoid causing discomfort that could result in low retention rates, it was decided that the Fibion device would only be worn in the first and last week of the 7-week intervention, which also reduced the amount of researcher visits to participants.

7A.3.4 Communication

After conducting the interviews, it became evident that emails were not the only form of communication that participants preferred, with many suggesting that offering text messages as an option would be useful as “people have always got their phones on them so they can always pick up a text message” [P1, 10%]. It was also discussed that if over a longer timeframe, contact would only be needed weekly rather than twice weekly. Consequently, for the 7-week intervention, both email and text message, via FireText, was offered for communication and contact would only be made once a week.

7A.3.5 Questionnaires

Going forward, an element of the intervention that remained unchanged was the inclusion and use of JISC for diary entries and questionnaires are they “were easy to do...weren’t too long” [P5, 15%] and allowed the researcher to remotely communicate rather than increasing the number of visits to participants. Overall, this design study allowed for further insight into the experience of individuals and the practicalities of the proposed 7-week intervention. With the adaptations made outlined above, the feasibility and acceptability of the intervention are likely to be increased, and experiences of participants improved.

CHAPTER 7B: INTERVENTION

Physical inactivity is a global concern, which, if addressed, could reduce the rate of preventable all-cause mortality. Goal setting is one of the most used behaviour change techniques for PA promotion, yet rates of inactivity remain high. Based on recommended guidance and the existing literature, the majority of goal users set specific goals (e.g., SMART). However more recent experimental evidence has demonstrated the efficacy of alternative goal types (e.g., open, learning), which could be more beneficial for those new to a behaviour, such as insufficiently active adults. This study employed a mixed methods design and sought to determine the effect of different goal types (specific, open and learning) on physical and psychological outcomes during a 7-week step count intervention (N = 45; M_{age} = 40.51 ± 13.39). Factorial ANOVA analysis revealed that over time, setting a goal was effective for increasing step count ($F[6, 228] = 5.28$, $p < .001$, partial $\eta^2 = .12$), mental well-being ($F[1, 38] = 10.74$, $p < .01$, partial $\eta^2 = .22$), motivation ($F[1, 38] = 16.50$, $p < .001$, partial $\eta^2 = .30$), and affect ($F[1, 38] = 10.75$, $p < .01$, partial $\eta^2 = .22$), but not self-efficacy of insufficiently active individuals. However, there were no differences between the goal types on any reported outcomes. Content analysis was also conducted, offering insights into participants' experiences and strategies used in goal pursuit. This study provides novel insight into the effect of different goal types over time for insufficiently active adults striving to be physically active.

7B.1 Introduction

PA is defined as any activity that increases energy expenditure past a state of rest (Casperson et al., 1985). Although considered to be a fundamental behaviour for a healthy lifestyle (Warburton & Bredin, 2017), global PA levels are low, with 43% of adults not currently meeting World Health Organisation (WHO, 2020) guidelines of 150-minutes of moderate-to-vigorous intensity activity per week. It is suggested that if individuals were to increase their PA levels, this would reduce the prevalence of millions of preventable health conditions (Santos et al., 2023), which in turn would reduce economic strain on healthcare systems.

One of the most utilised behaviour change tools for PA promotion is goal setting, with goal setting being the most employed tool for behaviour change for insufficiently active adults specifically (Howlett et al., 2019; McEwan et al., 2022). Overall, goal setting is effective for increasing PA (McEwan et al., 2016), particularly in an insufficiently active population (Garstang et al., 2024). However, this research is limited in the sense that a vast number of studies assessing this effect of goals fail to report the effects on psychological outcomes related to PA, and so they are relatively unknown. The few studies that have considered the effect on psychological outcomes in addition to PA are still limited as there is no comparison between goal types as only specific goals have been trialled vs. no goal or a baseline (see review by Garstang et al., 2024). To date only specific goals (e.g., "Walk 10,000 steps a day") have been reviewed in comparison to no goal at all in an insufficiently active population, highlighting the need to explore the effects of alternative goal types for PA promotion.

Best practice in goal pursuit has traditionally been to set specific, SMART (i.e., Specific, Measurable, Achievable, Realistic, and Timebound; Doran, 1981) goals (Swann et al., 2023), there are elements of the SMART acronym that can be supported by GST (Locke & Latham, 1990), but not all. However, GST (Locke & Latham, 1990; 2002) originated in a business context, where performance was a direct determinant of success and does not compare to a PA context, where the focus is more on participation and adherence. Furthermore, developments in GST state that specific goals are only efficacious when an individual is proficient in the skill and knowledge required to achieve the goal, and where this is not the case, learning goals (e.g., "Identify and implement a strategy to walk more") should be set instead to allow for individuals to develop relevant knowledge and skills. From the viewpoint of GST, vague, non-specific goals (e.g., open goals: "See how far you can walk") are not considered suitable for goal pursuit in any context (Locke & Latham, 2013). However, this is yet to be considered in a PA context for an insufficiently active population and so this study looks to provide comment on this theoretical assumption in this context.

Although it is suggested in GST that only specific and learning goals are appropriate, a more recent review of goal setting for PA behaviour by McEwan and colleagues (2016) reported no differences in the effects between specific and vague (i.e., non-specific) goal types, thus suggesting the initial theory to set specific goals is not necessarily the most optimal goal type in this context. Further empirical research has examined the effects on PA and a range of psychological outcomes multiple goal types in brief walking tests, including specific, SMART, open, learning, as-well-as-possible, and do-your-best goals (Carter et al., 2021; Hawkins et al., 2020; Swann et al., 2020; 2022). Findings consistently report all goal types (SMART, learning, open, AWAP and DYB) are better than a control in a 6MWT (Carter et al., 2021; Hawkins et al., 2020; Swann et al., 2020; 2022). Additionally, although mixed, early findings do however show promise for vaguer goal types (i.e., open, AWAP, and DYB), particularly for psychological outcomes, such as increased interest in repeating a task under an open goal compared to no goal (Swann et al., 2020; 2022) and self-efficacy under an open goal compared to a SMART goal (Carter et al., 2021). For example, one study reported the findings for insufficiently active individuals in isolation and found that these individuals experienced greater levels of pleasure and enjoyment when pursuing an open goal compared their active counterparts (Hawkins et al., 2020). However, these studies were limited in that they only report effects at a single time point in a 6MWT assessing distance walked in six minutes and so findings cannot be generalised to PA behaviour change as the processes needed to pursue a goal in real time for an extended period are very different to a single activity bout, highlighting the need to assess these goal types in a longitudinal 'real world' study design.

A participant's perceptions of the tasks can also be critical to goal pursuit and success. If a task is perceived to be too complex for an individual, particularly those in the early stages or learning or engaging in a new behaviour, specific goals should be avoided as they can be detrimental for goal performance (Locke & Latham, 2013). Instead, Locke and Latham (2013) suggest setting learning goals to allow for new skills and knowledge to be acquired for goal pursuit. However, learning goals are relatively under researched in PA contexts having only been employed in one experimental study using the 6MWT which also did not consider the complexity of the task (Carter et al., 2021), and further exploration of this goal type is required over time to better understand the effects of this goal type. Additionally, GST states that commitment is a moderator of goal success and without it a goal cannot be attained (Locke & Latham, 1990). Therefore, it is crucial to determine an insufficiently active individual's perceptions of how complex a goal is for PA, and how important and committed they are to it, to provide further understanding of the real-world effects of these goals over time and how this may change.

In addition to the types of goals set by individuals, it is also important to consider the motives underpinning goal pursuit as these can affect behaviours and overall well-being (Deci & Ryan, 2000; Sheldon & Elliot, 1999). There are two overarching goal motives; autonomous motives pursued out enjoyment or value, and controlled motives that are pursued because of internal or external pressures (Deci & Ryan, 1985b; Sheldon & Elliot, 1999). Although both types of motive can be beneficial for initiating goal pursuit (Deci & Ryan, 2008), researchers within the motives literature favours self-concordant, autonomous motives as these types of motive are pursued for enjoyment and are highly valued by individuals, resulting in more enduring pursuits of behaviours (Sheldon & Elliot, 1998; Ntoumanis et al., 2014a). Overall, the effects of goal motives (e.g., Ng et al., 2012) and goal types (e.g., McEwan et al., 2016) are widely reported, yet interventions fail to consider the two related variables together when examining these effects. As such, addressing this limitation could be valuable for providing greater clarity to practitioners and researchers when prescribing goals by highlighting the relationship between goal motives and goal types for PA pursuit.

Therefore, using a mixed methods design, the aim of this study was to determine how different goal types (specific, open and learning) affect step count and psychological outcomes (motivation, self-efficacy, affect and mental well-being) related to PA in a real-world context and across an extended period compared to the previous literature. Secondly, this study aimed to explore how an individual's goal motives may result in differences in physical and psychological outcomes over time. Thirdly, this study aimed to explore the experiences of insufficiently active individuals pursuing different goal types through diary entries. Based on the existing literature, we hypothesised that: H1: All goal conditions will elicit better step counts than at baseline; H2: Learning goals will elicit greater difference in baseline and week 6 step counts compared to the specific and open goal; H3: Open goals will elicit more adaptive changes in psychological variables (motivation, self-efficacy, affect and mental well-being); and H4: autonomous motives will have greater increases in physical and psychological outcomes (motivation, self-efficacy, affect and mental well-being).

7B.2 Methods

7B.2.1 Participants and Recruitment

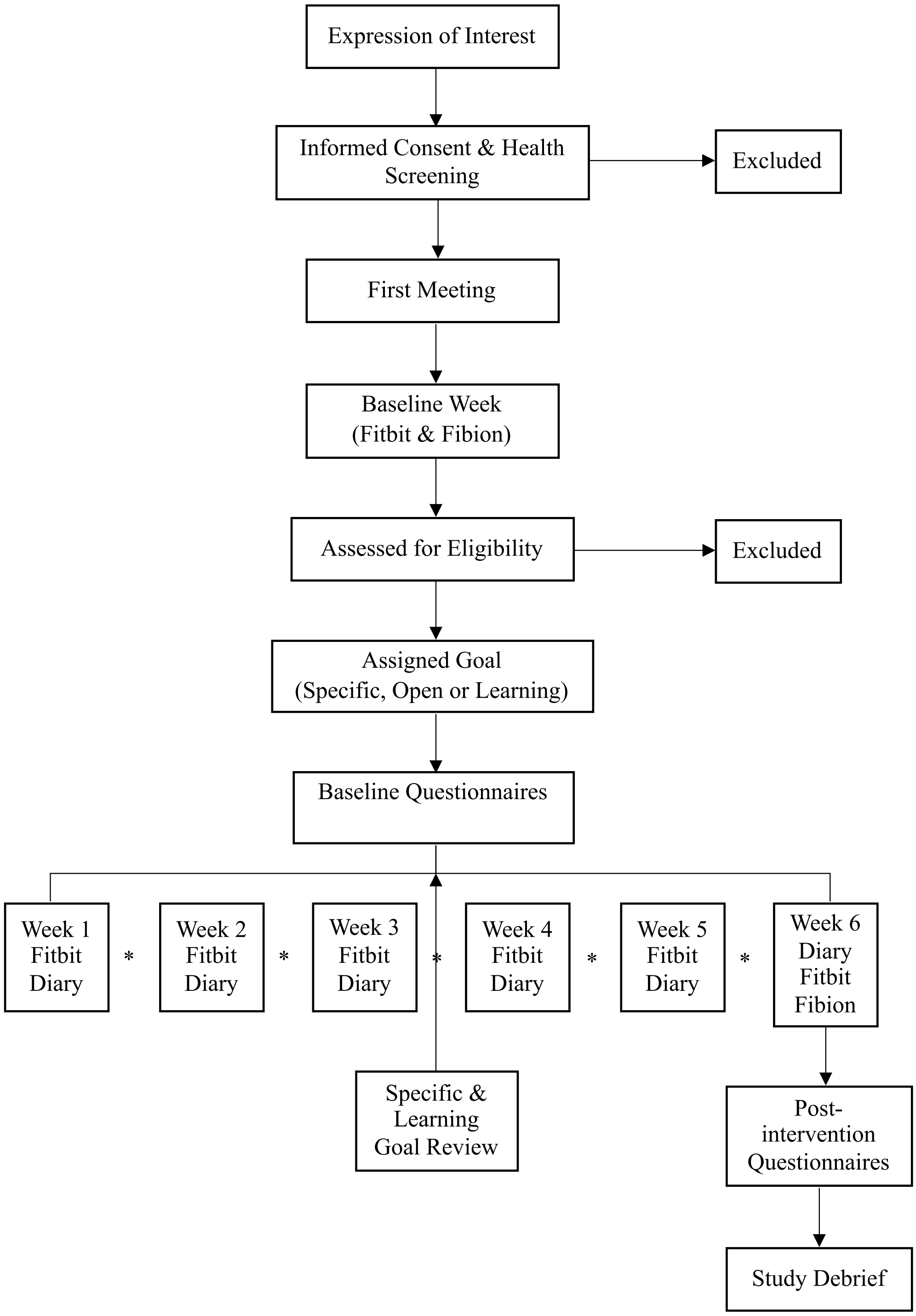
To be eligible to take part, participants had to be aged 18-64 years old, healthy (either free of infirmity, or with a well-managed condition), and insufficiently active (i.e., not meeting WHO [2020] PA guidelines of 150-minutes of moderate-to-vigorous intensity activity per week). Participants were ineligible for the study if they: (1) had an injury that prevented them from walking and going about their daily lives; (2) had a known, unmanaged health condition; or (3) incurred any short-term illnesses or conditions that prevented them from walking or required doctors' approval to commence PA. An *a priori* power analysis (α = .05; 80% power; f =.55 [McEwan et al., 2016]); correlation among repeated measures = 0.5) conducted using G*Power software (V3.1) indicated that a sample size of 36 participants was necessary, comprising 12 for each goal condition. To allow for attrition and non-compliance, we targeted recruiting a sample of 50 (based on a 37.4% increase of the calculated sample [Howie & Straker, 2016]). A total sample of 52 insufficiently active healthy adults, as determined by a health screen, meeting the eligibility criteria were recruited, however only 45 continued participation post-baseline due to ineligible activity levels (n = 5), poor health (n = 1), and not wearing devices (n = 1). Participants were recruited via convenience and snowball sampling through contacts of the research team and word of mouth, as well as via social media, and a university wide noticeboard website. Participants were only included in the full trial after completing a 7-day baseline period to assess activity level for eligibility inclusion and ensure we were recruiting insufficiently active adults. After participants completed the intervention, they were provided with a £20 gift card as compensation for their time.

7B.2.2 Procedure

Prior to commencing data collection, ethical approval was granted by the doctoral candidate's institutional ethics committee (ref: 1641482). An experimental, between-within groups design was used (Figure 10).

Figure 10

Intervention Schematic



Note. (*) is indicative of the time points where an individual received a reminder of their goal.

Potential participants contacted the doctoral candidate with expressions of interest. They were then provided with an information sheet, informed consent and health questionnaire. If at this time participants were considered eligible and remained interested in taking part, an initial meet was arranged to explain the study measures, devices and overview. Participants then completed a baseline week wearing a Fibion Research thigh-worn accelerometer (measuring amount of moderate-to-vigorous PA) and wrist-worn Fitbit Inspire 2 (to measure step-count and provide real time feedback to participants). After seven days, the researcher met with the participant to collect the Fibion device. The 7-day baseline data was assessed against eligibility criteria. Those partaking in less than 150-minutes of moderate, or 75-minutes of vigorous activity were included, and if more was completed, these participants were excluded. After eligibility screening, participants were randomised using simple randomisation to one of three goal conditions: *specific* ("walk baseline + 20% each day"), *open* ("see how many steps you can walk each day"), or *learning* ("identify and implement one strategy to walk baseline + 20% each day") and completed the pre-intervention psychological variable questionnaires. Participants then received weekly step count reminders and diary entry links by their preferred contact method; text message (via FireText) or email. At the mid-point of the intervention, participants were provided with an overview of their baseline levels of activity and step count and how this had changed in the first three weeks. Those in the specific and learning goal had their step counts re-evaluated, and if consistently met their goal, it was increased a further 20%; the open goal condition remained the same. After five weeks of goal pursuit, participants were provided with the Fibion device for the final seven days. At the end of the seven weeks, the researcher and participant met to collect all devices, complete the post-intervention questionnaires and to be de-briefed.

7B.2.3 Devices

7B.2.3.1 Fitbit Inspire 2. The Fitbit Inspire 2 is a wrist worn device and was used to record daily step counts. It was selected for this study as its interactive watch face enables participants to receive real time feedback which is essential for goal pursuit (Locke & Latham, 2013). A study found that ~98 of 100 stepping bouts were accurately recorded by Fitbit Inspire 2 devices, with only ~1 of 100 non-stepping bouts inaccurately recorded as a stepping bout

(Delobelle et al., 2024). All participants synced the devices to the Fitbit smartphone app to store daily step-count information and the device was worn for the full 7-week duration of the study.

7B.2.3.2 Fibion Research. As the study population is insufficiently active, it was predicted that individuals may be more sedentary than active. Therefore, the Fibion Research device was selected for its ability to distinguish between active and sedentary behaviours (Alkalih et al., 2022). The Fibion Research device is a tri-axial accelerometer to be worn at thigh level in a pocket or using the thigh strap provided. Overall, the device has an 85-89% accuracy (Montoye et al., 2022). The device was worn for seven days at baseline and for the final seven days (week 6) of goal pursuit.

7B.2.4 Measures

7B.2.4.1 Physical Activity. Self-report moderate-to-vigorous PA (MVPA) and the classification (i.e., transport, work, leisure) of PA was assessed using the IPAQ (Craig et al., 2003). The IPAQ was selected as it can be used to calculate total moderate and total vigorous activity time in isolation to other types of activity and could be comparable to total moderate-vigorous activity objectively reported by the Fibion Research device. The IPAQ has very good internal consistency ($\alpha = .70$; Moghaddam et al., 2012).

7B.2.4.2 Goal Motives. Goal motives were assessed after participants received their individualised goal using a 10-item Goal Motivation questionnaire (Riddell et al., 2022; Sheldon & Elliot, 2017). Participants were asked to rate their reasons for pursuing the goal provided on a 7-point Likert scale, ranging from 1 (*Not at all*) to 7 (*Very much so*). The measure was divided into subscales that represented the two motives: autonomous goal motives (i.e., identified and intrinsic motivation) had four items, and controlled motives (i.e., extrinsic, positive introjected and negative introjected) had six items. Scores were averaged for each motive. The internal reliability of the autonomous motives (a = .80) and controlled motives (a = .75) were very good (Riddell et al., 2022), which was reflected in this study (autonomous motives: $\alpha = .69$; controlled motives: $\alpha = .81$).

7B.2.4.3 Self-Efficacy. Self-efficacy was measured pre- and post-intervention using the General Self-Efficacy scale (GSE; Schwarzer & Jerusalem, 1995). The measure is a 10-item questionnaire (e.g., "*It is easy for me to stick to my aims and accomplish my goals*") was scored on a Likert scale from 1 to 4 (*1 = Not at all true; 2 = Hardly true; 3 = Moderately true; 4 = Exactly true)*. All items were totalled to provide an overall self-efficacy score; higher scores were indicative of higher self-efficacy. The GSE has very good internal consistency of $\alpha = .75$ (Scholz et al., 2002), which was reflected in this study ($\alpha = .88$).

7B.2.4.4 Motivation. Motivation was measured pre- and post-intervention using the Behavioural Regulations in Exercise Questionnaire 3 (BREQ-3; Markland & Tobin, 2004; Wilson et al., 2006). The BREQ-3 is a 24-item questionnaire based on SDT literature and computes scores for six subscales representing the six forms of regulation ('amotivation', 'external regulation', 'introjected regulation', 'identified regulation', 'integrated regulation', and 'intrinsic regulation') and also a relative autonomy index (RAI) of self-determination. Each item was scored on Likert scale ranging from 0 to 4 (*0 = Not true for me; 1, 2 = Sometime true for me; 3, 4 = Very true for me*). Each subscale was averaged to provide a score for each form of regulation and was then multiplied by its assigned weighting, which were then totalled for an overall RAI score; higher scores were indicative of greater autonomous motivations. The BREQ-3 has good internal consistency in adult populations ($.66 \leq \alpha \leq .75$; Vancampfort et al., 2018) which was reflected in this study ($\alpha = .79 \leq \alpha \leq \alpha = .92$).

7B.2.4.5 Affect. Affective exercise experiences were measured pre- and post-intervention using the AFFEXX questionnaire (Ekkekakis et al., 2021). The single scale of 'antipathy-attraction' was scored and presented as a representation of affective experiences and one's desire, or not, to complete PA due to its influence from the three core antecedent variables. The AFFEXX 'antipathy-attraction' scale includes five items by which participants rated pairs of opposite on a 7-point scale (e.g., 1 = *"Exercise is an uninviting activity" vs. 7 = "Exercise is a tempting activity"*); higher scores were indicative of higher attraction, and lower scores indicative of higher antipathy for exercise. The subscale has very good internal consistency ($\alpha = .92$; Ekkekakis et al., 2021) which was reflected in this study ($\alpha = .89$).

7B.2.4.6 Mental Well-being. Perceived mental well-being was captured pre- and post-intervention using the 7-item Short Warwick Edinburgh Mental Wellbeing Scale (SWEMWBS; Tennant et al., 2007); permission for use was sought prior to data collection. Participants responded to statements of their thoughts and feelings over the past two weeks on a 5-point Likert scale (*1 = None of the time; 2 = Rarely; 3 = Some of the time; 4 = Often; and 5 = All of the time*). The items were then totalled and converted; higher sores were indicative of higher positive mental well-being. The SWEMWBS has very good internal consistency (α = .89; Stewart-Brown et al., 2011), which was reflected in this study (α = .86).

7B.2.4.7 Goal Perceptions. Goal perceptions of complexity, commitment, and importance were scored using three single-item questions and were recorded pre- and post-intervention. Participants were asked to rate their perceived complexity ("*How complex do you believe your goal is*?"), perceived commitment ("*How committed are you to your goal*?"), and perceived importance ("*How important is your goal to you*?") of the goal on a Likert scale from 1 (*Not at all*) to 7 (*Very*) with a mid-point, 4 (*Somewhat*). Higher scores indicated higher perceptions of complexity, commitment, and importance.

7B.2.5 Qualitative Diary Entries

Diary entries were completed at the end of each week remotely using JISC online to capture participant experiences that could support quantitative findings and provide a greater understanding of the effect of goal types and the application of them. Participants would input the previous week's daily step counts (that were verified on the Fitbit app post-intervention) and were then provided with a space to provide any information regarding strategies used under each goal condition.

7B.2.6 Data Analysis

Prior to conducting statistical analysis, data were screened for missing responses and incomplete participant data. Following this, data were analysed using SPSS Version 29. Descriptive statistics were reported before a MANOVA analysis was performed to test the effect of goal types on goal motives upon receiving a goal. A 3 (goal group) x 7 (week) factorial within-between ANOVA was also conducted to test for goal group differences across the seven weeks in average daily steps. Six 3 (goal group) x 2 (time: pre/post) were used to assess for pre and post differences in self-efficacy, motivation, affect and mental well-being, and goal perceptions (complexity, importance and commitment respectively). Additionally, linear regression analyses were performed to identify the effect of goal motives on step count, motivation, self-efficacy, affect, mental well-being and participant perceptions of complexity, importance and commitment. Diary entry data of participants strategies and experiences were analysed using content analysis (Krippendorff, 2018). An inductive, deductive approach was employed based on past research (e.g., types of PA grouped in the IPAQ such as activity for transportation [Craig et al., 2003], and elements of GST deemed important such as feedback [Locke & Latham, 1990]), participant experiences and the researcher's prior knowledge of using goals and engaging in PA. Diary responses yielded a total of 6,664 words across the 41 participants over the six weeks of goal pursuit. For analysis, entries were split by goal condition to allow for comparisons of experiences to be made between different goal types. The doctoral candidate became familiar with the data by reading all diary entries as they were submitted and again during analysis before generating the codes which were reviewed with my director of studies prior to clustering the codes into categories which were then again reviewed by the doctoral candidate and director of studies together.

7B.3 Results

7B.3.1 Descriptive Statistics

Following data collection, four participants were removed, as equipment failures meant that objective PA levels were not available and IPAQ self-reported data excluded these participants as they were then considered ineligible (i.e., their self-report PA levels indicated that they met the WHO recommendations). A total of 41 participants completed data collection (M_{age} = 40.90 ± 13.65; n_{female} = 33, n_{male} = 8). Descriptive statistics are presented in Table 15.

Table 15

Means and standard deviations of all measured variables across the three goal conditions

	Specific (*n* = 14)	Open (*n* = 14)	Learning (*n* = 13)
Age	45.00 ± 12.01	36.15 ± 14.24	40.92 ± 14.31
Gender (% female/% male)	78.57/21.43	78.57/21.43	84.62/15.38
Daily Steps			
Baseline	7354.5 ± 1765.52	7183.50 ± 2987.04	7123.38 ± 2338.97
Week 6	8432.50 ± 2855.18	7878.79 ± 2643.24	8428.31 ± 3401.05
Autonomous Motives[a]			
Baseline	5.29 ± 1.42	4.59 ± 1.60	4.90 ± 1.09
Controlled Motives[a]			
Baseline	4.31 ± 1.65	4.07 ± 1.64	4.57 ± 1.17
Self-efficacy[b]			
Baseline	32.86 ± 4.29	28.79 ±3.85	31.07 ± 4.70
Week 6	32.86 ± 4.77	30.71 ± 4.79	31.54 ± 3.18
Affect[c]			
Baseline	3.97 ± 1.57	3.87 ± 1.28	3.23 ± 1.50
Week 6	4.64 ±1.70	4.40 ± 1.00	4.26 ± 1.30
Motivation[d]			
Baseline	6.16 ± 8.00	4.30 ± 5.18	2.88 ± 6.13
Week 6	9.14 ± 7.60	8.11 ± 5.95	7.33 ± 6.31
Mental Well-being[e]			
Baseline	23.28 ± 4.07	21.18 ± 3.37	21.88 ± 4.61
Week 6	25.53 ± 6.79	23.67 ± 5.61	24.39 ± 3.07
Perceived Complexity[f]			
Baseline	2.86 ± 1.83	2.64 ± 1.50	2.54 ± 1.39
Week 6	3.00 ± 2.04	2.92 ± 1.59	3.62 ± 2.10
Perceived Importance[f]			
Baseline	5.21 ± 1.37	5.21 ± 1.53	5.69 ± 1.03
Week 6	5.29 ± 1.27	5.21 ± 1.31	4.85 ± 1.07
Perceived Commitment[f]			
Baseline	6.29 ± 0.91	5.64 ± 1.69	5.62 ± 1.12
Week 6	5.21 ± 1.25	5.00 ± 1.24	4.77 ± 1.74

Note. (a) average scores ranged from 1 to 7 higher scores were indicative of greater association of that motive; (b) total score ranged from 10 to 40, higher scores were indicative of higher self-efficacy; (c) scores ranged from 1 to 7, scores closer to 1 related to antipathy and 7 attraction; (d) higher scores were indicative of greater autonomy; (e) higher scores were indicative of greater perceived well-being; (f) perceptions were a single measure with scores ranging from 1 to 7 with higher score indicative of higher perceived commitment/complexity/importance.

7B.3.2 Goal Motives

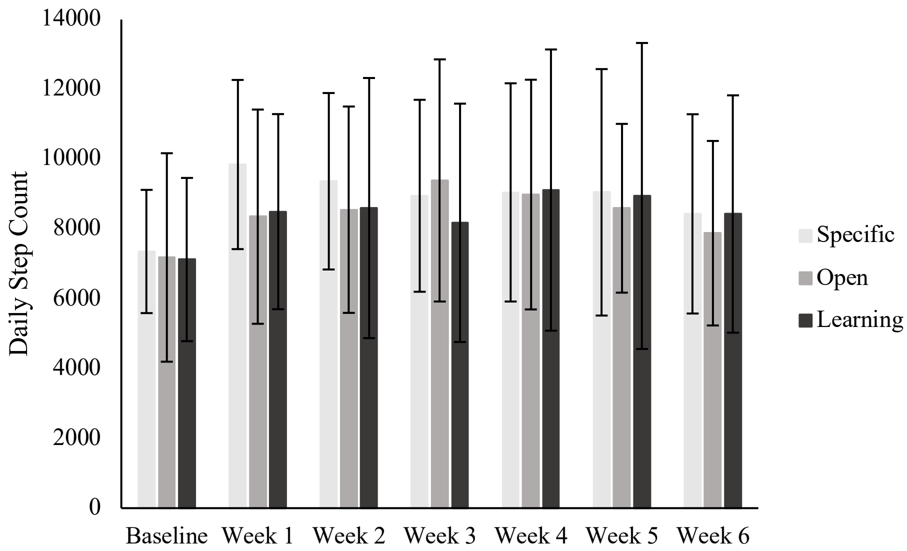
The were no differences between goal conditions on goal motives at baseline (F[4, 74] = 0.92, p = .46; Wilks' Λ = .91; partial η^2 = .05).

7B.3.3 Step Count

There was no main effect of goal condition (F[2, 38] = 0.14, p = .87, partial η^2 = .01) on step count. There was a main effect of time on step count (F[6, 228] = 5.28, p < .001, partial η^2 = .12). Post-hoc analysis revealed that participants recorded more steps in week 1 ($M_{\text{diff}} \pm SE$ = 1677.70 ± 310.67, p < .001), week 2 ($M_{\text{diff}} \pm SE$ = 1618.84 ± 361.21, p = .001), week 3 ($M_{\text{diff}} \pm SE$ = 1618.40 ± 344.36, p < .001) and week 4 ($M_{\text{diff}} \pm SE$ = 1828.69 ± 405.13, p = .001) compared to baseline ($M \pm SE$ = 7220.46 ± 377.85). There was no interaction effect between goal condition and time (F[12, 228] = 0.69, p = .76, partial η^2 = .04). Additionally, autonomous and controlled goal motives did not significantly predict step count post-intervention (F[2, 38] = 1.79, p = .18, R^2 = .09).

Figure 11

Weekly step count averages for each goal condition



As can be seen in the standard deviations in Figure 11, there is a large variability in step count week by week under each goal condition.

7B.3.4 Mental Well-being

There was no main effect of goal condition on mental well-being (F[2, 38] = 0.81, p = .45, partial η^2 = .04). There was a main effect of time on mental well-being (F[1, 38] = 10.74, p = .002 partial η^2 = .22). Post hoc analysis revealed post-intervention mental well-being scores were higher than pre-intervention ($M_{\text{diff}} \pm SE$ = 2.42 ± 0.74, p = .002). There was no interaction effect between goal condition and time (F[2, 38] = 0.01, p = .99, partial η^2 < .01). Additionally, autonomous and controlled goal motives did not significantly predict mental well-being post-intervention, however it did approach significance highlighting a trend (F[2, 38] = 2.82, p = .07, R^2 = .13).

7B.3.5 Self-Efficacy

There was no main effect of goal condition (F[2, 38] = 2.27, p = .12, partial η^2 = .11), time (F[1, 38] = 1.77, p = .19, partial η^2 = .04), or interaction effect between the two variables (F[2, 38] = 0.96, p = .39, partial η^2 = .05) on self-efficacy. Additionally, autonomous and controlled goal motives did not significantly predict self-efficacy post-intervention (F[2, 38] = 1.93, p = .16, R^2 = .09).

7B.3.6 Motivation

There was no effect of goal condition on motivation (F[2, 38] = 0.63, p = .54, partial η^2 = .03). There was an effect of time on motivation (F[1, 38] = 16.50, p < .001, partial η^2 = .30). Post hoc analysis revealed post-intervention motivation scores were higher than pre-intervention ($M_{\text{diff}} \pm SE$ = 3.74 ± 0.92, p < .001). There was no interaction effect between goal condition and time (F[2, 38] = 0.21, p = .81, partial η^2 = .01). Additionally, autonomous and controlled goal motives did not significantly predict motivation post-intervention (F[2, 38] = 2.07, p = .14, R^2 = .10).

7B.3.7 Affect

There was no effect of goal condition on affect (F[2, 38] = 0.75, p = .48, partial η^2 = .04). There was a main effect of time on affect (F[1, 38] = 10.75, p = .002, partial η^2 = .22). Post hoc analysis revealed post-intervention affect scores were higher than pre-intervention ($M_{\text{diff}} \pm SE$ =

0.74 ± 0.23, $p < .01$). There was no interaction effect between goal condition and time ($F[2, 38] = 0.43$, $p = .66$, partial $\eta^2 = .02$). Additionally, autonomous and controlled goal motives did not significantly predict affect post-intervention ($F[2, 38] = 0.43$, $p = .65$, $R^2 = .02$).

7B.3.8 Goal Perceptions

7B.3.8.1 Perceived Complexity. There was no main effect of goal condition on perceived complexity ($F[2, 38] = 0.11$, $p = .90$, partial $\eta^2 = .01$). There was a main effect of time on perceived complexity ($F[1, 38] = 0.14$, $p = .03$, partial $\eta^2 = .12$). Post hoc analysis revealed post-intervention perceptions of perceived complexity were higher than pre-intervention ($M_{\text{diff}} \pm SE = 0.50 \pm 0.22$, $p = .03$). There was no interaction effect between goal condition and time ($F[2, 38] = 1.70$, $p = .20$, partial $\eta^2 = .08$). Additionally, autonomous and controlled goal motives did not significantly predict perceived complexity post-intervention ($F[2, 38] = 0.32$, $p = .73$, $R^2 = .02$).

7B.3.8.2 Perceived Importance. There was no main effect of goal condition ($F[2, 38] = 0.01$, $p = .99$, partial $\eta^2 = .00$), time ($F[1, 38] = 1.97$, $p = .17$, partial $\eta^2 = .05$), or interaction effect between the two variables ($F[2, 38] = 2.51$, $p = .10$, partial $\eta^2 = .12$) on perceived importance. Goal motives were a significant predictor of perceived importance post-intervention ($F[2, 38] = 5.05$, $p = .01$, $R^2 = .21$). However, post hoc analysis did not report any significances of autonomous or controlled motives; this could be a result of the relatively small sample size compared to that usually needed for a MANOVA.

7B.3.8.3 Perceived Commitment. There was no main effect of goal condition ($F[2, 38] = 0.85$, $p = .43$, partial $\eta^2 = .04$) on perceived commitment. There was a main effect of time on perceived commitment ($F[1, 38] = 15.78$, $p < .001$, partial $\eta^2 = .29$). Post hoc analysis revealed pre-intervention perceptions of perceived commitment were higher than post-intervention ($M_{\text{diff}} \pm SE = 0.85 \pm 0.22$, $p < .001$). There was no interaction effect between goal condition and time ($F[2, 38] = 0.34$, $p = .71$, partial $\eta^2 = .02$). Additionally, autonomous and controlled goal motives did not significantly predict perceived commitment post-intervention ($F[2, 38] = 0.63$, $p = .54$, $R^2 = .03$).

7B.3.9 Qualitative Diary Entries

Diary entries were analysed to examine participant perceptions during the intervention. Four overarching categories were generated from the data (Table 16): (1) Challenges in goal pursuit; (2) Feedback; (3) Lifestyle change; and (4) Behaviour intentions.

Table 16

Participant experiences and strategies of goal pursuit under each goal condition

Categories	Code	Description	Example Quotes	
Challenges in goal pursuit	Barriers	Things that are perceived to impede progress towards goal success	Specific	“Despite wanting to push and achieve each day, work and daily life just didn't allow. This was a difficult week” [P43, Wk6]
			Open	“To keep goal in mind and to move/walk more on days when I’m WFH has been challenging” [P50, Wk6]
			Learning	“I did not actually complete the goal any of the days this past week. I wasn't feeling myself, and with the wetter and colder weather I could not bring myself to go outside and walk. My days this week were also varied and different from my usual routine. As I finished days without hitting the goal, I had less motivation to do better the next day” [P45, Wk4]
	Goal changing	Notable changes to the prescribed goal	Specific	“Decided that as I can’t reach the 8k goal I would just try to do as many steps as possible. This has meant I have reached my previous goal quite comfortably so I see that as a win in some ways!” [P40, Wk6]
			Open	“I need to actually give myself a specific goal (rather than walking where possible)” [P50, Wk2]
			Learning	“I am now walking as much as possible” [P21, Wk4]
	Vagueness		Specific	“Being outdoors more” [P19, Wk3]

		Lack of clarity in strategy for goal pursuit	Open	"Nothing specific, just trying to do a bit more than before" [P50, Wk2]
			Learning	"Just followed my daily routine" [P30, Wk1]
Feedback	Internal reflection	Looking back and reviewing activity/actions/ decisions that went well/didn't go well	Specific	"I have realised that if I have a day when I am working at home all day, I don't do enough steps" [P22, Wk1]
			Open	"The given goal is to walk as many steps as you can ... Think it would be relatively easy to walk 10000 steps each day but difficult to motivate myself when working from home. Office based is easy to be much higher" [P50, Wk3]
			Learning	"I have felt less motivated to have 7 complete days. My days vary and sometimes it's really easy to hit my target, some day it's more daunting. I like the feeling of hitting my step count, but it's become less of a motivator. [P45, Wk3]
	Device feedback	Monitoring step count/activity through wearable accelerometer device	Specific	"I increased the daily 250 step goal per hour from 8 to 10 times per day" [P28, Wk2]
			Open	"Make a conscious effort to walk when I see my achievement is low" [P44, Wk4]
			Learning	"I've tried to ensure that by early afternoon, I'm at least halfway through my goal" [P18, Wk1]
Lifestyle change	Seeking socialisation	Engaging with peers, family and friends to pursue the goal	Specific	"Suggested a walk with friends and take away coffee rather than meeting at a coffee place to sit down with drinks" [P49, Wk6]
			Open	"Meeting up with friends to walk socially" [P38, Wk1]
			Learning	"Try to hit my step count each day by going on a walk with someone else to motivate me further" [P03, Wk1]
	Activity for transport	Using physical means of travelling from place to place	Specific	"Taking the stairs at work" [P31, Wk3]
			Open	"Walking to and from places I might have driven to

				before, (Doctors, Dentist)" P47, Wk5]
			Learning	"On weekends I have actively walked rather than use other transport" [P09, Wk1]
	Structure walking	Pre-arranged periods of time to walk	Specific	"I have started to plan my walks to cover the steps rather than just going out for a walk" [P49, Wk2]
			Open	"Walk in the morning before work and / or in an evening after work" [P47, Wk4]
			Learning	"I have been going out for a walk most evenings and wherever possible, at lunchtime too" [P21, Wk3]
	Exercising	Structured physical activity other than walking	Specific	"I have started going to park run on a Saturday" [P49, Wk1]
			Open	"Some jogging on the spot or in the garden in lunch break" [P47, Wk3]
			Learning	"Monday's are my best day as I go to clubbercise so am easily able to achieve my goal" [P39, Wk2]
Behaviour intentions	Action planning	Identifying ways to conduct the behaviour in the future to be successful	Specific	"Knowing I had a week that I would be less able to schedule a daily walk set 2hrly reminders to do some activity" [P46, Wk4]
			Open	"Next few weeks I have less campus time so need to make more effort to walk during the day - plan to walk every morning for 30 mins and same at lunchtimes" [P50, Wk4]
			Learning	"We are getting the treadmill up and running this weekend in the garage" [P06, Wk1]
	Change of routine	Daily events that are not considered normal routine	Specific	"Try to take any phone calls on a walk" [P01, Wk2]
			Open	"When dog sitting, steps were much higher. Now not dog sitting & the numbers are low" [P26, Wk4]
			Learning	"Getting up earlier to create more opportunity to achieve my goal" [P42, Wk1]

Challenges in goal pursuit is a category that describes the obstacles and experiences of individuals pursuing different goal types. There were three codes that were identified in this category. Participants reported barriers to goal pursuit (i.e., things that were perceived to impede progress towards goal success) and spoke about the impacts of weather, daily life and work patterns. Throughout the intervention participants in all goal conditions mentioned goal changing (i.e., notable changes to the prescribed goal) with both specific and learning goals resulting in participants changing the goal of a set step count to instead an "as well as possible" goal which are a relatively under researched vague, non-specific goal (Swann et al., 2022), however this finding strengthens the rationale for further investigation of this goal type for PA for insufficiently active adults. Vagueness (i.e., lack of clarity in strategy for goal pursuit) was a third code in the category of challenges in goal pursuit. Although this may be expected in an open goal condition which is vague in nature, individuals also reported vague strategies in the specific and learning goal which do not align with the goal types nature of the defined outcomes.

Feedback is a category that describes participants using internal or external information about previous events, actions and/or decisions about the goal and is considered a key moderator in GST (Locke & Latham, 1990). There were two codes within this category. Internal reflection (i.e., looking back and reviewing activity, actions or decisions that went well, or didn't go well) occurred under all three goal conditions and were discussed in relation to day-to-day step count achievement and a reflection of the past week where participants past opportunity and capability to achieve the goal was reflected on. Device feedback (i.e., monitoring step count/activity through the wearable accelerometer device) was another code under the category of feedback. The Fitbits allowed for real-time feedback which is what then allowed for feedback on step count goal, whether this was done by utilising reminders on the device to walk or manually reviewing the step count so far.

To be physically active is a lifestyle (Kangasniemi et al., 2015), and lifestyle change was identified as a category during this analysis, where the category describes the adaptations an individual make to their usual lifestyle. This was seen to be done in four codes. Seeking socialisation (i.e., engaging with peers, family and friends to pursue the goal) was discussed by participants in all goal conditions with individuals opting to integrate activity into their social life or to keep themselves accountable. Additionally, activity for transport (i.e., using physical means of travelling from place to place) was another code form the diary data. Activity for transport can contribute to total activity time and could benefit an individual's health (Wanner et al., 2012). Participants described instances of walking to and from places, some specifically on weekends where they may have had more time and using alternative means of travelling in the day (e.g., stairs over lifts) which accumulatively increase step counts. Structured walking (i.e., pre-arranged periods of time to walk) was described by participants in the diary entries where they planned walks to meet a specific step count in the specific goal, and generally planned set times to walk in the day in the open and learning goal condition. A fourth code under the lifestyle change category was exercising (i.e., structured PA other than walking). Although participants did not explicitly state that the exercise (e.g., clubercise and park runs) was to increase step count even though it did, but the intervention did initiate participants engagement in exercise that was new since starting the intervention.

The fourth category presented from the diary entries was behaviour intentions which describes times were participants changed and made plans to alter behaviours to achieve a goal. Action planning (i.e., when a participant identifies ways to conduct the behaviour in the future to be successful) was another code described in the data. Whether it was planning activity into the day, or adding objects to the environment (e.g., home treadmills), participants reported action planning in the pursuit of all three goal conditions. A review found that implementation intentions, such as those described in the codes of this category, are effective for initiating goal pursuit, disengagement from goal failure, shielding from unwanted influences, and conservation of capability for future goal pursuit (Gollwitzer & Sheeran, 2006) and so are therefore key for PA behaviour change. Changes of routine (i.e., daily events that are not considered normal routine) were also described in the category of behaviour intentions. Some changes were more intentional (e.g., getting up earlier, taking walking calls) and some were a product of life circumstances (e.g., dog sitting) but both were noted by participants as changes to routine that resulted in an increase in steps.

7B.4 Discussion

This is the first study to assess the effects specific and non-specific goal types over time in a 'real-world' setting on PA and psychological outcomes in a solely insufficiently active population, as previously only specific goals had been tested in this population (Garstang et al., 2024). The first aim of this study was to determine how different goal types, specific, open and learning, impact step count and psychological outcomes (motivation, self-efficacy, affect and mental well-being) related to PA during a step-count walking intervention; of which there was no effect. To review, we hypothesised that (H1) all goal conditions would elicit better step counts than at baseline, (H2) learning goals would elicit greater difference in baseline and week 6 step counts compared to the specific and open goal, (H3) open goals would elicit more adaptive changes in psychological variables (motivation, self-efficacy, affect and mental well-being), and that (H4) autonomous motives would have greater increases in physical and psychological outcomes (motivation, self-efficacy, affect and mental well-being). However, all goals did elicit higher step counts than baseline and so H1 was accepted, but no differences were reported for psychological variables and so H2 was rejected. Additionally, this study aimed to explore how an individual's goal motives may result in differences in physical and psychological outcomes over time; however, no differences were found and H4 was therefore rejected. Overall, findings from the study provide initial insights into how different goal types are working overtime, and the effect had both physically and psychologically.

A previous review of goal setting for PA in mixed activity level populations found that specific and vague goals were equally effective for PA outcomes (McEwan et al., 2016). This study extends the literature and concludes that specific goals (specific and learning) and vague goals (open) are all effective for PA in an insufficiently active population. Furthermore, this study found that overtime, specific, open and learning goals were equally as effective at increasing affect (i.e., attraction to PA), motivation, and mental well-being compared to baseline measurements; thus, accepting H1, but rejecting H2 and H3. However, there was no change in participants self-efficacy, which could be a result of walking being an everyday task and so self-efficacy was already high for this activity; alternatively, this could be a result of the generalised nature of the GSE which was unable to account for task-efficacy. This study provides conflicting evidence to previous experimental evidence in the 6MWT (Carter et al., 2021; Hawkins et al., 2020; Swann et al., 2020; 2022) as no between-goal differences were observed for any outcome, indicating that over time, pursuit of any goal is better than no goal at all compared to a single timepoint when one goal type may be more preferable dependant on participant context and experience. These findings offer valuable insights for future PA consideration, as they have extended on previous initial understanding to offer novel insights into real-world goal experiences and outcomes over time which was a major limitation of past research.

As shown in Figure 11, there is a large variability in individual's step counts in relation to goal types at each time point. This variability could suggest that different goal types work best for different individuals, and at different times in the pursuit of PA behaviour change. Furthermore, these findings provide greater rationale for moving away from the ‘one-size fits all’ application of goals for PA and applying a more individualised approach to goal pursuit in this population.

Specifically, this study sought to address how goal types differed dependant on the perceived complexity of the goal. As it was suggested by Locke and Latham (2013) that learning goals are more efficacious than specific goals when tasks are new and complex, and when somebody is starting to become active (Swann & Rosenbaum, 2018), yet it was still to be tested at all, let alone in a longitudinal real-world study design. To date, this is the first study to consider how perceived complexity of a goal for PA may differ between goal types and the findings showed that although theorised and hypothesised (H3), there was no difference. Thus, suggesting a more individualised approach to goal setting could be more beneficial than setting a blanket rule for goal setting in different contexts.

Although goal motives have previously not been an indicator of increased PA (Knittle et al., 2018), previous research has shown that when teamed with high perceived control participants, autonomous motives resulted in increased goal progress, and well-being (Hortop et al., 2013). Therefore, it is still important to promote autonomous motives, particularly as they are more enduring for longer term behaviours (Sheldon & Elliot, 1998). However, this study found that no matter the goal type, motives did not differ for goal pursuit suggesting that goal motives are more ingrained and not effected by the context of *how* somebody strives for a desired outcome. As more self-concordant, autonomous motives are intrinsic and integrated in nature (i.e., pursued out of enjoyment or valued importance of the goal), it may be that educating individuals prior to goal pursuit on both goal and behaviour context could result in increased importance of the goal and greater autonomous motives in goal pursuit. Future research would benefit from exploring how to best support more autonomous goals and regulations for health behaviours, including PA, so that positive behaviours are more long lasting. Research could look to examine different forms of autonomous regulations for PA (e.g., supporting competence, seeking enjoyment, promoting autonomy) to identify which are better for whom.

The effect of goal types on individual's perceptions during the intervention were varied. No differences on perceived importance were reported over time or between goal conditions and remained consistently between "*somewhat*" and "*very*" important which could be an indication that participants engaged with the study initially as they deemed increasing their PA levels an important goal to have and this was consistent throughout. However, perceived commitment of the goals over time collectively decreased. As commitment to the goal is deemed essential for goal pursuit (Locke & Latham, 1990, 2002) it is concerning that individuals were less committed after the intervention. To rectify this in the future studies may explore the pursuit of a mixture of goal types, moving away from setting a 'one-size fits all' approach, and target a range of activities at once to offer variety as this has shown to increase enjoyment and participation (Juvancic-Heltzel et al., 2013). Moreover, identifying ways in which to maintain autonomous motives over time could be beneficial as this has also been related to commitment. It was reported by participants that their perceptions of complexity increased over time. Ahead of commencing goal pursuit, participants may have had misconceptions of goal complexity as walking is an everyday task, but as the intervention went on perceptions of complexity increased. This could then be the cause of reduced commitment to the goal types as a task that is too complex is not suitable for those new to a behaviour (Locke & Latham, 2013; Swann & Rosenbaum, 2018). This may also explain why behaviour change is hard to maintain as individual's have unrealistic expectations of what may be required for the goal/task. By reviewing goals more frequently, researchers may be able to assess the acceptability, and individual’s perceptions of the goal to promote more positive associations and affective exercise experiences.

When reporting on the experiences of different goal conditions in the diary entries, participants in all three goal conditions reported a form of goal changing. Language and goals reported in the diary entries, differed from that set under the assigned goal condition, such as “doing as well as possible” when a specific step count goal was not deemed achievable. Other participants who did not explicitly report a change in goal did discuss alternative preferences of having a defined target. Together with the objective PA results, this study suggest that although specific goals (e.g., SMART) are considered best practice and are most utilised for PA promotion (Swann et al., 2023), other goal types are equally valuable and it should be of the preference of the individual as to which type of goal is pursued, and for how long; this could then increase retention of a goal and increase activity levels. Additionally, this finding may suggest that different goal types may be more relevant for different individuals, and at different times in the PA behaviour change process.

Diary entry data captured further insight into the experiences and strategies of individuals under different goal conditions. Overall, participants reported perceived barriers across all goal types, however there was a higher prevalence of barriers reported by participants in the specific goal condition with a defined step count target compared for those with an open or learning goal conditions who had self-perception of success in goal pursuit or had identified strategies to achieve the goal. Additionally, participants reported action planning for goal pursuit. Although only learning goals require individuals to identify strategies and plan for goal pursuit, all goals showed to incite planning in individuals. This finding shows promise for goal success as planning for goal pursuit and developing implementation intentions (e.g., “if-then” plans that specify the when, where and how of goal pursuit for success [Gollwitzer, 1999]). Implementation intentions can increase rates of goal pursuit and achievement by initiating goal directed behaviours (Papies et al., 2009). As such, it may be worth considering adapting guidelines for goal setting to specifically include strategy development and incorporating implementation intentions into the process.

7B.4.1 Strengths, Limitations and Future Directions

There are several strengths to this study. The first being that this is the first study to implement and test multiple goal types for PA for insufficiently active adults over time whilst considering the effects on both physical and psychological variables as previously this has only been explored in short single-bout tasks (e.g., 6MWT). Additionally, it was done in an ecologically valid ‘real-world’ setting, and therefore more indicative of true responses to these goal types compared to the findings of prior studies. Second, the attrition rate in this study was very low, with the exception of ineligible activity levels, only two participants did not complete data collection (one for health, and one for not wearing the device). This is believed to be a result of the pre-intervention design considerations trial that allowed for adaptations to devices and communications with participants being more acceptable for participants. Third, PA levels, in the form of step counts, did increase over time suggesting that goal setting is an effective means to increase activity levels over time. Fourth, this study aimed to determine the effects of different goal types over time, and did so both quantitatively, employing objective measures of PA and questionnaires, and qualitatively, utilising diary entries. Thus, providing key insights to the experiences of individuals whilst also measuring objective effects. Although the detail provided by participants in the weekly diary entries offers a better picture of the effects had from different goal types and the ways in which goals were used by participants, diary entries are generally restricted in the quality of detail that can be provided. Therefore, future research may wish to conduct interviews at a mid- and endpoint to explore these experiences further and help develop our understanding of how these goal types are working in this population. Additionally, the Fibion Research devices proved to be difficult for data collection. The Fibions were selected due to their ability to distinguish between forms of sedentary behaviours as it was expected may be high in this study’s population. However, the devices were not highly accepted by individuals, particularly the leg strap, and so data was not highly accurate. Also, when retrieved, data was missing from the devices on certain instances which made assessing baseline levels using Fibion reports unreliable and the reporting of sedentary behaviours not possible. In the future a more consistent measure should be sought and the IPAQ employed alongside as done in this study to allow for any device failures. Furthermore, although intentional, this study did not include a control group and instead compared effects to baseline. Moreover, the study was conducted over a relatively short period of time for an intervention and did not include a follow-up measure. Future research should compare the effects of these goals to a control to account for this limitation and extend the timeframe of goal pursuit. Lastly, this study employed an eligibility criterion related to current PA WHO (2020) guidelines of 150-minutes of moderate, or 75-minutes of vigorous activity but did not include a cut off value for step count. Future studies may look to consider a step count value that would exclude individuals from partaking.

7B.4.2 Conclusions

To conclude, this is the first study to examine the effect of different goal types on an objective measure of PA and a range of psychological outcomes. Overall, goals were found to be effective in comparison to baseline, however no goal was considered more beneficial for measured outcomes than another. Thus, reiterating earlier review and experimental findings that there are no differences between goal types for PA (e.g., McEwan et al, 2016; Swann et al., 2022) and that pursuing any goal is better than nothing. Furthermore, there is a large variance in objective PA responses to goals, thus suggesting that individual and contextual differences are key considerations for future research, as we should be moving away from a ‘one-size-fits-all’ approach and adopt an individualised goal setting plan for PA, specifically in an insufficiently active population.

CHAPTER 8: GENERAL DISCUSSION

Globally, PA levels are low (Guthold et al., 2018). Goal setting is the most frequently used behaviour change technique for PA behaviours (Howlett et al., 2019), and the most commonly employed goal type is specific goals (Swann & Rosenbaum, 2018). Especially in populations that are new to a behaviour or in the early stages of learning, such as insufficiently active adults, these goal types could be detrimental to participation and engagement and research needs to explore other goal types. Additionally, goals are generally reported in relation to a PA outcome (see review by McEwan et al. [2016]) with research failing to consider the psychological effects had that could impact long-term engagement. Further to the effects of goal types, we have a limited understanding of how an individual's reason for goal pursuit and different goal types may be affecting each other. As motives are suggestive of engagement (see review by Teixeria et al. [2012]), it is crucial to understand further how these two variables may be related. This thesis addressed two overarching aims to address these gaps in the literature. First, this thesis aimed to explore the effects of different goal types on PA and psychological variables (e.g., (motivation, self-efficacy, affect and mental well-being). Second, this thesis aims to assess the effect of goal types and goal motives, and the subsequent effect on PA and well-being. To effectively respond to these two aims the following objectives were formed that are addressed in the five empirical chapters:

1. To develop understanding of the impact of goal types on psychological outcomes (e.g., motivation, self-efficacy) in insufficiently active adults.
2. To examine and assess the current literature base of the use of goal setting for PA and well-being interventions in adults.
3. To develop our understanding of the application and relevance of GST mechanism and moderators for PA.
4. To enhance the understanding of the impact goal motives have on PA and psychological outcomes (motivation, affect, self-efficacy and mental well-being).
5. To explore how goal types (specific, open and learning) effect goal motives and how this influences performance outcomes (WalCT score, goal perceptions, challenge/threat appraisal and future interest) during simple and complex trials in a walking task.

6. To assess the possible effect of goal types (specific, open and learning) on goal motives overtime.
7. To determine the effect of different goal types on PA and psychological outcomes (motivation, self-efficacy, affect, mental well-being and goal perceptions) during a step intervention.

These aims have been addressed using a number of research designs and methodologies. A systematic review and meta-analysis was used to provide a comprehensive overview of the current literature based in Chapter 3. In Chapters 4 and 5, an online survey was conducted offering cross-sectional observations analysed using regression analysis and structural equation modelling. Chapter 6 employed a pre-registered within-between randomised experimental design. Chapter 7 used an intervention design that measured both objective quantitative outcomes and explored the qualitative experiences of participants. Overall, our findings do not support the use of one goal over another for long-term PA or psychological benefits.

8.1 Summary of Findings and Contributions to the Literature

8.1.1 Chapter 3: *What Effects do Goal-setting Interventions have on Physical Activity and Psychological Outcomes in Insufficiently Active Adults? A Systematic Review and Meta-analysis*

The systematic review and meta-analysis that was conducted and presented in Chapter 3 addresses the first two objectives of this thesis that sought to examine the current literature base and develop greater understanding of the impact of goal types on physical and psychological outcomes (e.g., motivation, self-efficacy) in an insufficiently active population. Forming the foundations of this thesis and offering novel insights, Chapter 3 highlighted how few studies that have focused on goal setting for insufficiently active individuals have given due consideration to both physical and psychological outcomes. This is surprising given the importance of psychological variables for PA engagement (e.g., Ashford et al., 2010, Rhodes & Kates, 2015).

Specific goals were found effective for increasing PA. However, no additional goal types were reported therefore limiting the comparison of specific goals effect to baseline or control. It therefore remained unknown how other goal types (e.g., open goals) could benefit PA over longer timeframes. There have been calls to move away from a one-size-fits-all approach to goal setting in

PA (e.g., McEwan et al., 2016; Swann & Rosenbaum, 2018; Swann et al., 2022), which is clearly an evident practice shown in this Chapter. Additionally, only small effects were found of specific goals on the combined psychological outcomes, which strengthens the need for future research to employ a range of goal types within interventions for insufficiently active individuals as they may provide greater insight on the impact that goal type can have on both PA and psychological outcomes.

Generally, the findings in Chapter 3 support suggestions that recommendations for PA-promotion guidance should not only advise people to set weekly goals for PA (e.g., 150-minutes of moderate-to-vigorous activity per week [WHO, 2020]), but to also set daily PA goals (McEwan et al., 2016). The majority of the specific goals with the literature were set in relation to daily step-count, which is understandable given its ease of implementation and low cost, however the outcome of daily steps is not one that can be compared to overall activity level in reference to the WHO (2020) activity guidelines. Amending activity guidelines to incorporate walking (e.g., minimum 30-minutes of brisk walking of 3-4000 steps per week; Tudor-Locke et al., 2011) could increase activity levels in individuals as there would be more autonomy in activity choice for meeting PA guidelines. This Chapter offers novel contribution to the literature reporting the effects of goals on both physical and psychological outcomes providing a better understanding of the holistic effects of goal types for promotive PA in an insufficiently active population.

8.1.2 Chapter 4: Do goal-setting practices vary between adults who engage in different levels of physical activity?

The findings in this Chapter offer the first test of GST's recommendation, mechanisms and moderators for PA pursuit; and the subsequent effect on moderate-to-vigorous PA levels and perceived mental well-being. Findings pose questions as to the efficacy of GST (Locke & Latham, 1990) as only three components were associated with MVPA and mental well-being. However, it should be noted that the findings presented in this Chapter are limited by the items not being validated. Future could extend upon these initial contributions by assessing each component using validated measures to offer a more comprehensive understanding of GST in this context. Future studies may also benefit from assessing these effects over time to comment on the direction of the relationship.

Complexity was associated with both MVPA and mental well-being. The more complex an individual's PA goal is, the more MVPA they reported. This is consistent with proposed theoretical assumptions that complex activities are only not detrimental when the goal user has prior knowledge and sufficient skill set to be successful (Locke & Latham, 2013, Swann & Rosenbaum, 2018); i.e., the more active an individual is, the better equipped they are to pursue goals made up of complex tasks. In contrast, setting goals made up of complex tasks, could be inciting higher stress responses which are resulting in negative associations with mental well-being (Barbayannis et al., 2022; Priya et al., 2023). In addition to complexity, both preference of feedback and preferring to set challenging/difficult goals were associated with mental well-being. Individuals could enjoy the satisfaction of goal attainment when more challenging goals are set (Locke & Latham, 1990b) which then results in greater perceived mental well-being as well as receiving feedback to adapt and strive for goal attainment during pursuit.

Specific goals are effective for increasing PA (McEwan et al., 2016, Garstang et al., 2024), however the alternative goal types, e.g., open and learning goals, are relatively underexplored, particularly in a PA context (e.g., Swann et al., 2022). The findings of this study would suggest that specific, challenging goals lack relevance for those pursuing PA goals and question the efficacy of GST (Locke & Latham, 1990) in a PA context which is surprising considering the wide literature base to support the use of them. Additionally, the lack of GST (Locke & Latham, 2013) components associated with MVPA and perceived well-being contributes further to questions of GST's applicability and acceptability by goal users for PA. Being the only component of GST that was associated with MVPA and mental well-being, and the explicit theoretical suggestions of how goals should be set in different contexts (e.g., Locke & Latham, 2013, Swann & Rosenbaum, 2018), complexity requires further attention in future research to explore how goals effects can differ in differing task complexities.

8.1.3 Chapter 5: Psychological Mediators of the Relations Between Goal Motives, Physical Activity and Well-being: Testing a Model of Path Analysis.

Chapter 5 of this thesis sought to better understand the associations between an individual's reasons underpinning goals (i.e., motives), psychological variables (motivation, self-efficacy and affect), PA and mental well-being. Thus, offering initial insights into the sophisticated associations goal motives have with psychological variables (self-efficacy, motivation and affect) found to influence PA and mental well-being. Generally, this study found that autonomous goal pursuit resulted in positive associations with all measured variables. Whereas controlled motives were not associated with MVPA, consistent with previous PA literature (Standage et al., 2008) and were negatively associated with mental well-being. Thus, supporting previous motive literature suggesting that autonomous goal pursuit is more optimal and should be promoted for long-term behaviours (e.g., Sheldon & Elliot, 1998, Teixiera et al., 2012) not just for PA, but also for mental well-being.

Overall, the findings presented in this Chapter offer novel contribution by examining goal motives in relation to psychological outcomes that could be affecting MVPA and mental well-being. Previously self-efficacy (e.g., Bauman, 2012; Sallis et al., 1989), motivation (e.g., Teixeira et al., 2012) and affective experiences (e.g., Ekkekakis et al., 2021) have all been investigated separately for effects on MVPA and mental well-being, however this study supports the notion that future studies should consider a range of outcomes for behaviour change as each play a different role in goal pursuit and can respond differently when different motives are pursued. Although novel and insightful, these findings are from a single timepoint and can only be presented in the forms of associations as no causality can be inferred. Future research should seek to test the proposed model in a longitudinal study design to better understand the interactions between these variables over time in a more ecologically valid setting.

8.1.4 Chapter 6: Do the 'How' and 'Why' of Goal Setting matter for Complex Tasks? Findings in a Novel Walking Task.

Chapter 6 presents the findings from the first empirical test of different goal types (specific, open and learning) in simple and complex trials. Additionally, it is the first study to explore how goal types and goal motives could be affecting performance concurrently. This study was coined in response to research suggesting task complexity is a crucial factor in goal efficacy, and in a PA context, this could be applied for insufficiently active individuals (Locke & Latham, 2013; Swann & Rosenbaum, 2017). The task selected was the WalCT (Piccardi et al., 2013) due to its existing double trial design that lent itself to being adapted to meet the definition of complexity selected (Drach-Zahavy & Erez, 2002). However, it should be noted that the task is first and foremost a walking working memory task and not solely for PA implementation. Additionally, the distinction between simple and complex, although noted differently by participants manipulation checks, could be questioned and future research should seek to employ a task with greater accuracy in a PA context that has greater distinction in task complexities. That being said, as it is the first study to explore these effects, novel contribution to the literature is still made.

Swann and Rosenbaum (2018) questioned the efficacy of current best practice (i.e., specific goals [Swann et al., 2023]) for complex tasks such as starting to become active, yet this theory was still to be tested. This study is the first to address this suggestion offering initial novel insights to answer these poignant concerns. Research has suggested that learning goals are the most advantageous goal type in other contexts (Locke & Latham, 2013, Seijts & Latham, 2001), however in this study there were no reported differences between goal types on performance in the WalCT in either the simple or complex trials suggesting that actually, goal types are not important in differing contexts. However, these findings do support review (McEwan et al., 2016) and other experimental PA literature (e.g., Swann et al., 2022) that there are no differences between goal types on performance, and that the influential effects may lie elsewhere. An additional critique of current GST literature (Locke & Latham, 1990) is even in the simple condition, where specific goals are suggested to be most effective for performance, there was no difference compared to learning and open goals. Thus, again, highlighting the lack of applicability of GST in this context.

One goal type that did show initial promise in this study was learning goals. Learning goals resulted in the greatest levels of autonomous motives compared to the open and specific goals. Additionally, participants in this goal condition had the greatest future interest in the task which aligns with previous goal motive literature that autonomous motives can result in sustained engagement (Teixiera et al., 2012). Participants also were more likely to appraise the task as a challenge when they pursued a goal with autonomous motives, whereas controlled motives resulted in higher threat appraisal. Approach appraisals, such as challenge can increase goal attainment (Riddell et al., 2022), and when pursued with autonomous motives can lead to effortless sustained engagement (Milyaskaya et al., 2021). Therefore, if replicated in a longitudinal PA setting, individuals may perceive attainment to be less exerting and potentially more enjoyable resulting in continued and repeated participation. This study did report that in a complex task, individuals required more autonomous motives for the goal to be interested in repeating the task, which in a PA context is needed for repeated and sustained engagement. To conclude, the findings presented in Chapter 6 offer novel insight into the how and why of goal setting during a walking task. Findings indicate that goal types may be less influential than goal motives during the WalCT. Thus, suggesting future research should direct attentions towards the reasons, i.e., motives, of goal pursuits to promote more autonomous motives, rather than the types of goals being pursued.

8.1.5 Chapter 7: The Effect of Specific and Non-specific Goal Types Over Time in an Insufficiently Active Population.

Chapter 7 presents the first study to examine the effects of different goal types (specific, open and learning) on an objective measure of PA and a range of psychological outcomes (motivation, self-efficacy, affect, mental well-being and goal perceptions) over time and in a real-world context. A previous review, in a mixed-activity population reported no differences between specific and vague, non-specific goals on PA outcomes (McEwan et al., 2016). Additionally, experimental research has started to explore different goal types (e.g., open, learning, DYB, and AWAP) compared with specific goals to assess how these goals are affective other outcomes associated with PA engagement. Chapter 7 extends the literature further by reporting no differences in goal type on PA or psychological outcomes measured in a real-world ecologically valid setting.

Goals should be set in relation to the context it is being pursued in (Locke & Latham, 2013), with complexity being one such consideration. It is suggested in the theory that when specific goals could be detrimental for goal performance (i.e., when a task is complex and the individual is new to the task [Locke & Latham, 2013]), learning goals should be set. Swann and Rosenbaum suggest that when an individual is new to PA, they may perceive the task to be too complex and as such specific goals should not be used. However, this study found that there was no difference between goal types (specific, open, and learning) on goal performance or psychological variables associated with PA in an insufficiently active population. Additionally, the large variability of individual responses to the goals over the course of the intervention question the need to identify a best practice goal. Instead, the novel findings presented in this study promote the notion of an individualise goal setting approach rather than a 'one-size fits all' approach currently adopted by many. The findings presented in Chapter 7 also provide greater depth in understanding of how goals are working overtime in a real-world setting. Additionally, this is the first study to employ a mixed methods investigation of goal types over time. Individuals reported in their diary entries changing their goals to a preferred goal type; specific and learning goals were changed to AWAP goals which are relatively under researched (Swann et al., 2022) yet should be highlighted for further attention required. Again, a further example that an individual approach is required.

This study offered novel contribution to the literature by reporting the effect of different goals on goal motives for the intervention, yet no effect was found of goal types on goal motives. However, this study was limited in the fact that it did not report goal motives at mid- or post-intervention and future research should look to incorporate multiple measurement points of goal motives during goal setting interventions. Goal motives had not previously been a predictor of PA (Knittle et al., 2018), however due to the wide range of literature highlight the negative consequences of controlled motives (e.g., Briki, 2016, Maltby & Day, 2001) we would still stress the importance of measuring motives for PA alongside goal types as not all goal types were tested in this study and autonomous motives are suggested to be more enduring for longer term behaviours (Sheldon & Elliot, 1998) which is needed for PA behaviour change to take place.

8.1.6 Thesis Overview

Prior to this thesis there was limited insight into how goals were being used, specifically for insufficiently active adults who are most at risk of health concerns (Santos et al., 2023), and the effects had on psychological variables in addition to PA variables. As shown in Chapter 3, only specific goals had been used in this population for these outcomes. As such, prior to this thesis there was no evidence to support any goal other than specific goals over time in this population, proving the rhetoric the specific (e.g., SMART) goals are considered best practice for PA (Swann et al., 2023). However, both in Chapter 6 (experimental study) and Chapter 7 (longitudinal intervention), there were no differences found between learning, specific and open goals which is in agreement with early experimental evidence that had also reported this (Carter et al., 2021, Hawkins et al., 2020, Swann et al., 2020, 2022). In contrast, the effect of different goal types on psychological responses in PA (e.g., affective responses) that can predict length of engagement (e.g., Rhodes & Kates, 2015) were reported for the first time in a longitudinal study. Psychological variables over time during goal pursuit were influenced and could be influencing overall PA engagement. Thus, highlighting the need for further research to continue to consider the psychological effects of behaviour change interventions alongside the effects had on PA. Overall, the null hypothesis findings of this thesis draw us to the conclusion that there is no preferential goal type for PA promotion in an insufficiently active population. Therefore, collectively we should stop applying sweeping, generic goals for PA promotion and look further to identify the most effective goal type on an individual basis.

Upon reflection, there are several theoretical learnings related to GST (Locke & Latham, 1990) raised by the research in this thesis. Locke and Latham (1990) originally supported the sole use of specific goals for goal success, and learning goals when individuals started a new or complex task. Swann & Rosenbaum (2018) proposed that PA could be complex for those new to activity, and that although specific goals were most used, goal setting practices needed to change. The research in this thesis supports neither the propositions of Locke & Latham's GST nor Swann & Rosenbaum as there were no differences in goal effect for this population. However, in Chapter 4 the first exploration of GST in a PA context was presented and found that the suggestions and pre-requisites of GST were not correlated to increased activity levels or psychological well-being. Thus, the application of GST is questionable in the context of PA and future research testing the theory in this setting is needed. It could be that there is a need to develop specific theories for goal setting within specific contexts such as PA.

Another key element of this thesis was the additional consideration of goal motives. The two overarching goal motives can have distinct effects for behaviours. Although well reported in the literature (see review by Teixiera et al., 2012), they had not previously been considered alongside goal types, and no comment could be made on how the two are related and subsequently impact on outcomes. In the motive literature greater autonomous motives generally have more positive effects over time than controlled motives (Sheldon & Elliot, 1999). This study reported the findings of motives in a cross-sectional study (Chapter 5), experimental single-bout study (Chapter 6) and over time in a longitudinal intervention (Chapter 7). The evidence in a shorter and single point in time showed significant effects for psychological outcomes and reciprocates previous findings that generally motives are beneficial for outcomes, yet autonomous are more preferable (e.g., Deci & Ryan, 2008, Hagger et al., 2014, Sheldon & Elliot, 1998). Over time these effects were not replicated, however motives were not reassessed mid- or post-intervention and so future research would benefit from a continual assessment of motives in response to goals over time.

8.2 Practical Implications

The findings presented in this thesis have notable applied implications for individuals, practitioners and researchers that engage with goal setting for PA. Firstly, the research in thesis showed all goal types can be effective for PA and that there are no differences between the goal types in both one-time experimental tasks (Chapter 6), or during a 7-week intervention (Chapter 7). This raises significant questions as to why only specific goals had been researched in this population (Chapter 3) and why specific SMART goals were adopted as best practice (Swann et al., 2023). Further exploration of these effects shows that there is a large variability in goal responses over the duration of the intervention. In Chapter 7, participant's experiences of the different goals were presented alongside the objective effects highlighting the preferences of individuals, particularly of those stating they changed their goal, is crucial for effective goal setting for PA. The findings of this thesis implore future goal users, practitioners and researchers to move away from the 'one-size fits all' (or more accurately, no one) approach to goal setting and look to consider the contextual and individual factors alongside preferences of individuals for goal pursuit. Furthermore, variety in goal pursuit may also be key to maintaining attraction to exercise, which is important for sustained participation (e.g., Ekkekakis et al., 2021, Rhodes & Kates, 2015).

Additionally, within this thesis we presented some early evidence for how the context, e.g., complexity, of a task can result in differences in goal attainment. These findings suggest that when setting goals for PA, goal users, practitioners and researchers should consider setting the goal for simpler tasks in early stages in order to increase confidence in one's abilities of goal attainment (Locke & Latham, 2013, Swann & Rosenbaum, 2018). In practice, this may present as adjusting the activity of the goal to better align with an individual's capabilities and functional capacities, which in turn could result in increased vigorous intensity activity (Thøgersen-Ntoumani et al., 2023), and result in more active individuals and better global health (WHO, 2020). Goal users, practitioners and researchers should look to assess three complexity components of a task: how many components need to be addressed?; how much coordination of these components is required?; and will an individual be required to be flexible and adapt during the task?. A simpler task would be made up of fewer components, with minimal coordination, and require less need to adapt during the task, as individuals may not have the skill set or knowledge, particularly those new to exercise, to coordinate multiple components of a task and potentially change and adapt and this could result in threat appraisal and disengagement.

Although no difference of goal type on the motives goals are pursued with was found in this thesis, goal motives did show to have effects on psychological variables related to goal performance (e.g., challenge and threat appraisal, future interest, self-efficacy and quality of motivation [Chapters 5 & 6]). Therefore, those pursuing PA goals should still strive for more autonomous motives to increase the likelihood of longer-term engagement (Sheldon & Elliot, 1998), result in an increased likelihood of challenge appraisal (Chapter 6), and prevent negative consequences that can be experienced when pursuing controlled motives (e.g., negative well-being [Briki, 2016], failure to satisfy basic psychological needs [Hagger et al., 2014]). There is advice on how to promote more autonomous, self-concordant motives such as fostering an 'autonomy supportive environment' by encouraging choice (Deci & Ryan, 2008, Russell & Bray, 2010), which could be done by employing different goal types, including learning goals as these allow individuals to choose their own strategies for goal pursuit (Locke & Latham, 2013). Although yet to be explored, there may also be slight nuances in practice when goals are being set by an individual versus by/with a practitioner. Though not explored in this thesis, while assigned goals are most used (Shilts et al., 2004), this could be hindering an individual's autonomy. Practitioners may benefit from adopting a collaborative approach to setting PA goals supporting individuals to trust their instincts in goal pursuit. Potentially allowing individuals to set their own goal(s) could also increase autonomy, and further, competence when a goal is attained (Sheldon, 2014). Thus, satisfying one's basic psychological needs and increasing well-being (Sheldon & Elliot, 1999). Individuals on the other hand should focus on setting goals that are aligned with one's interests and values and should perhaps set goals focused on enjoyment rather than specific targets in the early stages of PA participation.

8.3 Strengths and Limitations of the Thesis and Future Research Directions

There are several strengths of the body of research presented in this thesis as well as some notable limitations that could be addressed by future research. Firstly, within this thesis we employed a number of different study designs and analyses that were best fit to answer the corresponding research questions and objectives whilst adhering to COVID-19 restrictions where necessary. These included: conducting a systematic review and meta-analysis with narrative synthesis (Chapter 3), online survey designs which were analysed using regressions (Chapter 4) and structural equation modelling (Chapter 5), a randomised experimental lab study (Chapter 6), and a longitudinal mixed methods goal setting intervention (Chapter 7A&B). By utilising a mixed methods approach, the final study of this thesis goes further than addressing the gap of understanding the effect of different goal types over time, but also presents the experiences of individuals in a real-world environment providing greater depth to the contributions made. Future research should also seek to employ mixed methods approaches when exploring the effects of goal types to obtain a truly comprehensive account of the effects made.

Secondly, the generalisability of the findings of this thesis are limited to a PA context. Whilst many would presume this is a limitation of the research, the current literature and theory of goal setting is founded from a business context with performance as the main predictor of success (Locke & Latham, 1990). This context is worlds apart from a PA setting where performance is less so important, and individual's participation is more important for health outcomes. And so, in this case, the lack of generalisability of this thesis' findings is a major strength and responds to calls in the literature to address this gap and explore how, particularly, insufficiently active individuals respond to goal types to promote PA participation (Swann & Rosenbaum, 2018) and therefore offers novel contribution to the current literature.

Thirdly, the findings presented in this thesis report on the effects of specific, open and learning goals explicitly. By including the additional goal types of open and learning goals, the evidence when in comparison to specific goals has been expanded past that presented in the first study of this thesis (Chapter 3). Although the novel contribution of additional goal types is clear, having only included open and learning goals within the thesis has limited the findings to the effects of these three goal types and as found in Chapter 7B participants did report AWAP goals. Given the limited evidence of AWAP in PA contexts (Swann et al., 2023) future research would benefit from exploring the effect of multiple vague, non-specific goals (e.g., AWAP and DYB) over time to assess the real-world effects. Additionally, although from other contexts, future research would benefit from looking beyond a PA context to assess other goal types that have shown promise for goal pursuit (e.g., process goals in a sport context [Williamson et al., 2022]) to assess the applicability and efficacy for PA for insufficiently active individuals.

Fourthly, this body of work utilised several validated, published questionnaires to explore the psychological effects of goal types, and updated these measures to the most relevant and recent as and when appropriate (e.g., the goal motives questionnaire was updated between Chapter 5 and Chapter 6/7 and so the most up to date questionnaire was used in replacement of the earlier one). Although several psychological outcomes were assessed throughout Chapters 4, 5, 6 and 7A&B, this thesis did not consider individual differences, such as personality, and prior goal pursuit in the outcomes that could also have contributed to the large variability seen in Chapter 7B. Future research would benefit from including these variables, as recent evidence is suggestive of different combinations of personality traits and profiles being an indicator for PA behaviours (Wang et al., 2024), yet this is still to be assessed in relation to goal pursuit.

Fifthly, in regard to study designs, there were several limitations that could be rectified in future research. Both Chapters 4 and 5 reported cross-sectional survey responses which were a design product of the COVID-19 pandemic restrictions. For the purpose of this thesis, participants were more easily accessible online, however the nature of cross-sectional surveys mean data is limited and causal relationships cannot be established, and although can establish prevalence of a variable, it cannot determine the incidence of it (Chirico, 2023). Future research may be better employing a longitudinal survey design to counter these limitations in findings' conclusions. Additionally, although Chapter 7 included an element of participant guided design to the intervention which we believe contributed to the high retention rate, the intervention conducted and presented in Chapter 7B was conducted over a relatively short period of time, did not include a control group and did not take a follow-up measure, mostly due to time restrictions. Future research should look to employ an intervention lasting ≥ 6 months for results most likely to result in maintained behaviour change (Prochaska & Velicer, 1997) with follow-up measurements to assess the long-term effects of goals on this population in comparison to a control group.

Additionally, there are notable challenges with how Chapter 7 classified an individual to be 'active', and ineligible, or 'insufficiently active', and eligible to take part. A binary classification of PA based on doing more or less than 150-miutes of PA/week does not allow for nuances of activities such as the intensity or the type of PA completed (Casperson et al., 1985). Furthermore, there is then no distinction able to be made between those who are sedentary versus doing *some* activity, which is ultimately better than nothing, or between those who are largely sedentary but complete 150-minutes of activity/week who are still at risk of poor health (Patterson et al., 2018). As such, this is why the decision for MVPA to remain as a continuous variable was made in Chapter 4 and 5. However, although there are challenges with classifying an individual's PA level based on the WHO (2020) guidelines of 150-minutes of activity/week, there are multiple known health benefits in engaging in 150-minutes of more and so any person doing less than this may benefit from further support to meet the WHO (2020) PA guidelines and reap the health rewards available.

Lastly, this thesis is the first, to the candidate's knowledge, that has sought to explore the *how* and *why* of goal pursuit at the same time to optimise the outcome of PA behaviour offering novel contribution to the literature. A limitation of this thesis was that goal motives were not assessed over time and so no comment can be made as to whether effects are had after commencing goal pursuit, and behaviours have started to change. Given the importance of autonomous motives for long-lasting engagement (Sheldon & Elliot, 1998), future research may wish to employ questionnaires, or interviews, at multiple time points during an intervention to develop our understanding of the longitudinal effects had, or made, by an individual's motives.

8.4 Conclusion

To conclude, this thesis sought to address several gaps in the goal setting literature advancing the literature in this area. The findings presented support the use of goal setting, particularly specific, open and learning goals, for PA and psychological outcomes, yet do not distinguish between goal types, thus suggesting no one goal type is best in this population and a more individualised approach is required. Second, the application of GST is critiqued in a PA context, with the findings in Chapters 4, 6 and 7 questioning the applicability of its theoretical assumptions for PA goals. The additional evidence provided in Chapters 5, 6 and 7 also offer initial insights into the relationship between *how* (goal types) and *why* (goal motives) goals are set for PA with the aim to understand how the setting and pursuit of PA goals can be optimised. Although the effects of motives showed initial promise in a one-time walking task, these effects were not replicated over time and require further attention. Overall, the research presented in this thesis offers novel contribution to the existing body of evidence and highlights several future directions that are required for further understanding.

CHAPTER 9: REFERENCES

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APPENDICES

APPENDIX A: CHAPTER 3 SUPPLEMENTARY MATERIAL

A.1: PROSPERO Registration: CRD42021243970

Optimising the setting and pursuit of physical activity goals in insufficiently active adults: an exploration of how goal types and goal motives can impact physical activity and psychological well-being

Citation

Katie Garstang, Daniele Magistro, Simon Cooper, Laura Healy, Patricia Jackman. Optimising the setting and pursuit of physical activity goals in insufficiently active adults: an exploration of how goal types and goal motives can impact physical activity and psychological well-being. PROSPERO 2021 CRD42021243970 Available from: https://www.crd.york.ac.uk/prospero/display_record.php?ID=CRD42021243970

Review question

What are the effects of different goal types on physical activity and psychological outcomes in insufficiently active adults?

1. What goal types are beneficial for physical activity?

2. What goal types are beneficial for psychological well-being?

Searches

The sources that will be searched include: Academic Search Complete; MEDLINE; APA PsycINFO; PubMed; and SPORTDiscus.

Additional records will be searched for by screening the reference lists and forward citations (Google Scholar) of all included articles.

A selection of relevant reviews of physical activity and goal setting will also be used to search for additional records by screening the reference lists and forward citations of these studies.

Grey literature will be searched in an attempt to reduce publication bias (Hopewell et al., 2005).

Limits: the search will be limited to papers published in the English language. The search will not be restricted by publication date.

Bibliographic management: Zotero software will be used to store and manage search results.

Searches will be conducted from 23/03/2021 for one month.

Additional search strategy information can be found in the attached PDF document (link provided below).

Types of study to be included

Inclusion:

All study designs that obtain original, empirical data will be included.

Studies that use goal setting as the intervention and include data on at least one psychological outcome measure and a measure of physical activity in insufficiently active adults will be included.

Adults between the ages of 18 - 65 years old, who are insufficiently active.

Exclusion:

Older adults, and active adults.

Condition or domain being studied

Any measure of psychological variable outcomes (e.g.: motivation; self-efficacy) will be studied alongside any measure of physical activity, in order to gain insight into the impact of goal types on these variables.

Participants/population

Inclusion:

Adults, aged between 18 and 65 years old, who are insufficiently active (sedentary (i.e. MET value <2 (Salmon et al., 2003), e.g. sitting or lying down (Owen et al., 2000)) or inactive (<150 minutes of moderate to vigorous activity per week (WHO, 2020)).

Exclusion:

Active populations (i.e. those deemed to be physical active according to World Health Organisation physical activity guidelines (WHO, 2020); i.e. 150 minutes of moderate-vigorous activity per week), and adults over 65 years old.

If studies with mixed populations do not distinguish between activity level or age of participants, data will not be included. If they pertaining to eligible participants can be separated, data relevant to insufficiently active adults will be used. If it is unclear at the title and abstract screening stage whether the sample matches the criteria, these articles will be checked at full text level.

Intervention(s), exposure(s)

Insufficiently active adults who undertake physical activity in accordance with a goal will be included, with a goal being defined as "the objective or aim of an individual's actions" (Locke et al., 1981, p. 126); i.e. in relation to outcomes (e.g. to spend less time sitting in the day), events (e.g. to complete a 5k run), or processes (e.g. to increase physical activity levels, however this is measured individually) (Swann et al., 2020). Whether stated explicitly or implicitly, where reference is made to a goal or target (e.g. walk more, walk 10, 000 steps).

Comparator(s)/control

Included studies will have a form of control condition (e.g., control group, baseline for within-subjects).

Context

Main outcome(s)

Any quantitative, qualitative, or mixed method study that includes a measure of at least one psychological outcome and assesses physical activity will be included.

Measures of effect

All relevant quantitative statistics will be considered (e.g., means, effect sizes [e.g., correlation or change]). In the case of qualitative studies being included, data included in the results or findings sections (e.g., author interpretations, participant quotes) will be considered.

Additional outcome(s)

None.

Measures of effect

Not applicable.

Data extraction (selection and coding)

Once all duplicates have been removed, all returns will be screened independently for eligibility in relation to the inclusion and exclusion criteria by two reviewers; first at title and abstract, then at full text. If disagreements occur, a third reviewer will be included in the process to reach a decision. Information that will be extracted includes: authors; publication year; sample characteristics; study design; study aim; intervention characteristics (e.g.: activity type; length of intervention); goal conditions; comparison groups; data collection method (e.g. the measure used for the variable); outcome measures (psychological variable outcomes and physical activity); data analysis; and results.

Risk of bias (quality) assessment

The Cochrane Risk of Bias Tool Version 2 and GRADE assessment will be used by two researchers to assess study quality.

Strategy for data synthesis [1 change]

A narrative synthesis of the findings will be provided for quantitative and qualitative data, including: studies included; type of physical activity; goal used; population characteristics; type of psychological variable measured; content of the intervention. Summaries for intervention effects will be included for each study (risk ratios will be calculated for dichotomous data; standardised mean differences will be calculated for continuous data).

There may be limited scope for meta-analysis as a result of a large range of psychological outcomes that can be measured using different scales and the sparse literature in the area. However, a quantitative aggregate data synthesis is planned, using a random effects meta-analysis if studies use the same type of goal intervention, physical activity levels and psychological variable comparator/outcome, and if the studies are sufficiently homogenous (heterogeneity will be assessed by a visual inspection of forest plots, and using the χ^2 and I^2 statistic, where χ^2 of $P < 0.10$, and I^2 of 50% or greater indicates a substantial grade of heterogeneity), 95% confidence intervals will also be calculated.

In studies where the effects of clustering have not been taken into account, we will adjust the standard deviations for the design effect. Sensitivity analysis will be carried out to explore heterogeneity in effect estimates of: study quality; study populations; the method of intervention application; level of physical activity; and intervention goal type. Publication bias will also be assessed.

Analysis of subgroups or subsets

If adequate data are available, subgroup analyses will be conducted on: (i) different goal conditions; (ii) length of intervention; and (iii) types of intervention.

Contact details for further information

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Organisational affiliation of the review

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https://www.ntu.ac.uk/study-and-courses/academic-schools/science-and-technology

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Dr Laura Healy. Nottingham Trent University

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Type and method of review

Intervention, Meta-analysis, Narrative synthesis, Systematic review

Anticipated or actual start date [1 change]

19 April 2021

Anticipated completion date [1 change]

07 March 2022

Funding sources/sponsors

This project forms part of doctoral research conducted by Katie Garstang and supervised by the other team members. This studentship is funded by Nottingham Trent University (funding from 05/01/21 to 04/01/2024)

Conflicts of interest

Language

English

Country

England

Stage of review [2 changes]

Review Completed published

Details of final report/publication(s) or preprints if available [2 changes]

Garstang KR, Jackman PC, Healy LC, Cooper SB, Magistro D. What effect do goal setting interventions have on physical activity and psychological outcomes in insufficiently active adults? A systematic review and meta-analysis. Journal of Physical Activity and Health. 2024.

https://doi.org/10.1123/jpah.2023-0340

Subject index terms status

Subject indexing assigned by CRD

Subject index terms

Adult; Exercise; Exercise Therapy; Goals; Humans; Mental Health; Motivation; Psychological Techniques; Psychology; Sedentary Behavior

Date of registration in PROSPERO

09 April 2021

Date of first submission

19 March 2021

Stage of review at time of this submission [1 change]

Stage	Started	Completed
Preliminary searches	Yes	Yes
Piloting of the study selection process	Yes	Yes
Formal screening of search results against eligibility criteria	Yes	Yes
Data extraction	Yes	Yes
Risk of bias (quality) assessment	Yes	Yes
Data analysis	Yes	Yes

Revision note

The review has now been published.

The record owner confirms that the information they have supplied for this submission is accurate and complete and they understand that deliberate provision of inaccurate information or omission of data may be construed as scientific misconduct.

The record owner confirms that they will update the status of the review when it is completed and will add publication *details in due course.*

Versions

09 April 2021

03 April 2024

A.2: SWiM Guidelines

SWiM is intended to complement and be used as an extension to PRISMA			
SWiM reporting item	**Item description**	**Page in manuscript where item is reported**	**Other***
Methods			
1 Grouping studies for synthesis	1a) Provide a description of, and rationale for, the groups used in the synthesis (e.g., groupings of populations, interventions, outcomes, study design)	Page 6-7	
	1b) Detail and provide rationale for any changes made subsequent to the protocol in the groups used in the synthesis	Pages 6-7	
2 Describe the standardised metric and transformation methods used	Describe the standardised metric for each outcome. Explain why the metric(s) was chosen, and describe any methods used to transform the intervention effects, as reported in the study, to the standardised metric, citing any methodological guidance consulted	Pages 8-9	
3 Describe the synthesis methods	Describe and justify the methods used to synthesise the effects for each outcome when it was not possible to undertake a meta-analysis of effect estimates	Pages 6-10	
4 Criteria used to prioritise results for summary and synthesis	Where applicable, provide the criteria used, with supporting justification, to select the particular studies, or a particular study, for the main synthesis or to draw conclusions from the synthesis	Pages 7-10 & Table 2	

	(e.g., based on study design, risk of bias assessments, directness in relation to the review question)		
5 Investigation of heterogeneity in reported effects	State the method(s) used to examine heterogeneity in reported effects when it was not possible to undertake a meta-analysis of effect estimates and its extensions to investigate heterogeneity	Overall Psychological variable heterogeneity: Page 13	
6 Certainty of evidence	Describe the methods used to assess certainty of the synthesis findings	Overall Psychological variable heterogeneity: Pages 13	Overall Psychological variable GRADE: Appendix 7 Risk of Bias: Appendix 6
7 Data presentation methods	Describe the graphical and tabular methods used to present the effects (e.g., tables, forest plots, harvest plots). Specify key study characteristics (e.g., study design, risk of bias) used to order the studies, in the text and any tables or graphs, clearly referencing the studies included	Study characteristics: Table 2	Risk of Bias: Appendix 6
Results			
8 Reporting results	For each comparison and outcome, provide a description of the synthesised findings, and the certainty of the findings. Describe the result in language that is consistent with the question the synthesis addresses, and indicate which studies contribute to the synthesis	Pages 14-16	

Discussion			
9 Limitations of the synthesis	Report the limitations of the synthesis methods used and/or the groupings used in the synthesis, and how these affect the conclusions that can be drawn in relation to the original review question	Pages 19-21	

Note. The page numbers referenced in this table correspond with the published manuscript.

A.3 MARS Guidelines

Section/topic	#	Checklist item	Reported in this book
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	Yes
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	No, book chapters do not contain abstracts
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	Yes
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	Yes
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information.	Protocols are available from the author
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	Yes
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	Yes
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	Yes

Section/topic	#	Checklist item	Reported in this book
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	Yes
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	Yes
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	No, available from the authors
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	No, within-study bias was not estimated
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	Yes
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	Yes
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	Yes
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	Yes
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	No, most studies were located prior to 2009
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	No, this data is available from the authors
Risk of bias within	19	Present data on risk of bias of each study and, if available, any outcome-level assessment (see	No, within-study

Section/topic	#	Checklist item	Reported in this book
studies		Item 12).	bias was not estimated
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group and (b) effect estimates and confidence intervals, ideally with a forest plot.	No, this data is available from the authors
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	Yes
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	Yes
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression) (see Item 16).	Yes
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., health care providers, users, and policy makers).	Yes
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review level (e.g., incomplete retrieval of identified research, reporting bias).	Yes
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	Yes
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	Yes

Note. The page numbers referenced in this table correspond with the published manuscript.

A.4: PRISMA Guidelines

Section and Topic	Item #	Checklist item	Location where item is reported
TITLE			
Title	1	Identify the report as a systematic review.	Title Page
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	Abstract
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	Pages 2-3
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	Page 3
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	Page 4
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	Page 4
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	Table 1 & Page 4
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	Page 5
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	Page 5
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	Pages 6 - 7
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding	Pages 6 - 7

Section and Topic	Item #	Checklist item	Location where item is reported
		sources). Describe any assumptions made about any missing or unclear information.	
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	Pages 5 - 6
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	Page 6
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	Table 2 & Page 8
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	Page 7
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	Table 2
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	Pages 6 - 7
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	Page 6
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	-
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	Pages 5 - 6
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	Page 6
RESULTS			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	Page 7 & Figure 1
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	Supplementary Material

Section and Topic	Item #	Checklist item	Location where item is reported
Study characteristics	17	Cite each included study and present its characteristics.	Table 2
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	Table 2 & Supplementary Material
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	Pages 7 - 12 & Supplementary Material
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	Pages 7 - 12
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	Pages 7 - 12 & Supplementary Material
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	Page 6 & Pages 8 - 11
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	-
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	-
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	Pages 8 - 10
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	Pages 12 - 18
	23b	Discuss any limitations of the evidence included in the review.	Pages 16 - 17
	23c	Discuss any limitations of the review processes used.	Pages 16 - 17
	23d	Discuss implications of the results for practice, policy, and future research.	Pages 16 - 18

Section and Topic	Item #	Checklist item	Location where item is reported
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	Abstract & Page 4
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	Abstract & Page 4
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	Pages 6 - 7
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	Declaration
Competing interests	26	Declare any competing interests of review authors.	Declaration
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	Table 2 & Supplementary Material

Note. The page numbers referenced in this table correspond with the published manuscript.

A.5: Search String

Table

Search and outputs at each stage for the five databases search (Updated February 2023).

	Search String	Academic Search Complete	APA PsycInfo	MEDLINE	PubMed	SPORTDiscus
S1	TI/AB goal* OR step*	1,499,311	286,951	1,174,875	1,194,108	97,471
S2	TX “phys* activ*” OR exer* OR fitness OR activ* OR walk* OR “phys* train*”	10,901,461	925,217	8,380,380	6,738,823	939,834
S3	TX “seden* adult*” OR “seden* older* adult*” OR “inactiv* adult*” OR “inactiv* older* adult*” OR “seden* individual*” OR “inactiv* individual*” OR “insufficient* activ* adult*” OR “insufficient* activ* older* adult*” OR “insufficient* activ* individual*”	6,461	722	6,260	88,947	4,974
S4	TX psych* OR wellbeing OR well-being OR “well being” OR “mental health”	4,080,328	3,373,961	4,086,531	10,704,155	367,560
S5	S1 AND S2 AND S3 AND S4	382	68	410	3,266	300
S6	S5 *full text*	352	68	313	3,104	286
S7	S6 *english*	350	68	311	3,062	280

A.6: Full Text Screening

Table

Titles screened at full text.

Author	Title	Year	Included/ Excluded	Reason
**Adams et al.	Adaptive goals and reinforcement timing to increase physical activity in adults: a factorial randomised trial.	2022	Excluded	Missing measure: No psychological variable measured
Agarwal et al.	Feasibility of an electronic health tool to promote physical activity in primary care: pilot cluster randomized controlled trial.	2020	Excluded	Excluded population: Age range not reported separately
Al-Eisa et al.	Association between physical activity and psychological status among Saudi female students.	2014	Excluded	No Baseline or control
*Allman-Farinelli et al.	A mobile health lifestyle program for prevention of weight gain in young adults (TXT2BFiT): nine-month outcomes of a randomized controlled trial.	2016	Excluded	Missing measure: No psychological variable measured
Anderson-Bill et al.	Aging and the social cognitive determinants of physical activity behaviour and behaviour change: evidence from the guide to health trial.	2011	Excluded	No goal or type mentioned, it is a health intervention
Annesi & Whitaker	Relations of mood and exercise with weight loss in formerly sedentary obese women.	2008	Excluded	Missing measure: No physical activity variable measured
*Annesi et al.	Weight loss and the prevention of weight regain: evaluation of a treatment model of exercise self-regulation generalizing to controlled eating.	2016	Excluded	No goal: Informed of benefits but no goal for physical activity in the intervention
Arbour & Martin	A randomised controlled trial of the effects of implementation intentions on women's walking behaviour.	2009	Excluded	No response from contacting for more information

*Ashton et al.	Feasibility and preliminary efficacy of the ‘HEYMAN’ healthy lifestyle program for young men: a pilot randomised controlled trial.	2017	Excluded	No goal for physical activity in the intervention
Baker et al.	The effect of a pedometer-based community walking intervention "Walking for Wellbeing in the West" on physical activity levels and health outcomes: a 12-week randomized controlled trial.	2008	Excluded	Duplicate data: Data is reported in a more up to date research article (Fitzsimons et al.)
**Ballinger et al.	A personalised, dynamic physical activity intervention is feasible and improves energetic capacity, energy expenditure, and quality of life in breast cancer survivors.	2021	Excluded	Excluded population: No mention of participant activity level prior to data collection
**Berger et al.	“Feeling Good” after exercise during a weight loss program: subjective well-being in support of a hedonic paradigm.	2022	Excluded	Missing measure: No post intervention physical activity measure
**Berninger et al.	The effects of UPcomplish on office workers’ sedentary behaviour, quality of life and psychosocial determinants: a stepped-wedged design.	2022	Excluded	Excluded population: No mention of participant activity level prior to data collection
**Berry et al.	Efficacy and mechanisms of a brief adaptive goal-setting intervention for physical activity: a randomised pilot trial.	2022	Excluded	Excluded population: Age range not reported separately
Blough & Loprinzi	Experimentally investigating the joint effects of physical activity and sedentary behaviour on depression and anxiety: a randomized controlled trial.	2018	Excluded	Excluded population: Sufficiently active population at start of study
Bort-Roig et al.	Uptake and factors that influence the use of 'sit less, move more' occupational intervention strategies in Spanish office employees.	2014	Excluded	Missing measure: No psychological variable measured
Boyce et al.	The effects of assigned and self-set goals on task performance.	1994	Excluded	Missing measure: No physical activity variable measured

Brakenridge et al.	Evaluating the effectiveness of organisational-level strategies with or without an activity tracker to reduce office workers' sitting time: a cluster-randomised trial.	2016	Excluded	Excluded population: No mention of participant activity level prior to data collection
**Brett & Pires-Yftantouda	Enhancing participation in a national pedometer-based workplace intervention amongst staff at a Scottish university.	2017	Excluded	Excluded population: No mention of participant activity level prior to data collection
Burkart et al.	The impact of a randomized controlled trial of a lifestyle intervention on postpartum physical activity among at-risk Hispanic women: Estudio PARTO.	2020	Excluded	Excluded population: Multiple activity levels reported with no separated results
Burke et al.	Group goal setting and group performance in a physical activity context.	2010	Excluded	Excluded population: Multiple activity levels reported with no separated results
Busch et al.	The influence of fitness-app usage on psychological well-being and body awareness -a daily diary randomized trial.	2020	Excluded	No response from contacting for more information
*Butler et al.	Effects of a pedometer-based intervention on physical activity levels after cardiac rehabilitation: a randomized controlled trial.	2009	Excluded	Missing measure: No psychological variable measured
*Bycura	A cognitive behavioural intervention examining exercise adherence in college - aged students – ProQuest.	2009	Excluded	Excluded population: No mention of participant activity level prior to data collection
Chae et al.	The effects of an academic–workplace partnership intervention to promote physical activity in sedentary office workers.	2015	Included	
**Chan & Tudor-Locke	Real-world evaluation of a community-based pedometer intervention.	2008	Excluded	Excluded population: No mention of participant activity level prior to data collection
Choi et al.	Effects of a physical activity and sedentary behaviour program on activity levels, stress, body size, and sleep in sedentary Korean college students.	2018	Excluded	No intervention
Choi et al.	mHealth physical activity intervention: a randomized pilot study in physically inactive pregnant women.	2016	Excluded	No response from contacting for more information

**Cioe et al.	The effect of increased physical activity on symptom burden in older persons living with HIV.	2019	Excluded	Missing measure: No psychological variable measured
**Clemes et al.	The effectiveness of the Structured Health Intervention For Truckers (SHIFT): a cluster randomised controlled trial (RCT).	2022	Excluded	Missing measure: No psychological variable measured
**Cody et al.	Short-term outcomes of physical activity counselling in in-patients with Major Depressive Disorder: results from the PACINPAT randomized controlled trial.	2022	Excluded	No goal clarification: Goal setting used as part of the program but no consistency suggested across the group
Coote et al.	Effect of exercising at minimum recommendations of the multiple sclerosis exercise guideline combined with structured education or attention control education - secondary results of the step it up randomised controlled trial.	2017	Excluded	No intervention: Program not an intervention
**Cruz et al.	Walk2Bactive: a randomised controlled trial of a physical activity-focused behavioural intervention beyond pulmonary rehabilitation in chronic obstructive pulmonary disease.	2016	Excluded	Excluded population: Age range not reported separately
*Dallow & Anderson	Using self-efficacy and a transtheoretical model to develop a physical activity intervention for obese women.	2003	Included	
**de Buisonjé et al.	Investigating rewards and deposit contract financial incentives for physical activity behaviour change using a smartphone app: randomized controlled trial.	2022	Excluded	Missing measure: No psychological variable measured
**Denton	Exercise group participation and the effects on adherence and exercise self-efficacy.	2004	Excluded	No goal clarification
*Dishman et al.	Move to improve: a randomized workplace trial to increase physical activity.	2009	Excluded	Excluded population: No mention of participant activity level prior to data collection

**Erathe & DiGennaro Reed	Technology-based contingency management for walking to prevent prolonged periods of workday sitting.	2022	Excluded	Missing measure: No psychological variable measured
Ezeugwu & Manns	The feasibility and longitudinal effects of a home-based sedentary behaviour change intervention after stroke.	2018	Excluded	Excluded population: Age range not included
Fitzsimons et al.	Does physical activity counselling enhance the effects of a pedometer-based intervention over the long-term: 12-month findings from the Walking for Wellbeing in the west study.	2012	Included	
Fjeldsoe et al.	MobileMums: a randomized controlled trial of an SMS-based physical activity intervention.	2010	Excluded	No goal types mentioned
Folta et al.	The StrongWomen-Healthy Hearts program: reducing cardiovascular disease risk factors in rural sedentary, overweight, and obese midlife and older women.	2009	Excluded	No intervention: Program not an intervention
Fukuoka et al.	The mPED randomized controlled clinical trial: applying mobile persuasive technologies to increase physical activity in sedentary women protocol.	2011	Excluded	Missing data: Only the protocol
Fukuoka et al.	Innovation to motivation–pilot study of a mobile phone intervention to increase physical activity among sedentary women.	2010	Excluded	Excluded population: Age range not reported separately
**Gardner et al.	Behaviour change among overweight and socially disadvantaged adults: a longitudinal study of the NHS Health Trainer Service.	2012	Excluded	Excluded population: No mention of participant activity level prior to data collection
**Giacobbi et al.	Exercise for overweight and obese women: A multimodal pilot intervention comparing in-person with phone-based delivery of guided imagery.	2018	Excluded	Missing measure: No physical activity variable measured
Gilson et al.	Experiences of route and task-based walking in a university community: qualitative perspectives in a randomized control trial.	2008	Excluded	Missing measure: Psychological variables were discussed qualitatively but no quantitative measure so excluded for the purpose of the meta-analysis

Haile et al.	Pilot testing of a nudge-based digital intervention (Welbot) to improve sedentary behaviour and wellbeing in the workplace.	2020	Excluded	No intervention: Program not an intervention
*Hallmark et al.	Use of a pedometer and goal setting to effect changes in physical activity.	2005	Excluded	Missing measure: No psychological variable measured
Harden et al.	Home-based aerobic conditioning for management of symptoms of fibromyalgia: a pilot study.	2012	Excluded	Missing measure: No physical activity variable measured
Harris et al.	A pedometer-based walking intervention in 45- to 75-year-olds, with and without practice nurse support: the PACE-UP three-arm cluster RCT.	2018	Excluded	Excluded population: Although age is reported in increments, analysis is not separated
Heesch et al.	Experiences of women in a minimal contact pedometer-based intervention: a qualitative study.	2005	Excluded	Missing measure: Qualitative discussion of psychological variables, no quantitative assessment so excluded for the purpose of the meta-analysis
**Hopstock et al.	Changes in adiposity, physical activity, cardiometabolic risk factors, diet, physical capacity and well-being in inactive women and men aged 57-74 years with obesity and cardiovascular risk – a 6-month complex lifestyle intervention with 6-month follow-up.	2021	Excluded	Excluded population: Age range not reported separately
*Houle et al.	Innovative program to increase physical activity following an acute coronary syndrome: randomized controlled trial.	2011	Excluded	Excluded population: Age range not included
**Huebschmann et al.	Integrating a physical activity coaching intervention into diabetes care: a mixed-methods evaluation of a pilot pragmatic trial.	2022	Excluded	Excluded population: Age range not included
**Huffman et al.	A psychological-behavioural intervention to improve physical activity in midlife adults with low baseline physical activity.	2021	Excluded	Excluded population: Age range not reported separately
**Hume et al.	Feasibility and acceptability of a physical activity behavioural modification tele-coaching intervention in lung transplant recipients.	2022	Excluded	Excluded population: Age range not included

**Humphreys et al.	Evaluation of a city-wide physical activity pathway for people affected by cancer: the Active Everyday service.	2023	Excluded	No goal clarification: Goal setting was encouraged but not standardised
**Iolascon et al.	Personalised paths for physical activity: developing a person-centred quantitative function to determine a customised amount of exercise and enhancing individual commitment.	2021	Excluded	No intervention
**Jeong et al.	Multi-component intervention program on habitual physical activity parameters and cognitive function in patients with mild cognitive impairment: a randomized controlled trial.	2021	Excluded	Excluded population: Age range not included
**Johnson et al.	A pilot randomised controlled trial of a Fitbit- and a Facebook-based physical activity intervention for young adult cancer survivors.	2021	Excluded	No goal clarification: the goal was not standardised, it was an encouragement for the use of goals
Kaleth et al.	Does increasing steps per day predict improvement in physical function and pain interference in adults with fibromyalgia?	2014	Excluded	No intervention: Exercise program
Karnes	Investigation of web-based motivational interviewing to increase physical activity participation among adults.	2014	Excluded	No intervention: Self-guided web sessions
Kilmer et al.	Impact of a home-based activity and dietary intervention in people with slowly progressive neuromuscular diseases.	2005	Excluded	Excluded population: No age range provided
**Kim & Kang	A tailored domain-specific intervention using contextual information about sedentary behaviour to reduce sedentary time: a Bayesian approach.	2021	Excluded	Missing measure: No psychological variable measured
King et al.	Identifying subgroups that succeed or fail with three levels of physical activity intervention: the activity counselling trial.	2006	Excluded	Excluded population: Age range not included (up to 75)
**Kuenze et al.	Feasibility of a wearable-based physical activity goal-setting intervention among individuals with anterior cruciate ligament reconstruction.	2021	Excluded	Excluded population: No mention of participant activity level prior to data collection

**Lemola et al.	Can a 'rewards-for-exercise app' increase physical activity, subjective well-being and sleep quality? An open-label single-arm trial among university staff with low to moderate physical activity levels.	2021	Excluded	Excluded population: Mixed activity levels reported
*Lewis et al.	Healthy for life: a randomized trial examining physical activity outcomes and psychosocial mediators.	2013	Included	
Ligibel et al.	Physical and psychological outcomes among women in a telephone-based exercise intervention during adjuvant therapy for early-stage breast cancer.	2010	Excluded	Missing measure: No psychological variable measured
Lindegård et al.	Changes in mental health in compliers and non-compliers with physical activity recommendations in patients with stress-related exhaustion.	2015	Excluded	No response from contacting for more information
Macniven et al.	Does a corporate worksite physical activity program reach those who are inactive? Findings from an evaluation of the global corporate challenge.	2015	Excluded	Excluded population: Mixed activity levels reported and not analysed separately
Mansi et al.	Investigating the effect of a 3-month workplace-based pedometer-driven walking programme on health-related quality of life in meat processing workers: a feasibility study within a randomized controlled trial.	2015	Included	
*Martin	Increasing physical activity in women who are relatively sedentary – ProQuest.	1998	Excluded	No goal clarification: Mention of goals being encouraged in one group but no clarification
**McCormack et al.	The effect of neighbourhood walkability on changes in physical activity and sedentary behaviour during a 12-week pedometer-facilitated intervention.	2022	Excluded	No goal setting employed
Melville et al.	Effectiveness of a walking programme to support adults with intellectual disabilities to increase physical activity: walk well cluster-randomised controlled trial.	2015	Excluded	Excluded population: No upper limit for age, only over 18 y/o were stated
Merom et al.	Can a motivational intervention overcome an unsupportive environment for walking–findings from the step-by-step study.	2009	Excluded	No response from contacting for more information

Miragall et al.	Increasing physical activity through an internet-based motivational intervention supported by pedometers in a sample of sedentary students: a randomised controlled trial.	2018	Included	
Monroe et al.	Effect of adding online social support tools to an adult walking program: a pilot randomized controlled trial.	2017	Included	
Morgan et al.	Walking toward a new me: the impact of prescribed walking 10,000 steps/day on physical and psychological well-being.	2010	Excluded	Excluded population: Age range not reported separately
Motl et al.	Internet intervention for increasing physical activity in persons with multiple sclerosis.	2011	Excluded	No goal clarification or prescribed goal
*Mutrie et al.	"Walk in to Work Out": a randomised controlled trial of a self-help intervention to promote active commuting.	2002	Excluded	Excluded population: No mention of participant activity level prior to data collection
**Naber et al.	Exploration of individualised goals and ergonomic modifications to address sedentary behaviours and perceived health and well-being among office workers.	2021	Excluded	Excluded population: No mention of participant activity level prior to data collection
**Nastasi et al.	Stepping up: an evaluation of social comparison of physical activity during Fitbit challenges.	2022	Excluded	Missing measure: No psychological variable measured
Nguyen et al.	Patient-centred physical activity coaching in COPD (Walk On!): A study protocol for a pragmatic randomized controlled trial.	2016	Excluded	Missing data: Only the protocol
Nies et al.	Southern women's response to a walking intervention.	2003	Excluded	Missing measure: No physical activity variable measured
*Nies & Partridge	Comparison of 3 interventions to increase walking in sedentary women.	2006	Excluded	No response from contacting for more information
*Ornes	A theory-based, web-mediated physical activity intervention for college women.	2020	Excluded	Missing measure: No psychological variable measured (Self-Efficacy = mediator variable)
**Park et al.	Mobile health intervention promoting physical activity in adults post cardiac rehabilitation: pilot randomised controlled trial.	2021	Excluded	Excluded population: No mention of participant activity level prior to data collection

**Passos et al.	Increased physical activity reduces sleep disturbances in asthma: a randomized controlled trial.	2023	Excluded	No goal clarification: Guidance on goal setting given, but no indication of what type of goal setting
**Patel et al.	Individual versus team-based financial incentives to increase physical activity: a randomized, controlled trial.	2016	Excluded	Excluded population: No mention of participant activity level prior to data collection
**Patel et al.	Framing financial incentives to increase physical activity among overweight and obese adults: a randomized, controlled trial.	2016	Excluded	Missing measure: No psychological variable measured
Pekmezi et al.	Physical activity and related psychosocial outcomes from a pilot randomized trial of an interactive voice response system-supported intervention in the deep south.	2018	Excluded	No response from contacting for more information
Plow et al.	Intervention mediators in a randomized controlled trial to increase physical activity and fatigue self-management behaviours among adults with Multiple Sclerosis.	2020	Excluded	No goal clarification: Guidance on goal setting given, but no indication of what type of goal setting
*Pope et al.	Use of wearable technology and social media to improve physical activity and dietary behaviours among college students: a 12-week randomized pilot study.	2019	Excluded	Missing measure: No psychological variable measured
Prestwich et al.	Do web-based competitions promote physical activity? Randomized controlled trial.	2017	Included	
Rabin et al.	Internet-based physical activity intervention targeting young adult cancer survivors.	2011	Excluded	No goal clarification: Advised to use goal setting, but no indication of what goals were set or if they were
Rovniak et al.	Enhancing theoretical fidelity: an e-mail-based walking program demonstration.	2005	Included	
Samuels et al.	A randomized controlled trial of continuous activity, short bouts, and a 10,000 step guideline in inactive adults.	2011	Excluded	Excluded population: Age not reported separately

**Sari et al.	A community intervention for behaviour modification: an experience to control cardiovascular diseases in Yogyakarta, Indonesia.	2013	Excluded	No goal
*Sharp & Caperchione	The effects of a pedometer-based intervention on first-year university students: a randomized control trial	2016	Excluded	Excluded population: Ineligible participants
**Snethen et al.	The relationship between community participation and physical activity among individuals with serious mental illnesses.	2021	Excluded	Excluded population: No mention of participant activity level prior to data collection
Soucy et al.	Efficacy of guided self-help behavioural activation and physical activity for depression: a randomized controlled trial.	2017	Excluded	No goal clarification: Goal setting encouraged, but no indication of goal types or what goal setting was used, more program than intervention
Steeves et al.	Physical activity with and without tv viewing: effects on enjoyment of physical activity and tv, exercise self-efficacy, and barriers to being active in overweight adults.	2016	Included	
*Stephens et al.	Smartphone technology and text messaging for weight loss in young adults: a randomized controlled trial.	2017	Excluded	No response when contacted for more information
*Stetson et al.	Prospective evaluation of the effects of stress on exercise adherence in community-residing women.	1997	Excluded	Excluded population: No mention of participant activity level prior to data collection
Stovitz et al.	Pedometers as a means to increase ambulatory activity for patients seen at a family medicine clinic.	2005	Included	
**St Quinton et al.	Promoting physical activity through test messages: the impact of attitude and goal priority messages.	2021	Excluded	Excluded population: No mention of participant activity level prior to data collection
Tayama et al.	Effect of baseline self-efficacy on physical activity and psychological stress after a one-week pedometer intervention.	2012	Excluded	Excluded population: No mention of participant activity level prior to data collection

Tobin et al.	Uprising: an examination of sit-stand workstations, mental health and work ability in sedentary office workers, in Western Australia.	2016	Excluded	No goal was set, participants could choose to sit or stand but no instruction was given
Tomas-Carus et al.	Eight months of physical training in warm water improves physical and mental health in women with fibromyalgia: a randomized controlled trial.	2008	Excluded	Excluded population: Age not reported separately
**Tu et al.	Walking for fun or for "likes"? The impacts of different gamification orientations of fitness apps on consumers' physical activities.	2019	Excluded	No intervention: Fitness tracking study not an intervention
Van Geel et al.	Feasibility study of a 10-week community-based program using the WalkWithMe application on physical activity, walking, fatigue and cognition in persons with Multiple Sclerosis.	2020	Excluded	Excluded population: Age range not included in the study
** Vairavasundaram et al.	Dynamic physical activity recommendation delivered through a mobile fitness app: a deep learning approach.	2022	Excluded	No intervention
Vetrovsky et al.	Mental health and quality of life benefits of a pedometer-based walking intervention delivered in a primary care setting.	2017	Included	
**Walters et al.	An experimental test of a generic messaging approach for the Canadian 24-hour movement guidelines for adults.	2022	Excluded	No intervention
**Weng & Voss	Brain network predictors of exercise behaviour change in sedentary older adults: an emotion and decision making perspective	2018	Excluded	Excluded population: Age range not included in the study
**Western et al.	Supporting behaviour change in sedentary adults via real-time multidimensional physical activity feedback: mixed methods randomized controlled trial	2022	Excluded	Excluded population: Age range not included in the study
Wilson & Brookfield	Effect of goal setting on motivation and adherence in a six-week exercise program.	2009	Excluded	Excluded population: Population of exercisers
Wyke et al.	The effect of a programme to improve men's sedentary time and physical activity: the European Fans in Training (EuroFIT) randomised controlled trial.	2019	Excluded	No intervention: No goal intervention, it was a program

**Xu et al.	Self-expansion is positively associated with Fitbit-measured daily steps across 4-weeks.	2022	Excluded	Missing measure: No psychological variable measured
Yuenyongchaiwat	Effects of 10,000 steps a day on physical and mental health in overweight participants in a community setting: a preliminary study.	2016	Included	

(*) studies retrieved from review bibliography searches, *n* = 18

(**) studies retrieved from the repeated searches and assessed at Full Text (Updated February 2023), *n* = 43

Table

Reasons for exclusion.

Reason	**Study count:**
Excluded population	45
Missing measure	24
No goal/goal clarification	17
No intervention	11
No response when contact for information	8
Missing data	2
No control/baseline	1
Duplicate data	1

A.7: Risk of Bias

Table

Randomised control trials risk of bias judgement using Rob-2.

Study	Domain					Overall RoB Judgement
	1	2a	3	4	5	
Dallow and Anderson (2003)	Low	High	Low	High	Some Concern	High
Fitzsimons et al. (2012)	Low	Some Concern	Low	High	Some Concern	High
Lewis et al. (2013)	Low	Low	Low	Low	Some Concern	Some Concern
Mansi et al. (2015)	Low	Some Concern	Low	Low	Low	Some Concern
Miragall et al. (2018)	Low	Some Concern	Low	Low	Low	Some Concern
Monroe et al. (2017)	Low	Some Concern	Low	High	Some Concern	High
Prestwich et al. (2017)	Low	Some Concern	Low	Low	Some Concern	High
Rovniak et al. (2015)	Low	High	Low	High	Some Concern	High
Steeves et al. (2016)	Low	High	Low	High	Some Concern	High
Stovitz et al. (2005)	Low	Some Concern	Low	High	Some Concern	High

RoB = Risk of Bias

Table

Non-randomised control trials risk of bias judgement using ROBINS-I.

Study	Domain							Overall RoB Judgement
	1	2	3	4	5	6	7	
Chae et al. (2015)	Low	Low	Low	NI	Moderate	Moderate	Low	Moderate
Vetrovsky et al. (2017)	Low	Low	Low	NI	Low	Low	Low	Low
Yuenyongchaiwat (2016)	Low	Low	Low	NI	Low	Low	Low	Low

RoB = Risk of Bias

A.8. GRADE Certainty of Evidence

Table

GRADE rating using GRADEpro.

Certainty assessment							№ of patients		Effect		Certainty	Importance
№ of studies	**Study design**	**Risk of bias**	**Inconsistency**	**Indirectness**	**Imprecision**	**Other considerations**	**Overall Effect**	**placebo**	**Relative (95% CI)**	**Absolute (95% CI)**		
Goal - PA												
13	randomised trials	very serious[a]	serious[b]	not serious	not serious	strong association	915	937	-	SMD **1.11 SD higher** (0.74 higher to 1.47 higher)	⊕⊕◯◯ Low	CRITICAL
Goal - Psych												
13	randomised trials	very serious[a]	very serious[c]	not serious	not serious	none	2407	2433	-	SMD **0.25 SD higher** (0.1 higher to 0.4 higher)	⊕◯◯◯ Very low	CRITICAL
Specific Goal - Step												
10	randomised trials	very serious[a]	serious[b]	not serious	not serious	strong association	609	608	-	SMD **1.12 SD higher** (0.66 higher to 1.59 higher)	⊕⊕◯◯ Low	IMPORTANT
Mode of Intervention - Multiple Methods												

Certainty assessment							№ of patients		Effect		Certainty	Importance
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Overall Effect	placebo	Relative (95% CI)	Absolute (95% CI)		
9	randomised trials	very serious[a]	serious[b]	not serious	not serious	strong association	378	402	-	SMD **1.21 SD higher** (0.88 higher to 1.54 higher)	⊕⊕◯◯ Low	NOT IMPORTANT
Mode of Intervention - Remote												
4	randomised trials	very serious[a]	serious[b]	not serious	not serious	strong association	537	535	-	SMD **0.81 higher** (0.23 higher to 1.39 higher)	⊕⊕◯◯ Low	NOT IMPORTANT
PA Intensity - Moderate												
6	randomised trials	very serious[a]	very serious[b]	not serious	not serious	strong association	425	443	-	SMD **1.17 SD higher** (0.57 higher to 1.77 higher)	⊕◯◯◯ Very low	IMPORTANT
PA Intensity - Not specified												
7	randomised trials	very serious[a]	serious[b]	not serious	not serious	strong association	490	494	-	SMD **1.06 SD higher** (0.52 higher to 1.59 higher)	⊕⊕◯◯ Low	IMPORTANT

PA Measure - Technology (pedometer)

Certainty assessment							№ of patients		Effect		Certainty	Importance
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Overall Effect	placebo	Relative (95% CI)	Absolute (95% CI)		
10	randomised trials	very serious[a]	not serious	not serious	not serious	strong association	609	608	-	SMD **1.12 SD higher** (0.66 higher to 1.59 higher)	⨁⨁⨁◯ Moderate	IMPORTANT
PA Measure - Self-report (Questionnaire)												
4	randomised trials	very serious[a]	serious[b]	not serious	serious[c]	strong association	306	329	-	SMD **1.1 SD higher** (0.29 higher to 1.91 higher)	⨁◯◯◯ Very low	IMPORTANT
Sex - Female												
2	randomised trials	very serious[a]	serious[b]	not serious	not serious	strong association	83	108	-	SMD **1.05 higher** (0.32 higher to 1.78 higher)	⨁⨁◯◯ Low	NOT IMPORTANT
Sex - Mixed sex												
11	randomised trials	very serious[a]	very serious[b]	not serious	not serious	strong association	832	829	-	SMD **1.12 SD higher** (0.71 higher to 1.53 higher)	⨁◯◯◯ Very low	NOT IMPORTANT
Goal Type - Specific - Relative												

Certainty assessment							№ of patients		Effect		Certainty	Importance
№ of studies	**Study design**	**Risk of bias**	**Inconsistency**	**Indirectness**	**Imprecision**	**Other considerations**	**Overall Effect**	**placebo**	**Relative (95% CI)**	**Absolute (95% CI)**		
5	randomised trials	very serious[a]	not serious	not serious	not serious	strong association	206	205	-	SMD **0.81 SD higher** (0.45 higher to 1.17 higher)	⊕⊕⊕◯ Moderate	IMPORTANT
Goal Type - Specific - Absolute												
8	randomised trials	very serious[a]	very serious[b]	not serious	not serious	strong association	709	732	-	SMD **1.29 higher** (0.77 higher to 1.81 higher)	⊕◯◯◯ Very low	IMPORTANT
Goal Time Frame - Daily												
7	randomised trials	very serious[a]	serious[b]	not serious	not serious	strong association	485	489	-	SMD **1.33 SD higher** (0.69 higher to 1.96 higher)	⊕⊕◯◯ Low	IMPORTANT
Goal Time Frame - Weekly												
6	randomised trials	very serious[a]	very serious[b]	not serious	not serious	strong association	430	448	-	SMD **0.87 SD higher** (0.37 higher to 1.36 higher)	⊕◯◯◯ Very low	IMPORTANT
Reward - Yes												

Certainty assessment							№ of patients		Effect		Certainty	Importance
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Overall Effect	placebo	Relative (95% CI)	Absolute (95% CI)		
4	randomised trials	very serious[a]	serious[b]	not serious	not serious	strong association	518	520	-	SMD **0.6 SD higher** (0.2 higher to 1 higher)	⊕⊕◯◯ Low	NOT IMPORTANT

Reward - No

9	randomised trials	very serious[a]	very serious[b]	not serious	not serious	strong association	397	417	-	SMD **1.3 SD higher** (0.86 higher to 1.74 higher)	⊕◯◯◯ Very low	NOT IMPORTANT

Edcational Component - Yes

8	randomised trials	very serious[a]	serious[b]	not serious	not serious	strong association	491	513	-	SMD **0.97 SD higher** (0.56 higher to 1.39 higher)	⊕⊕◯◯ Low	IMPORTANT

Edcational Component - No

5	randomised trials	very serious[a]	serious[b]	not serious	not serious	strong association	424	424	-	SMD **1.37 higher** (0.5 higher to 2.24 higher)	⊕⊕◯◯ Low	IMPORTANT

Follow-up - Yes

Certainty assessment							№ of patients		Effect		Certainty	Importance
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Overall Effect	placebo	Relative (95% CI)	Absolute (95% CI)		
6	randomised trials	very serious[a]	serious[d]	not serious	not serious	strong association	357	415	-	SMD **0.98 SD higher** (0.47 higher to 1.5 higher)	⊕⊕◯◯ Low	IMPORTANT

Follow-up - No

7	randomised trials	very serious[a]	not serious	not serious	not serious	strong association	526	526	-	SMD **1.15 SD higher** (0.58 higher to 1.73 higher)	⊕⊕⊕◯ Moderate	IMPORTANT

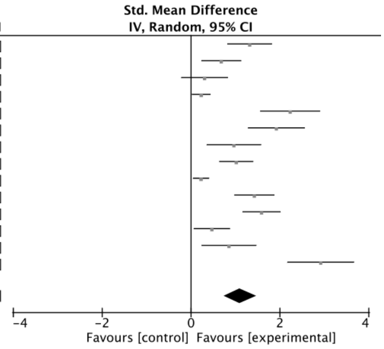
A.9: Subgroup Moderator Analysis

Figure

Overall goal effect on PA (with raw data).

	Experimental			Control				Std. Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Random, 95% CI
Chae et al. 2015	9,240.44	3,105.16	39	5,811.23	1,898.08	39	7.1%	1.32 [0.83, 1.81]
Dallow & Anderson. 2003	33.4758	0.6379	33	33.15	0.3518	58	7.3%	0.68 [0.24, 1.12]
Fitzsimons et al. 2012	9,977	4,669	32	8,693	3,483	27	7.1%	0.30 [−0.21, 0.82]
Lewis et al. 2013	176.74	147.7	194	144.02	137.5	192	8.0%	0.23 [0.03, 0.43]
Mansi et al. 2015	1,469	524	29	538	254	29	6.5%	2.23 [1.57, 2.90]
Mansi et al. 2015	9,792	2,053	29	6,551	1,154	29	6.6%	1.92 [1.29, 2.55]
Miragall et al. 2018	7,958	2,005	22	6,251	1,484	26	6.7%	0.96 [0.36, 1.57]
Monroe et al. 2017	6,504.2381	2,327.6872	63	4,564.8254	1,328.1338	63	7.6%	1.02 [0.65, 1.39]
Prestwich et al. 2017	6,057.1901	2,761.0828	263	5,428.0214	2,828.5076	263	8.1%	0.22 [0.05, 0.40]
Rovniak et al. 2005	67.865	44.7675	50	16.925	22.695	50	7.3%	1.42 [0.98, 1.86]
Steeves et al. 2016	7,735	2,205.3203	58	4,760.05	1,443.1792	58	7.4%	1.59 [1.17, 2.00]
Stovitz et al. 2005	8,855	4,690	50	6,779	4,079	50	7.5%	0.47 [0.07, 0.87]
Vetrovsky et al. 2017	6,719.1739	2,358.5438	23	5,043.087	1,377.1125	23	6.7%	0.85 [0.25, 1.46]
Yuenyongchaiwat. 2016	10,500.2	2,070.54	30	4,540.53	1,959	30	6.1%	2.92 [2.18, 3.66]
Total (95% CI)			**915**			**937**	**100.0%**	**1.11 [0.74, 1.47]**

Heterogeneity: $Tau^2 = 0.43$; $Chi^2 = 159.99$, $df = 13$ ($P < 0.00001$); $I^2 = 92\%$
Test for overall effect: $Z = 5.93$ ($P < 0.00001$)

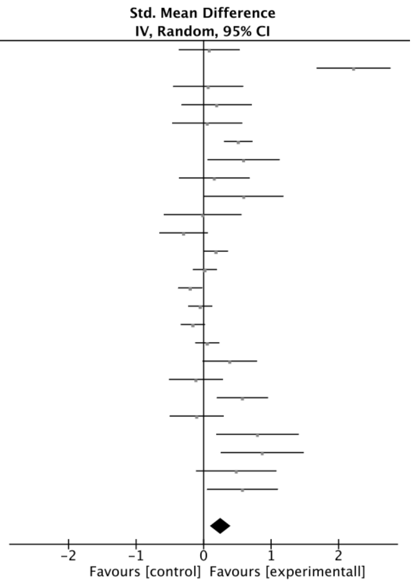


Figure

Overall goal effect on psychological outcomes (with raw data).

	Experimental			Control				Std. Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Random, 95% CI
Chae et al. 2015	42.8	13.52	39	41.62	14.36	39	3.8%	0.08 [−0.36, 0.53]
Dallow & Anderson. 2003	1.7252	0.1667	33	1.33	0.1816	58	3.3%	2.22 [1.68, 2.76]
Fitzsimons et al. 2012	0.89	0.12	32	0.88	0.17	27	3.4%	0.07 [−0.44, 0.58]
Fitzsimons et al. 2012	33.5	7.4	32	32.1	6.8	27	3.4%	0.19 [−0.32, 0.71]
Fitzsimons et al. 2012	19.5	7.5	27	19.1	7	32	3.4%	0.05 [−0.46, 0.57]
Lewis et al. 2013	3	0.87	194	2.56	0.84	192	5.1%	0.51 [0.31, 0.72]
Mansi et al. 2015	3.1	0.5	29	2.8	0.5	29	3.3%	0.59 [0.07, 1.12]
Mansi et al. 2015	52.7	5.2	29	51.7	7.1	29	3.4%	0.16 [−0.36, 0.67]
Miragall et al. 2018	29.14	3.18	22	25.62	7.34	26	3.1%	0.59 [0.01, 1.18]
Miragall et al. 2018	10.73	2.83	22	10.77	2.82	26	3.1%	−0.01 [−0.58, 0.55]
Monroe et al. 2017	6.4556	2.1383	63	7.1016	2.1967	63	4.3%	−0.30 [−0.65, 0.05]
Prestwich et al. 2017	1.8651	1.0251	263	1.6766	1.0313	263	5.3%	0.18 [0.01, 0.35]
Prestwich et al. 2017	0.8221	0.9753	263	0.8046	0.8607	263	5.3%	0.02 [−0.15, 0.19]
Prestwich et al. 2017	7.1217	1.7843	263	7.4698	1.7271	263	5.3%	−0.20 [−0.37, −0.03]
Prestwich et al. 2017	0.6803	0.8168	263	0.7196	0.768	263	5.3%	−0.05 [−0.22, 0.12]
Prestwich et al. 2017	0.8006	0.9604	263	0.9535	0.9676	263	5.3%	−0.16 [−0.33, 0.01]
Prestwich et al. 2017	2.1538	0.8832	263	2.1055	0.8918	263	5.3%	0.05 [−0.12, 0.23]
Rovniak et al. 2005	5.815	0.8359	50	5.45	1.0243	50	4.1%	0.39 [−0.01, 0.78]
Rovniak et al. 2005	3.545	0.7456	50	3.62	0.5487	50	4.1%	−0.11 [−0.51, 0.28]
Steeves et al. 2016	62.95	20.8758	58	50.45	22.2833	58	4.2%	0.58 [0.20, 0.95]
Stovitz et al. 2005	20.7	5.3	50	21.2	4.4	50	4.1%	−0.10 [−0.49, 0.29]
Vetrovsky et al. 2017	5.3	3.7	23	2.8	2.3	23	3.0%	0.80 [0.20, 1.40]
Vetrovsky et al. 2017	79	12	23	66	17	23	2.9%	0.87 [0.26, 1.48]
Vetrovsky et al. 2017	6.6	3.3	23	5.2	2.3	23	3.0%	0.48 [−0.10, 1.07]
Yuenyongchaiwat. 2016	59.37	24.83	30	47.1	16.41	30	3.4%	0.58 [0.06, 1.09]
Total (95% CI)			**2407**			**2433**	**100.0%**	**0.25 [0.10, 0.40]**

Heterogeneity: $Tau^2 = 0.11$; $Chi^2 = 138.67$, $df = 24$ ($P < 0.00001$); $I^2 = 83\%$
Test for overall effect: $Z = 3.25$ ($P = 0.001$)

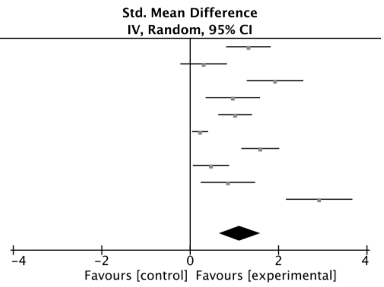


Figure

Effect of specific goal on step count.

	Experimental			Control				Std. Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Random, 95% CI
Chae et al. 2015	9,240.44	3,105.16	39	5,811.23	1,898.08	39	10.1%	1.32 [0.83, 1.81]
Fitzsimons et al. 2012	9,977	4,669	32	8,693	3,483	27	10.0%	0.30 [−0.21, 0.82]
Mansi et al. 2015	9,792	2,053	29	6,551	1,154	29	9.4%	1.92 [1.29, 2.55]
Miragall et al. 2018	7,958	2,005	22	6,251	1,484	26	9.5%	0.96 [0.36, 1.57]
Monroe et al. 2017	6,504.2381	2,327.6872	63	4,564.8254	1,328.1338	63	10.6%	1.02 [0.65, 1.39]
Prestwich et al. 2017	6,057.1901	2,761.0828	263	5,428.0214	2,828.5076	263	11.2%	0.22 [0.05, 0.40]
Steeves et al. 2016	7,735	2,205.3203	58	4,760.05	1,443.1792	58	10.4%	1.59 [1.17, 2.00]
Stovitz et al. 2005	8,855	4,690	50	6,779	4,079	50	10.5%	0.47 [0.07, 0.87]
Vetrovsky et al. 2017	6,719.1739	2,358.5438	23	5,043.087	1,377.1125	23	9.5%	0.85 [0.25, 1.46]
Yuenyongchaiwat. 2016	10,500.2	2,070.54	30	4,540.53	1,959	30	8.8%	2.92 [2.18, 3.66]
Total (95% CI)			**609**			**608**	**100.0%**	**1.12 [0.66, 1.59]**

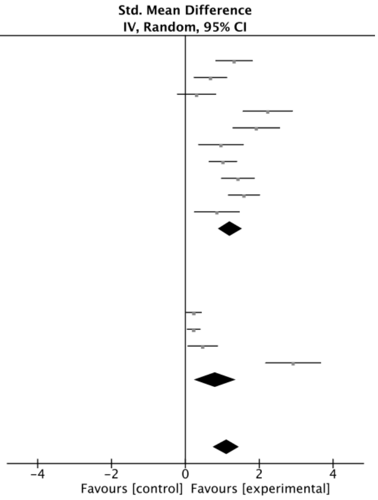
Heterogeneity: $Tau^2 = 0.50$; $Chi^2 = 109.01$, $df = 9$ ($P < 0.00001$); $I^2 = 92\%$
Test for overall effect: $Z = 4.71$ ($P < 0.00001$)



Figure

Moderator analysis: Mode of intervention.

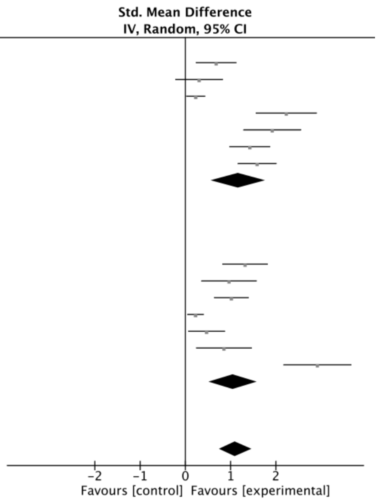
Study or Subgroup	Experimental Mean	Experimental SD	Experimental Total	Control Mean	Control SD	Control Total	Weight	Std. Mean Difference IV, Random, 95% CI
6.1.1 Multiple Methods								
Chae et al. 2015	9,240.44	3,105.16	39	5,811.23	1,898.08	39	7.1%	1.32 [0.83, 1.81]
Dallow & Anderson. 2003	33.4758	0.6379	33	33.15	0.3518	58	7.3%	0.68 [0.24, 1.12]
Fitzsimons et al. 2012	9,977	4,669	32	8,693	3,483	27	7.1%	0.30 [−0.21, 0.82]
Mansi et al. 2015	1,469	524	29	538	254	29	6.5%	2.23 [1.57, 2.90]
Mansi et al. 2015	9,792	2,053	29	6,551	1,154	29	6.6%	1.92 [1.29, 2.55]
Miragall et al. 2018	7,958	2,005	22	6,251	1,484	26	6.7%	0.96 [0.36, 1.57]
Monroe et al. 2017	6,504.2381	2,327.6872	63	4,564.8254	1,328.1338	63	7.6%	1.02 [0.65, 1.39]
Rovniak et al. 2005	67.865	44.7675	50	16.925	22.695	50	7.3%	1.42 [0.98, 1.86]
Steeves et al. 2016	7,735	2,205.3203	58	4,760.05	1,443.1792	58	7.4%	1.59 [1.17, 2.00]
Vetrovsky et al. 2017	6,719.1739	2,358.5438	23	5,043.087	1,377.1125	23	6.7%	0.85 [0.25, 1.46]
Subtotal (95% CI)			**378**			**402**	**70.3%**	**1.21 [0.88, 1.54]**
Heterogeneity: $Tau^2 = 0.21$; $Chi^2 = 38.43$, df = 9 (P < 0.0001); $I^2 = 77\%$								
Test for overall effect: Z = 7.26 (P < 0.00001)								
6.1.2 Remote								
Lewis et al. 2013	176.74	147.7	194	144.02	137.5	192	8.0%	0.23 [0.03, 0.43]
Prestwich et al. 2017	6,057.1901	2,761.0828	263	5,428.0214	2,828.5076	263	8.1%	0.22 [0.05, 0.40]
Stovitz et al. 2005	8,855	4,690	50	6,779	4,079	50	7.5%	0.47 [0.07, 0.87]
Yuenyongchaiwat. 2016	10,500.2	2,070.54	30	4,540.53	1,959	30	6.1%	2.92 [2.18, 3.66]
Subtotal (95% CI)			**537**			**535**	**29.7%**	**0.81 [0.23, 1.39]**
Heterogeneity: $Tau^2 = 0.31$; $Chi^2 = 49.86$, df = 3 (P < 0.00001); $I^2 = 94\%$								
Test for overall effect: Z = 2.75 (P = 0.006)								
Total (95% CI)			**915**			**937**	**100.0%**	**1.11 [0.74, 1.47]**
Heterogeneity: $Tau^2 = 0.43$; $Chi^2 = 159.99$, df = 13 (P < 0.00001); $I^2 = 92\%$								
Test for overall effect: Z = 5.93 (P < 0.00001)								
Test for subgroup differences: $Chi^2 = 1.40$, df = 1 (P = 0.24), $I^2 = 28.4\%$								



Figure

Moderator analysis: Physical activity intensity.

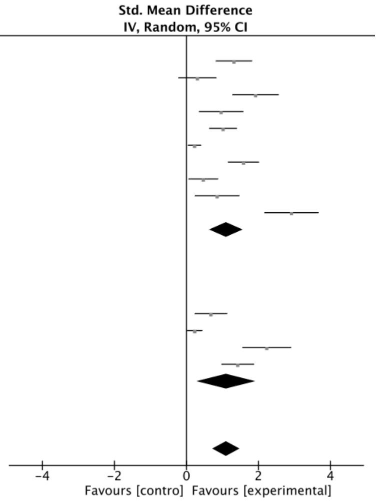
Study or Subgroup	Experimental Mean	Experimental SD	Experimental Total	Control Mean	Control SD	Control Total	Weight	Std. Mean Difference IV, Random, 95% CI
6.2.1 Moderate								
Dallow & Anderson. 2003	33.4758	0.6379	33	33.15	0.3518	58	7.3%	0.68 [0.24, 1.12]
Fitzsimons et al. 2012	9,977	4,669	32	8,693	3,483	27	7.1%	0.30 [−0.21, 0.82]
Lewis et al. 2013	176.74	147.7	194	144.02	137.5	192	8.0%	0.23 [0.03, 0.43]
Mansi et al. 2015	1,469	524	29	538	254	29	6.5%	2.23 [1.57, 2.90]
Mansi et al. 2015	9,792	2,053	29	6,551	1,154	29	6.6%	1.92 [1.29, 2.55]
Rovniak et al. 2005	67.865	44.7675	50	16.925	22.695	50	7.3%	1.42 [0.98, 1.86]
Steeves et al. 2016	7,735	2,205.3203	58	4,760.05	1,443.1792	58	7.4%	1.59 [1.17, 2.00]
Subtotal (95% CI)			**425**			**443**	**50.2%**	**1.17 [0.57, 1.77]**
Heterogeneity: $Tau^2 = 0.60$; $Chi^2 = 85.62$, df = 6 (P < 0.00001); $I^2 = 93\%$								
Test for overall effect: Z = 3.81 (P = 0.0001)								
6.2.2 Not specified								
Chae et al. 2015	9,240.44	3,105.16	39	5,811.23	1,898.08	39	7.1%	1.32 [0.83, 1.81]
Miragall et al. 2018	7,958	2,005	22	6,251	1,484	26	6.7%	0.96 [0.36, 1.57]
Monroe et al. 2017	6,504.2381	2,327.6872	63	4,564.8254	1,328.1338	63	7.6%	1.02 [0.65, 1.39]
Prestwich et al. 2017	6,057.1901	2,761.0828	263	5,428.0214	2,828.5076	263	8.1%	0.22 [0.05, 0.40]
Stovitz et al. 2005	8,855	4,690	50	6,779	4,079	50	7.5%	0.47 [0.07, 0.87]
Vetrovsky et al. 2017	6,719.1739	2,358.5438	23	5,043.087	1,377.1125	23	6.7%	0.85 [0.25, 1.46]
Yuenyongchaiwat. 2016	10,500.2	2,070.54	30	4,540.53	1,959	30	6.1%	2.92 [2.18, 3.66]
Subtotal (95% CI)			**490**			**494**	**49.8%**	**1.06 [0.52, 1.59]**
Heterogeneity: $Tau^2 = 0.46$; $Chi^2 = 71.44$, df = 6 (P < 0.00001); $I^2 = 92\%$								
Test for overall effect: Z = 3.87 (P = 0.0001)								
Total (95% CI)			**915**			**937**	**100.0%**	**1.11 [0.74, 1.47]**
Heterogeneity: $Tau^2 = 0.43$; $Chi^2 = 159.99$, df = 13 (P < 0.00001); $I^2 = 92\%$								
Test for overall effect: Z = 5.93 (P < 0.00001)								
Test for subgroup differences: $Chi^2 = 0.07$, df = 1 (P = 0.79), $I^2 = 0\%$								



Figure

Moderator analysis: Physical activity measure.

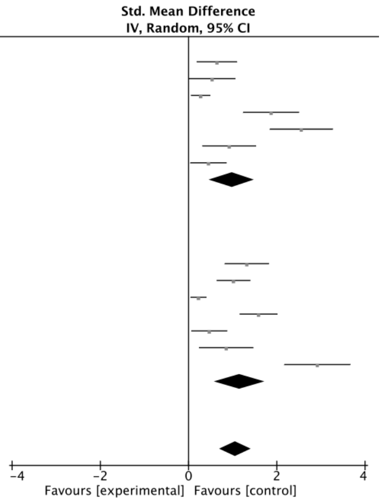
Study or Subgroup	Experimental Mean	Experimental SD	Experimental Total	Control Mean	Control SD	Control Total	Weight	Std. Mean Difference IV, Random, 95% CI
6.3.2 Technology (pedometer)								
Chae et al. 2015	9,240.44	3,105.16	39	5,811.23	1,898.08	39	7.1%	1.32 [0.83, 1.81]
Fitzsimons et al. 2012	9,977	4,669	32	8,693	3,483	27	7.1%	0.30 [−0.21, 0.82]
Mansi et al. 2015	9,792	2,053	29	6,551	1,154	29	6.6%	1.92 [1.29, 2.55]
Miragall et al. 2018	7,958	2,005	22	6,251	1,484	26	6.7%	0.96 [0.36, 1.57]
Monroe et al. 2017	6,504.2381	2,327.6872	63	4,564.8254	1,328.1338	63	7.6%	1.02 [0.65, 1.39]
Prestwich et al. 2017	6,057.1901	2,761.0828	263	5,428.0214	2,828.5076	263	8.1%	0.22 [0.05, 0.40]
Steeves et al. 2016	7,735	2,205.3203	58	4,760.05	1,443.1792	58	7.4%	1.59 [1.17, 2.00]
Stovitz et al. 2005	8,855	4,690	50	6,779	4,079	50	7.5%	0.47 [0.07, 0.87]
Vetrovsky et al. 2017	6,719.1739	2,358.5438	23	5,043.087	1,377.1125	23	6.7%	0.85 [0.25, 1.46]
Yuenyongchaiwat. 2016	10,500.2	2,070.54	30	4,540.53	1,959	30	6.1%	2.92 [2.18, 3.66]
Subtotal (95% CI)			**609**			**608**	**70.9%**	**1.12 [0.66, 1.59]**
Heterogeneity: $Tau^2 = 0.50$; $Chi^2 = 109.01$, df = 9 (P < 0.00001); $I^2 = 92\%$								
Test for overall effect: Z = 4.71 (P < 0.00001)								
6.3.3 Self-report (Questionnaire)								
Dallow & Anderson. 2003	33.4758	0.6379	33	33.15	0.3518	58	7.3%	0.68 [0.24, 1.12]
Lewis et al. 2013	176.74	147.7	194	144.02	137.5	192	8.0%	0.23 [0.03, 0.43]
Mansi et al. 2015	1,469	524	29	538	254	29	6.5%	2.23 [1.57, 2.90]
Rovniak et al. 2005	67.865	44.7675	50	16.925	22.695	50	7.3%	1.42 [0.98, 1.86]
Subtotal (95% CI)			**306**			**329**	**29.1%**	**1.10 [0.29, 1.91]**
Heterogeneity: $Tau^2 = 0.63$; $Chi^2 = 49.81$, df = 3 (P < 0.00001); $I^2 = 94\%$								
Test for overall effect: Z = 2.67 (P = 0.008)								
Total (95% CI)			**915**			**937**	**100.0%**	**1.11 [0.74, 1.47]**
Heterogeneity: $Tau^2 = 0.43$; $Chi^2 = 159.99$, df = 13 (P < 0.00001); $I^2 = 92\%$								
Test for overall effect: Z = 5.93 (P < 0.00001)								
Test for subgroup differences: $Chi^2 = 0.00$, df = 1 (P = 0.97), $I^2 = 0\%$								



Figure

Moderator analysis: Follow-up.

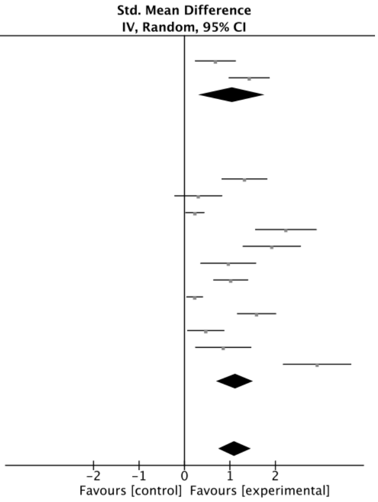
Study or Subgroup	Experimental Mean	Experimental SD	Experimental Total	Control Mean	Control SD	Control Total	Weight	Std. Mean Difference IV, Random, 95% CI
6.6.1 Yes								
Dallow & Anderson. 2003	33.6032	1.0855	31	33.15	0.3518	58	7.3%	0.64 [0.20, 1.09]
Fitzsimons et al. 2012	8,678	3,871	24	6,802	3,212	39	7.0%	0.53 [0.02, 1.05]
Lewis et al. 2013	188.5	159.89	174	147.97	135.79	184	8.1%	0.27 [0.07, 0.48]
Mansi et al. 2015	9,645	1,906	29	6,266	1,648	29	6.6%	1.87 [1.25, 2.49]
Mansi et al. 2015	1,383	402	29	520	246	29	6.2%	2.55 [1.85, 3.26]
Miragall et al. 2018	8,116	2,759	22	5,943	1,876	26	6.7%	0.92 [0.32, 1.52]
Rovniak et al. 2005	37.95	61.8624	48	16.925	22.695	50	7.5%	0.45 [0.05, 0.85]
Subtotal (95% CI)			**357**			**415**	**49.4%**	**0.98 [0.47, 1.50]**
Heterogeneity: $Tau^2 = 0.42$; $Chi^2 = 56.66$, df = 6 (P < 0.00001); $I^2 = 89\%$								
Test for overall effect: Z = 3.73 (P = 0.0002)								
6.6.2 No								
Chae et al. 2015	9,240.44	3,105.16	39	5,811.23	1,898.08	39	7.1%	1.32 [0.83, 1.81]
Monroe et al. 2017	6,504.2381	2,327.6872	63	4,564.8254	1,328.1338	63	7.6%	1.02 [0.65, 1.39]
Prestwich et al. 2017	6,057.1901	2,761.0828	263	5,428.0214	2,828.5076	263	8.1%	0.22 [0.05, 0.40]
Steeves et al. 2016	7,735	2,205.3203	58	4,760.05	1,443.1792	58	7.4%	1.59 [1.17, 2.00]
Stovitz et al. 2005	8,855	4,690	50	6,779	4,079	50	7.5%	0.47 [0.07, 0.87]
Vetrovsky et al. 2017	6,719.1739	2,358.5438	23	5,043.087	1,377.1125	23	6.7%	0.85 [0.25, 1.46]
Yuenyongchaiwat. 2016	10,500.2	2,070.54	30	4,540.53	1,959	30	6.1%	2.92 [2.18, 3.66]
Subtotal (95% CI)			**526**			**526**	**50.6%**	**1.15 [0.58, 1.73]**
Heterogeneity: $Tau^2 = 0.54$; $Chi^2 = 90.95$, df = 6 (P < 0.00001); $I^2 = 93\%$								
Test for overall effect: Z = 3.94 (P < 0.0001)								
Total (95% CI)			**883**			**941**	**100.0%**	**1.06 [0.71, 1.42]**
Heterogeneity: $Tau^2 = 0.39$; $Chi^2 = 147.92$, df = 13 (P < 0.00001); $I^2 = 91\%$								
Test for overall effect: Z = 5.88 (P < 0.00001)								
Test for subgroup differences: $Chi^2 = 0.19$, df = 1 (P = 0.66), $I^2 = 0\%$								



Figure

Moderator analysis: Sex.

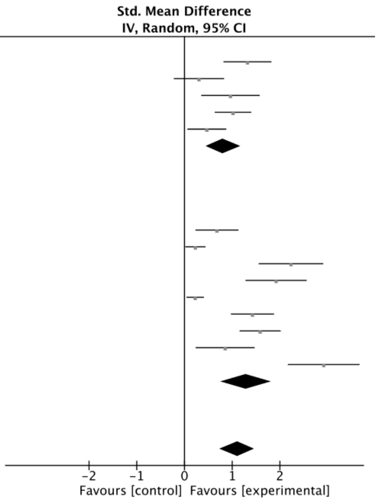
Study or Subgroup	Experimental Mean	Experimental SD	Experimental Total	Control Mean	Control SD	Control Total	Weight	Std. Mean Difference IV, Random, 95% CI
7.1.1 Female								
Dallow & Anderson. 2003	33.4758	0.6379	33	33.15	0.3518	58	7.3%	0.68 [0.24, 1.12]
Rovniak et al. 2005	67.865	44.7675	50	16.925	22.695	50	7.3%	1.42 [0.98, 1.86]
Subtotal (95% CI)			**83**			**108**	**14.7%**	**1.05 [0.32, 1.78]**
Heterogeneity: $Tau^2 = 0.23$; $Chi^2 = 5.50$, df = 1 (P = 0.02); $I^2 = 82\%$								
Test for overall effect: Z = 2.83 (P = 0.005)								
7.1.2 Mixed sex								
Chae et al. 2015	9,240.44	3,105.16	39	5,811.23	1,898.08	39	7.1%	1.32 [0.83, 1.81]
Fitzsimons et al. 2012	9,977	4,669	32	8,693	3,483	27	7.1%	0.30 [−0.21, 0.82]
Lewis et al. 2013	176.74	147.7	194	144.02	137.5	192	8.0%	0.23 [0.03, 0.43]
Mansi et al. 2015	1,469	524	29	538	254	29	6.5%	2.23 [1.57, 2.90]
Mansi et al. 2015	9,792	2,053	29	6,551	1,154	29	6.6%	1.92 [1.29, 2.55]
Miragall et al. 2018	7,958	2,005	22	6,251	1,484	26	6.7%	0.96 [0.36, 1.57]
Monroe et al. 2017	6,504.2381	2,327.6872	63	4,564.8254	1,328.1338	63	7.6%	1.02 [0.65, 1.39]
Prestwich et al. 2017	6,057.1901	2,761.0828	263	5,428.0214	2,828.5076	263	8.1%	0.22 [0.05, 0.40]
Steeves et al. 2016	7,735	2,205.3203	58	4,760.05	1,443.1792	58	7.4%	1.59 [1.17, 2.00]
Stovitz et al. 2005	8,855	4,690	50	6,779	4,079	50	7.5%	0.47 [0.07, 0.87]
Vetrovsky et al. 2017	6,719.1739	2,358.5438	23	5,043.087	1,377.1125	23	6.7%	0.85 [0.25, 1.46]
Yuenyongchaiwat. 2016	10,500.2	2,070.54	30	4,540.53	1,959	30	6.1%	2.92 [2.18, 3.66]
Subtotal (95% CI)			**832**			**829**	**85.3%**	**1.12 [0.71, 1.53]**
Heterogeneity: $Tau^2 = 0.45$; $Chi^2 = 147.38$, df = 11 (P < 0.00001); $I^2 = 93\%$								
Test for overall effect: Z = 5.38 (P < 0.00001)								
Total (95% CI)			**915**			**937**	**100.0%**	**1.11 [0.74, 1.47]**
Heterogeneity: $Tau^2 = 0.43$; $Chi^2 = 159.99$, df = 13 (P < 0.00001); $I^2 = 92\%$								
Test for overall effect: Z = 5.93 (P < 0.00001)								
Test for subgroup differences: $Chi^2 = 0.03$, df = 1 (P = 0.87), $I^2 = 0\%$								



Figure

Moderator analysis: Goal type.

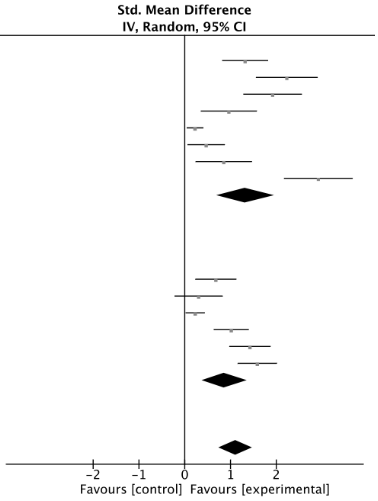
Study or Subgroup	Experimental Mean	Experimental SD	Experimental Total	Control Mean	Control SD	Control Total	Weight	Std. Mean Difference IV, Random, 95% CI
8.1.1 Specific - Relative								
Chae et al. 2015	9,240.44	3,105.16	39	5,811.23	1,898.09	39	7.1%	1.32 [0.83, 1.81]
Fitzsimons et al. 2012	9,977	4,669	32	8,693	3,483	27	7.1%	0.30 [−0.21, 0.82]
Miragall et al. 2018	7,958	2,005	22	6,251	1,484	26	6.7%	0.96 [0.36, 1.57]
Monroe et al. 2017	6,504.2381	2,327.6872	63	4,564.8254	1,328.1338	63	7.6%	1.02 [0.65, 1.39]
Stovitz et al. 2005	8,855	4,690	50	6,779	4,079	50	7.5%	0.47 [0.07, 0.87]
Subtotal (95% CI)			**206**			**205**	**36.0%**	**0.81 [0.45, 1.17]**
Heterogeneity: $Tau^2 = 0.11$; $Chi^2 = 12.10$, df = 4 (P = 0.02); $I^2 = 67\%$								
Test for overall effect: Z = 4.39 (P < 0.0001)								
8.1.2 Specific - Absolute								
Dallow & Anderson. 2003	33.4758	0.6379	33	33.15	0.3518	58	7.3%	0.68 [0.24, 1.12]
Lewis et al. 2013	176.74	147.7	194	144.02	137.5	192	8.0%	0.23 [0.03, 0.43]
Mansi et al. 2015	1,469	524	29	538	254	29	6.5%	2.23 [1.57, 2.90]
Mansi et al. 2015	9,792	2,053	29	6,551	1,154	29	6.6%	1.92 [1.29, 2.55]
Prestwich et al. 2017	6,057.1901	2,761.0828	263	5,428.0214	2,828.5076	263	8.1%	0.22 [0.05, 0.40]
Rovniak et al. 2005	67.865	44.7675	50	16.925	22.695	50	7.3%	1.42 [0.98, 1.86]
Steeves et al. 2016	7,735	2,205.3203	58	4,760.05	1,443.1792	58	7.4%	1.59 [1.17, 2.00]
Vetrovsky et al. 2017	6,719.1739	2,358.5438	23	5,043.087	1,377.1125	23	6.7%	0.85 [0.25, 1.46]
Yuenyongchaiwat. 2016	10,500.2	2,070.54	30	4,540.53	1,959	30	6.1%	2.92 [2.18, 3.66]
Subtotal (95% CI)			**709**			**732**	**64.0%**	**1.29 [0.77, 1.81]**
Heterogeneity: $Tau^2 = 0.57$; $Chi^2 = 144.82$, df = 8 (P < 0.00001); $I^2 = 94\%$								
Test for overall effect: Z = 4.83 (P < 0.00001)								
Total (95% CI)			**915**			**937**	**100.0%**	**1.11 [0.74, 1.47]**
Heterogeneity: $Tau^2 = 0.43$; $Chi^2 = 159.99$, df = 13 (P < 0.00001); $I^2 = 92\%$								
Test for overall effect: Z = 5.93 (P < 0.00001)								
Test for subgroup differences: $Chi^2 = 2.17$, df = 1 (P = 0.14), $I^2 = 53.9\%$								



Figure

Moderator analysis: Goal time frame.

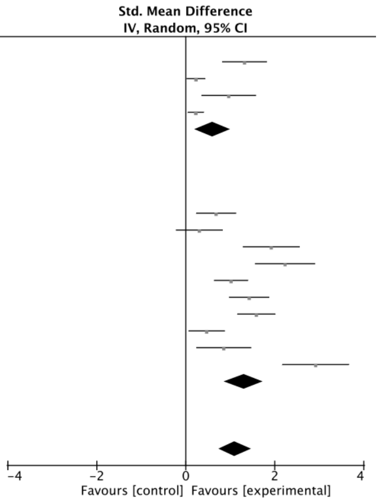
Study or Subgroup	Experimental Mean	Experimental SD	Experimental Total	Control Mean	Control SD	Control Total	Weight	Std. Mean Difference IV, Random, 95% CI
8.2.1 Daily								
Chae et al. 2015	9,240.44	3,105.16	39	5,811.23	1,898.08	39	7.1%	1.32 [0.83, 1.81]
Mansi et al. 2015	1,469	524	29	538	254	29	6.5%	2.23 [1.57, 2.90]
Mansi et al. 2015	9,792	2,053	29	6,551	1,154	29	6.6%	1.92 [1.29, 2.55]
Miragall et al. 2018	7,958	2,005	22	6,251	1,484	26	6.7%	0.96 [0.36, 1.57]
Prestwich et al. 2017	6,057.1901	2,761.0828	263	5,428.0214	2,828.5076	263	8.1%	0.22 [0.05, 0.40]
Stovitz et al. 2005	8,855	4,690	50	6,779	4,079	50	7.5%	0.47 [0.07, 0.87]
Vetrovsky et al. 2017	6,719.1739	2,358.5438	23	5,043.087	1,377.1125	23	6.7%	0.85 [0.25, 1.46]
Yuenyongchaiwat. 2016	10,500.2	2,070.54	30	4,540.53	1,959	30	6.1%	2.92 [2.18, 3.66]
Subtotal (95% CI)			**485**			**489**	**55.3%**	**1.33 [0.69, 1.96]**
Heterogeneity: $Tau^2 = 0.75$; $Chi^2 = 106.45$, df = 7 (P < 0.00001); $I^2 = 93\%$								
Test for overall effect: Z = 4.12 (P < 0.0001)								
8.2.2 Weekly								
Dallow & Anderson. 2003	33.4758	0.6379	33	33.15	0.3518	58	7.3%	0.68 [0.24, 1.12]
Fitzsimons et al. 2012	9,977	4,669	32	8,693	3,483	27	7.1%	0.30 [−0.21, 0.82]
Lewis et al. 2013	176.74	147.7	194	144.02	137.5	192	8.0%	0.23 [0.03, 0.43]
Monroe et al. 2017	6,504.2381	2,327.6872	63	4,564.8254	1,328.1338	63	7.6%	1.02 [0.65, 1.39]
Rovniak et al. 2005	67.865	44.7675	50	16.925	22.695	50	7.3%	1.42 [0.98, 1.86]
Steeves et al. 2016	7,735	2,205.3203	58	4,760.05	1,443.1792	58	7.4%	1.59 [1.17, 2.00]
Subtotal (95% CI)			**430**			**448**	**44.7%**	**0.87 [0.37, 1.36]**
Heterogeneity: $Tau^2 = 0.34$; $Chi^2 = 53.52$, df = 5 (P < 0.00001); $I^2 = 91\%$								
Test for overall effect: Z = 3.43 (P = 0.0006)								
Total (95% CI)			**915**			**937**	**100.0%**	**1.11 [0.74, 1.47]**
Heterogeneity: $Tau^2 = 0.43$; $Chi^2 = 159.99$, df = 13 (P < 0.00001); $I^2 = 92\%$								
Test for overall effect: Z = 5.93 (P < 0.00001)								
Test for subgroup differences: $Chi^2 = 1.25$, df = 1 (P = 0.26), $I^2 = 19.9\%$								



Figure

Moderator analysis: Reward.

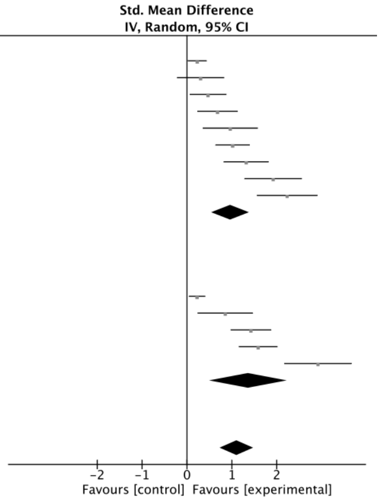
Study or Subgroup	Experimental Mean	Experimental SD	Experimental Total	Control Mean	Control SD	Control Total	Weight	Std. Mean Difference IV, Random, 95% CI
9.2.1 Yes								
Chae et al. 2015	9,240.44	3,105.16	39	5,811.23	1,898.08	39	7.1%	1.32 [0.83, 1.81]
Lewis et al. 2013	176.74	147.7	194	144.02	137.5	192	8.0%	0.23 [0.03, 0.43]
Miragall et al. 2018	7,958	2,005	22	6,251	1,484	26	6.7%	0.96 [0.36, 1.57]
Prestwich et al. 2017	6,057.1901	2,761.0828	263	5,428.0214	2,828.5076	263	8.1%	0.22 [0.05, 0.40]
Subtotal (95% CI)			**518**			**520**	**29.9%**	**0.60 [0.20, 1.00]**
Heterogeneity: $Tau^2 = 0.13$; $Chi^2 = 22.21$, df = 3 (P < 0.0001); $I^2 = 86\%$								
Test for overall effect: Z = 2.94 (P = 0.003)								
9.2.2 No								
Dallow & Anderson. 2003	33.4758	0.6379	33	33.15	0.3518	58	7.3%	0.68 [0.24, 1.12]
Fitzsimons et al. 2012	9,977	4,669	32	8,693	3,483	27	7.1%	0.30 [−0.21, 0.82]
Mansi et al. 2015	9,792	2,053	29	6,551	1,154	29	6.6%	1.92 [1.29, 2.55]
Mansi et al. 2015	1,469	524	29	538	254	29	6.5%	2.23 [1.57, 2.90]
Monroe et al. 2017	6,504.2381	2,327.6872	63	4,564.8254	1,328.1338	63	7.6%	1.02 [0.65, 1.39]
Rovniak et al. 2005	67.865	44.7675	50	16.925	22.695	50	7.3%	1.42 [0.98, 1.86]
Steeves et al. 2016	7,735	2,205.3203	58	4,760.05	1,443.1792	58	7.4%	1.59 [1.17, 2.00]
Stovitz et al. 2005	8,855	4,690	50	6,779	4,079	50	7.5%	0.47 [0.07, 0.87]
Vetrovsky et al. 2017	6,719.1739	2,358.5438	23	5,043.087	1,377.1125	23	6.7%	0.85 [0.25, 1.46]
Yuenyongchaiwat. 2016	10,500.2	2,070.54	30	4,540.53	1,959	30	6.1%	2.92 [2.18, 3.66]
Subtotal (95% CI)			**397**			**417**	**70.1%**	**1.30 [0.86, 1.74]**
Heterogeneity: $Tau^2 = 0.43$; $Chi^2 = 70.92$, df = 9 (P < 0.00001); $I^2 = 87\%$								
Test for overall effect: Z = 5.82 (P < 0.00001)								
Total (95% CI)			**915**			**937**	**100.0%**	**1.11 [0.74, 1.47]**
Heterogeneity: $Tau^2 = 0.43$; $Chi^2 = 159.99$, df = 13 (P < 0.00001); $I^2 = 92\%$								
Test for overall effect: Z = 5.93 (P < 0.00001)								
Test for subgroup differences: $Chi^2 = 5.39$, df = 1 (P = 0.02), $I^2 = 81.5\%$								



Figure

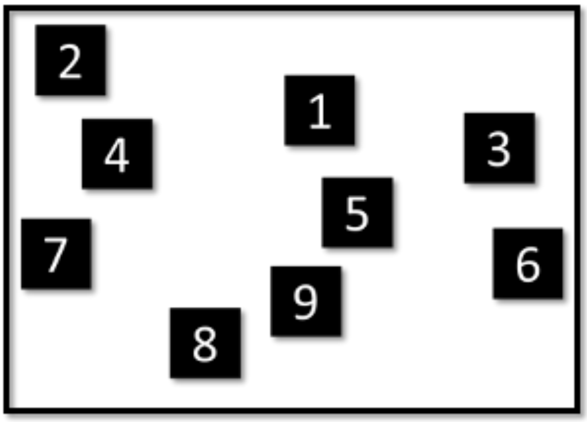
Moderator analysis: Educational component.

Study or Subgroup	Control Mean	Control SD	Control Total	Experimental Mean	Experimental SD	Experimental Total	Weight	Std. Mean Difference IV, Random, 95% CI
9.3.1 Yes								
Lewis et al. 2013	176.74	147.7	194	144.02	137.5	192	8.0%	0.23 [0.03, 0.43]
Fitzsimons et al. 2012	9,977	4,669	32	8,693	3,483	27	7.1%	0.30 [−0.21, 0.82]
Stovitz et al. 2005	8,855	4,690	50	6,779	4,079	50	7.5%	0.47 [0.07, 0.87]
Dallow & Anderson. 2003	33.4758	0.6379	33	33.15	0.3518	58	7.3%	0.68 [0.24, 1.12]
Miragall et al. 2018	7,958	2,005	22	6,251	1,484	26	6.7%	0.96 [0.36, 1.57]
Monroe et al. 2017	6,504.2381	2,327.6872	63	4,564.8254	1,328.1338	63	7.6%	1.02 [0.65, 1.39]
Chae et al. 2015	9,240.44	3,105.16	39	5,811.23	1,898.08	39	7.1%	1.32 [0.83, 1.81]
Mansi et al. 2015	9,792	2,053	29	6,551	1,154	29	6.6%	1.92 [1.29, 2.55]
Mansi et al. 2015	1,469	524	29	538	254	29	6.5%	2.23 [1.57, 2.90]
Subtotal (95% CI)			**491**			**513**	**64.4%**	**0.97 [0.56, 1.39]**
Heterogeneity: $Tau^2 = 0.35$; $Chi^2 = 68.83$, df = 8 ($P < 0.00001$); $I^2 = 88\%$								
Test for overall effect: $Z = 4.58$ ($P < 0.00001$)								
9.3.2 No								
Prestwich et al. 2017	6,057.1901	2,761.0828	263	5,428.0214	2,828.5076	263	8.1%	0.22 [0.05, 0.40]
Vetrovsky et al. 2017	6,719.1739	2,358.5438	23	5,043.087	1,377.1125	23	6.7%	0.85 [0.25, 1.46]
Rovniak et al. 2005	67.865	44.7675	50	16.925	22.695	50	7.3%	1.42 [0.98, 1.86]
Steeves et al. 2016	7,735	2,205.3203	58	4,760.05	1,443.1792	58	7.4%	1.59 [1.17, 2.00]
Yuenyongchaiwat. 2016	10,500.2	2,070.54	30	4,540.53	1,959	30	6.1%	2.92 [2.18, 3.66]
Subtotal (95% CI)			**424**			**424**	**35.6%**	**1.37 [0.50, 2.24]**
Heterogeneity: $Tau^2 = 0.92$; $Chi^2 = 91.14$, df = 4 ($P < 0.00001$); $I^2 = 96\%$								
Test for overall effect: $Z = 3.08$ ($P = 0.002$)								
Total (95% CI)			**915**			**937**	**100.0%**	**1.11 [0.74, 1.47]**
Heterogeneity: $Tau^2 = 0.43$; $Chi^2 = 159.99$, df = 13 ($P < 0.00001$); $I^2 = 92\%$								
Test for overall effect: $Z = 5.93$ ($P < 0.00001$)								
Test for subgroup differences: $Chi^2 = 0.64$, df = 1 ($P = 0.42$), $I^2 = 0\%$								



APPENDIX B: CHAPTER 6 SUPPLEMENTARY MATERIAL

B.1 Corsi Block Tapping (CBT) and Walking Corsi Test (WalCT) Routes



Span	Forward	Score C	Score WC	Backwards	Score C	Score WC
Trial	61 326			38 542		
LDC2	- - -			85 43 19		
LDC3	389 146 572			841 293 615		
LDC4	6127 2973 9438			7532 1946 3715		
LDC5	63785 39647 26391			54861 71249 39165		
LDC6	459721 964782 349165			369452 892473 138479		
LDC7	3649872 7216345 1298547			3127865 2936478 7351849		
LDC8	27185963 61298745 73961248			4 6 1 5 7 2 3 8 5 4 6 1 2 7 3 9 2 4 6 5 3 9 7 1		

APPENDIX C: INFORMATION SHEETS AND INFORMED CONSENT

C.1 Chapter 4 and 5

Participant Information Sheet

Hello, and thank you for expressing an interest to take part in this study. Please take some time to read the information below before continuing with the survey.

1. Invitation and Purpose
We are inviting you to take part in a research study exploring the use of goal setting for physical activity, and the impact on psychological wellbeing. The study is being conducted by the Lead Researcher as part of a PhD qualification. Please read the following information carefully before you decide whether or not to take part.

2. Legal Basis for Research Studies
The University undertakes research as part of its function for the community under its legal status. All University research is reviewed to ensure that participants are treated appropriately, and their rights respected. This study has been approved by Nottingham Trent University Ethics Committee. Further information can be found at: https://www.ntu.ac.uk/research/research-environment-and-governance/governance-and-integrity

3. Why have I been asked to participate?
You have been approached about this study because you are an adult aged between 18 and 64 years old who are trying to be, or are, physically active.

4. Do I have to take part?
Taking part in this research is voluntary. If you would prefer not to take part, you do not have to give any reason. You have the right to withdraw from this study at any time, after completing the survey, you have 30 days to change your mind and you should contact either the lead researcher or supervisor to withdraw. If you withdraw after this point your data may be retained as part of the study.

5. What will taking part involve?
The interview will take place online using a device with internet capabilities. The questionnaire should take approximately 15 minutes to complete. We will ask you about your physical activity habits, use of goal setting and the survey will include some questions relating to psychological wellbeing.

6. What are the possible disadvantages and risks of taking part?
We do not anticipate that there are any risks in taking part. You will not be under any pressure to answer questions or talk about topics that you prefer not to discuss, and you can choose to halt or withdraw from the survey at any point. Only the research team will have access to the data until published or the thesis is submitted, all information will be anonymised, and no personal information will be taken.

7. What are the possible benefits of taking part?
The questionnaire may make you more aware of your goal setting habits in a physical activity context, and the impact this has on your psychological wellbeing through various psychological variables including motivation, self-efficacy and health perceptions.

8. What will happen to my data during the study and once the study is over?
Electronic copies of your questionnaire data will be stored in electronic files that will be password protected and only accessible by the research team.
All data will be collected anonymously, and data stored securely and confidentially. Once the study is over, we will only keep the research data that would allow others to check and verify our findings. Any anonymous data, which could not lead to the identification of either you or your organisation, will be publicly available. This will allow anyone else (including researchers, businesses, governments, charities, and the general public) to use the anonymised data for any purpose that they wish, providing they credit the University and research team as the original creators.

9. How will the data be used?
Data from the questionnaire responses that you provide will be analysed and will form discussion and conclusions for future research which will be publicly available. If you are interested, copies of any resulting publications will be available on request.

10. Who can I contact if I have any questions or concerns about the study?
Should you have any further questions about the study, please feel free to contact the lead researcher (Katie Garstang). Alternatively, if you wish to contact a senior member of the research team at Nottingham Trent University (Dr Daniele Magistro), contact information can be found below.

Contact Lead Researcher:
Katie Garstang
PhD Student
Department of Sport Science, School of Science and Technology Nottingham Trent University
Clifton Campus, Clifton Lane
Nottingham
NG11 8NS
Email address: katie.garstang2020@my.ntu.ac.uk

Contact Research Supervisor:
Dr Daniele Magistro
Senior Lecturer in Physical Activity and Health
Department of Sport Science, School of Science and Technology Nottingham Trent University
Clifton Campus, Clifton Lane
Nottingham
NG11 8NS
Email address: Daniele.magistro@ntu.ac.uk

Informed Consent

1. I confirm that I have read and understood the information sheet for "An exploration of physical activity goals effect on psychological well-being".
2. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.
3. I agree to partake as a participant in the above study.
4. I understand that the information I provide in this study will be anonymised and de-identified. If I wish to withdraw my participation from the study I am aware that I can quote my ID number to the lead researcher and my data will be destroyed accordingly.
5. I understand that my participation is voluntary and that I can ask to withdraw without giving a reason up until 30 days after completing the questionnaire.
6. I confirm that I understand my data will be stored securely on the NTU DataStore for three years for the purpose of publishing the research. I am aware that any research data will be kept on an NTU endorsed data store for a minimum of 10 years in compliance with the Universities Repository Retention and Ethics policy.
7. I understand what is required of me to participate in this study, and know of no reason, medical or otherwise, that would prevent me from partaking in this research.

Please confirm that you have read the participant information sheet and that you consent to your participation:
Yes, I consent to participate in this study

To ensure anonymity, but to allow us to identify your responses if you later decide to withdraw, please enter a unique identification code with the following information:

…………………………………………………..

Last two letters of your surname -First two letters of your first name -Month and Year of your birth (MMYY)

For example: **Ja**ne Smi**th** born **11/**19**87** = THJA1187

C.2 Chapter 6

Participant Information

Study title

The interaction between goal types and goal motives, and the subsequent effect on performance related outcomes.

Invitation and brief summary

How (goal types) and why (goal motives) individual's set goals are important factors to consider when setting goals to be successfully in a task. Yet research has set to look at possible interactions between how and why individual's set goals and the consequent effect on performance. This study is looking to see how goal types and goal motives interact and effect outcomes during a walking working memory task.

You have been invited to take part in a study that looks at how the way we set goals and the reasons people pursue goals effect our performance in tasks. In doing so, we can better our understanding of how to set goals more effectively.

What will taking part involve?

Once you have agreed to participate, we will check that you meet our inclusion criteria (aged 18+, a without any current injury or medical condition which may affect walking or balance). You will then be asked to attend one data collection session at The Biomechanics Laboratory (CELS001/CEL005) in the CELS building, Clifton Campus, Nottingham Trent University, NG11 8NS. The testing session will last approximately 2 hours. We ask that you attend this session wearing your preferred exercise shoes and appropriate comfortable clothing.

Before we start, we will run through the participant information sheet with you and you will have an opportunity to ask questions. If you are happy with the procedures, you will then be asked to provide informed consent through reading and signing an informed consent form.

The session will consist of two parts:

Part 1: You will first have your age, height and weight taken. You will then be asked to complete the Corsi Block Tapping test. This is a measure of visual-spatial memory. You will be seated at a table and the investigator will tap a series of plastic blocks, which you will be asked to repeat. The researcher will explain the task in full before completing it on the day of data collection.

Part 2: You will then be asked to complete the Walking Corsi Block Tapping Test. Again the test will all be explained to you at the beginning of the session but here is a brief outline: This is a walking version of the CBT, where instead of tapping blocks you will walk between them. You will be provided with a goal during this test. There are two conditions during the test, before each condition you will be asked to complete questions relating to your goal motives and perceptions, and after each condition you will be asked to complete questions relating to your future intention to participate and challenge/threat appraisal.

COVID Special measures.

Interaction between people from different households carries an increased risk of COVID19 infection. Other than when attaching sensors to the participant, the researcher will ensure they maintain a two-metre distance from participants. All facilities in which research is being conducted have been COVID-19 risk assessed. To mitigate any risks when the need for particular measurements requires that a two-metre distance cannot be maintained, all participants will be provided with PPE (personal protective equipment – specifically a surgical mask and face shield). In addition, the researcher will also wear PPE.

What are the possible benefits of taking part?

There are no specific benefits of taking part in the current study for you other than investigators will be able to comment on some aspects of your physical and cognitive function. However, investigators will not be able to interpret these results and they should not be considered as any form of diagnosis.

What are the possible disadvantages and risks of taking part?

There are a number of possible disadvantages of taking part in this study. Although unlikely, these have been listed below.

- Fatigue/tiredness from walking trials.
- Small risk of tripping/falling in the laboratory.

First aid cover will be provided by local technical staff and first aiders present in CELS (Jodie Levick) who are on the School's list of First Aiders as shown in the School Safety Handbook. They will be present in the lab or immediately contactable and be on-site within 30 seconds.

Further supporting information (full guidance covering further supporting information)

All participants will have the right to withdraw at any stage without detriment. Any personal information involving any participant gained through participation in the study will be treated as confidential and only handled by individuals relevant to the performance of the study.

Participants will be given a participant ID, therefore all data will be pseudonymised with identities known only to the research team. All personal data (such as names) and sensitive personal data, (such as information about gender, height and weight), will only be processed with the participants informed consent. The data will not be stored for any longer than is necessary.

Contacts

Who should then contact for further information.

Dr. Laura Healy

Email: laura.healy@ntu.ac.uk

Tel: +44 115 84 85516

Address: NHB168, Clifton Campus, Clifton Lane, Nottingham, NG11 8NS.

Katie Garstang

Email: katie.garstang2020@my.ntu.ac.uk

Address: ERD259, Clifton Campus, Clifton Lane, Nottingham, NG11 8NS

"If at any point you decide to withdraw from the study your data will be destroyed."

Informed Consent

The interaction between goal types and goal motives, and the subsequent effect on performance related outcomes.

1) I,……………………………………………………………… agree to partake as a participant in the above study.
2) I understand from the participant information sheet, which I have read in full, and from my discussion(s) with Katie Garstang that this will involve me fulfilling the requirements stated in the PIS.
3) It has also been explained to me by Katie Garstang that the risks and side effects that may result from my participation are as described in the PIS.
4) I confirm that I have had the opportunity to ask questions about the study and, where I have asked questions, these have been answered to my satisfaction.
5) I undertake to abide by University regulations and the advice of researchers regarding safety.
6) I am aware that I can withdraw my consent to participate in the procedure at any time and for any reason, without having to explain my withdrawal and that my personal data will be destroyed and that my medical care or legal rights will not be affected.
7) I understand that any personal information regarding me, gained through my participation in this study, will be treated as confidential and only handled by individuals relevant to the performance of the study and the storing of information thereafter. Where information concerning myself appears within published material, my identity will be kept anonymous.
8) I understand that my participation is voluntary, and I have the right to withdraw my data at any time, up until the point of publication, with no obligation to provide reasons behind the decision.
9) I confirm that I have had the University's policy relating to the storage and subsequent destruction of sensitive information explained to me. I understand that sensitive information I have provided through my participation in this study, in the form of personal contact details will be handled in accordance with this policy and destroyed before November 2027.
10) I confirm that I have completed the health questionnaire and know of no reason, medical or otherwise that would prevent me from partaking in this research.
11) I confirm that I am aware that I need to complete a COVID-19 symptom questionnaire prior to every trial in the study / visit to the University's research facilities.
12) I confirm that I recognise that my involvement with this research could result in an increased risk of me contracting COVID-19, despite all the mitigation employed by the researchers.

Participant signature: Date:

Independent witness signature: Date:

Primary Researcher signature: Date:

C.3 Chapter 7A

Participant Information

Hello, and thank you for expressing an interest to take part in this study. Please take some time to read the information below before continuing.

Study title
The effect of different goal types on physical activity and psychological variables during a 1-week intervention in insufficiently active adults.

Invitation and brief summary
Increased physical activity has many known benefits for health, especially for those who are insufficiently active. Goal setting is one of the most common ways to increase individual's physical activity. Although the effects goals have on physical activity is well- known, the effects goals, and different types of goals, have on psychological outcomes is fairly unknown.
You have been invited to take part in a study that looks at the effects of goal types on physical activity and psychological outcomes. The outcomes of this study have the potential to guide future research and aid the setting of goals for physical and psychological well-being for insufficiently active adults.

What would taking part involve?
Once you have agreed to participate, we will check that you meet our inclusion criteria (not currently meeting physical activity guidelines of 150-minutes of moderate to vigorous activity per week over at least 5 days, aged between 18-64 years old, and are without chronic illness or injury). You will then be contacted to arrange a time to meet with a researcher to receive two physical activity monitors. One is a Fitbit worn on the wrist, the second is a Fibion accelerometer worn at hip or thigh level. During this time you will have the opportunity to ask any additional questions you may have.
Week 1: You will be asked to wear the two devices and go about your usual activities and day to day life. On the final day you will meet with the researcher so that data can be collected from the Fitbit and Fibion, and a goal to be set for you.
Week 2: You will be asked to complete some validated psychological questionnaires (Warwick-Edinburgh Mental Well-Being Scale (WEMWBS; Tennant et al., 2007); the Exercise and Me Questionnaire (AFFEXX; Ekkekakis et al., 2021); The Brief Self-Control Scale (Tangney et al., 2004); the General Self-Efficacy Scale (GSE; Schwarzer et al., 1995), and the BREQ-3 (Markland & Tobin., 2004; Wilson et al., 2006), before following a daily step goal for 7 days. On day 3 and day 7 you will be sent a link to a semi-structured online diary to complete questions regarding the goal you are pursuing (e.g., how difficult is your goal?).
Week 3: The researcher will meet with you again to retrieve the previous week of data. Again you will complete the validate psychological questionnaires (Warwick-Edinburgh Mental Well-Being Scale (WEMWBS; Tennant et al., 2007); the Exercise and Me Questionnaire (AFFEXX; Ekkekakis et al., 2021); The Brief Self-Control Scale (Tangney et al., 2004); the General Self-Efficacy Scale (GSE; Schwarzer et al., 1995), and the BREQ-3 (Markland & Tobin., 2004; Wilson et al., 2006). You will continue to wear the Fitbit and Fibion for a further 7 days. On completion the researcher will meet you to retrieve the Fitbit and Fibions and you will be provided with a 3-week report of your physical activity during the intervention.

COVID Special measures (Please include information on COVID).
Interaction between people from different households carries an increased risk of COVID19 infection. When meeting with the participant a 2-meter distance will be maintained. In addition, the researcher will wear PPE. As all data is being collected online and in the participants usual environments, there is no additional risk.

What are the possible benefits of taking part?
There are no specific benefits of taking part in the current study for you other than investigators will be able to comment on some aspects of your physical activity and some psychological outcomes. However, investigators will not be able to interpret these results and they should not be considered as any form of diagnosis.
Once you have completed data collection you will be sent a report of your physical activity over the three weeks, and if you wish will be placed in a prize draw to win one of six available Amazon vouchers.

What are the possible disadvantages and risks of taking part?
There are a number of possible disadvantages of taking part in this study. Although unlikely, these have been listed below.

- Fatigue/tiredness from increased walking
- Muscle ache, particularly in the legs, from increased walking

Further supporting information (full guidance covering further supporting information)
All participants will have the right to withdraw at any stage without detriment. Any personal information involving any participant gained through participation in the study will be treated as confidential and only handled by individuals relevant to the performance of the study.
Participants will be given a participant ID, therefore all data will be pseudonymised with identities know to the research team. All personal data (such as names, addresses, telephone numbers and email addresses) and sensitive personal data, (such as information about racial ethnic origin, physical or mental health or sex life), will only be processed with the participants informed consent. The data will not be stored for any longer than is necessary.

Contacts
Who should then contact for further information.
Dr Laura Healy
Email: laura.healy@ntu.ac.uk Tel: +44 115 84 85516
Katie Garstang
Email: katie.garstang2020@my.ntu.ac.uk

“If at any point you decide to withdraw from the study your data will be destroyed.”

Informed Consent

1. I agree to partake as a participant in the above study.
2. I understand from the participant information sheet (Dated 23.02.2022 Version 1), which I have read in full, and from my discussion(s) with the researchers that this will involve me wearing a Fitbit on my wrist and a Fibion accelerometer for 3 weeks whilst pursuing a goal for a 7 day period and completing pre and post psychological variable questionnaires.
3. It has also been explained to me by the researchers that the risks and side effects that may result from my participation are as follows: fatigue, tiredness and leg muscle ache from increased walking.
4. I confirm that I have had the opportunity to ask questions about the study and, where I have asked questions, these have been answered to my satisfaction.
5. I undertake to abide by University regulations and the advice of researchers regarding safety.
6. I am aware that I can withdraw my consent to participate in the procedure at any time and for any reason, without having to explain my withdrawal and that my personal data will be destroyed and that my medical care or legal rights will not be affected.
7. I understand that any personal information regarding me, gained through my participation in this study, will be treated as confidential and only handled by individuals relevant to the performance of the study and the storing of information thereafter. Where information concerning myself appears within published material, my identity will be kept anonymous.
8. I confirm that I have had the University's policy relating to the storage and subsequent destruction of sensitive information explained to me. I understand that sensitive information I have provided through my participation in this study, in the form of questionnaires and accelerometer data will be handled in accordance with this policy.
9. I confirm that I have completed the health questionnaire and know of no reason, medical or otherwise that would prevent me from partaking in this research.
10. If appropriate) I understand that the information collected about me will be used to support other research in the future and may be shared anonymously with other researchers.
11. It has been explained to me that there may be additional risks arising from the current COVID pandemic. I have read the NTU recommendations for undertaking 'Research with human participants' and undertake to abide by the special measures which have been explained to me for this study together with such Government Guidelines that are at the time prevailing.

Please confirm that you have read the participant information sheet and that you consent to your participation:
Yes, I consent to participate in this study

To ensure anonymity, but to allow us to identify your responses if you later decide to withdraw, please enter a unique identification code with the following information:

………………………………………………..

Last two letters of your surname -First two letters of your first name -Month and Year of your birth (MMYY)

For example: **Ja**ne Smi**th** born **11/**19**87** = THJA1187

C.4 Chapter 7B

Participant Information

Study title

The Effect of Specific And Non-specific Goal Types Over Time During a Walking Intervention

Invitation and brief summary

Increased physical activity has many known benefits for health, especially for those who are insufficiently active. Goal setting is one of the most common ways to increase individual's physical activity. Although the effects goals have on physical activity is well-known, the effects goals, and different types of goals, have on psychological variables is fairly unknown.

You have been invited to take part in a study that looks at the effects of goal types on physical activity and psychological variables. The outcomes of this study have the potential to guide future research and aid the setting of goals for physical and psychological well-being to promote greater physical activity.

What will taking part involve?

Once you have agreed to participate, we will check that you meet our inclusion criteria (not currently meeting physical activity guidelines of 150-minutes of moderate to vigorous activity per week over at least 5 days, aged between 18-64 years old, and are without an unmanaged chronic illness or injury). You will then be contacted to arrange a time to meet with a researcher to receive two physical activity monitors. One is a Fitbit worn on the wrist, the second is a Fibion accelerometer worn at hip or thigh level. During this time you will have the opportunity to ask any additional questions you may have.

The study is 7 weeks in total. Height and weight will be recorded on the first visit with the participant.

You will be only asked to wear the Fibion device in week 1 and week 7, to receive and return the devices at these time points you will be contacted by the researcher to organise a suitable time. The Fitbit is to be worn for the full duration. Throughout this time you will be asked to pursue a walking goal. Each week you will receive a text or email reminder, whichever you prefer, to remind you of your step goal and to complete a weekly diary entry. Before, at the midpoint, and in the final week you will be asked to complete questionnaires relating to psychological variables.

Week 1: Complete normal activity whilst wearing the Fitbit and Fibion and completing one diary entry. At the end of this week you will be asked to complete a number of psychological questionnaires.

Week 2-4: You will be asked to follow a daily step goal for 3-weeks and wear the Fitbit. You will be asked to complete one diary entry each week. Each week you will receive an email or text reminder of your goal and to complete the diary entry.

At week 4 you will be asked to complete the psychological questionnaires and submit the daily step count so far. At this time you will be provided with an updated step goal.

Week 5-6: You will be asked to follow the daily step goal for 2 more week wearing the Fitbit. You will be asked to complete one diary entry each week. Each week you will receive an email or text reminder of your goal and to complete the diary entry.

Week 7: Fibions will be returned to participants. In the final week both the Fitbit and Fibions will be worn whilst pursuing the daily step goal. You will receive a weekly email or text reminder of the goal and to complete the diary entry.

After week 7 participants will complete the psychological questionnaires and all devices will be returned.

All meetings between the researcher and participants will be arranged at a suitable time, ideally between 7am and 7pm, and should be in a safe place for all – the researcher has the right to refuse a meeting location is deemed to be unsuitable.

COVID Special measures.

Interaction between people from different households carries an increased risk of COVID19 infection. Other than when attaching sensors to the participant, the researcher will ensure they maintain a two-metre distance from participants. All facilities in which research is being conducted have been COVID-19 risk assessed. To mitigate any risks when the need for particular measurements requires that a two-metre distance cannot be maintained, all participants will be provided with PPE (personal protective equipment – specifically a surgical mask and face shield). In addition, the researcher will also wear PPE.

What are the possible benefits of taking part?

There are no specific benefits of taking part in the current study for you other than investigators will be able to comment on some aspects of your physical and cognitive function. However, investigators will not be able to interpret these results and they should not be considered as any form of diagnosis.

You may see improvements associated with increased physical activity.

You may also if you decide to receive a £20 Amazon voucher to compensate for your time if all elements of the study are completed.

What are the possible disadvantages and risks of taking part?

The disadvantages of taking part in this study, although unlikely, these have been listed below.

- Fatigue/tiredness from walking.

Further supporting information (full guidance covering further supporting information)

All participants will have the right to withdraw at any stage without detriment. Any personal information involving any participant gained through participation in the study will be treated as confidential and only handled by individuals relevant to the performance of the study.

Participants will be given a participant ID, therefore all data stored will be pseudonymised with identities known only to the research team. All personal data (such as names) and sensitive personal data, (such as information about gender, height and weight), will only be processed with the participants informed consent. The data will not be stored for any longer than is necessary.

Contacts

Who should then contact for further information.

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“If at any point you decide to withdraw from the study your data will be destroyed.”

Informed Consent

The Effect Of Specific And Non-specific Goal Types Over Time During a Walking Intervention

1) I,………………………………………………………… agree to partake as a participant in the above study.
2) I understand from the participant information sheet, which I have read in full, and from my discussion(s) with Katie Garstang that this will involve me fulfilling the requirements stated in the PIS.
3) It has also been explained to me by Katie Garstang that the risks and side effects that may result from my participation are as described in the PIS.
4) I confirm that I have had the opportunity to ask questions about the study and, where I have asked questions, these have been answered to my satisfaction.
5) I undertake to abide by University regulations and the advice of researchers regarding safety.
6) I am aware that I can withdraw my consent to participate in the procedure at any time and for any reason, without having to explain my withdrawal and that my personal data will be destroyed and that my medical care or legal rights will not be affected.
7) I understand that any personal information regarding me, gained through my participation in this study, will be treated as confidential and only handled by individuals relevant to the performance of the study and the storing of information thereafter. Where information concerning myself appears within published material, my identity will be kept anonymous.
8) I understand that my participation is voluntary, and I have the right to withdraw my data at any time, up until the point of publication, with no obligation to provide reasons behind the decision.
9) I confirm that I have had the University's policy relating to the storage and subsequent destruction of sensitive information explained to me. I understand that sensitive information I have provided through my participation in this study, in the form of personal contact details will be handled in accordance with this policy and destroyed before November 2027.
10) I confirm that I have completed the health questionnaire and know of no reason, medical or otherwise that would prevent me from partaking in this research.
11) I confirm that I am aware that I need to complete a COVID-19 symptom questionnaire prior to every trial in the study / visit to the University's research facilities.
12) I confirm that I recognise that my involvement with this research could result in an increased risk of me contracting COVID-19, despite all the mitigation employed by the researchers.

Participant signature: Date:

Independent witness signature: Date:

Primary Researcher signature: Date:

APPENDIX D: RECRUITMENT MATERIAL

D.1 Recruitment Poster (Chapter 4 and 5)

Nottingham Trent University

An exploration of individuals physical activity goals and the effect on psychological variables

CALL FOR PARTICIPANTS

Who are we looking to recruit?
Adults aged between 18 and 64 years old

What is involved?
Completing a 15-20 minute online questionnaire exploring goal setting, physical activity and psychological variables via this link:
https://ntusurvey.onlinesurveys.ac.uk/an-exploration-of-pa-goals-effect-on-psych

If you have any questions, or would like more information, please contact Katie Garstang:
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D.2 Recruitment Poster (Chapter 7A)

D.3 Recruitment Post (Chapter 7B)

APPENDIX E: QUESTIONNAIRES

E.1 Goal Setting Theory Questionnaire

Thinking about your previously identified physically activity goal, to what extent do you agree that the below statements help to define your goals?

	1 Disagree	2	3	4	5 Agree
"I like to have clear, specific goals when taking part in physical activity"					
"I like to set myself challenging/difficult goals for physical activity"					
"Goals give me direction when taking part in physical activity"					
"Goals increase my effort when taking part in physical activity"					
"Goals give me greater persistence during physical activity"					
"I use goal setting as a strategy to be more physically active"					
"I am more physically active when I am committed to the goal"					
"I am more physically active when the goal is important to me"					
"I have greater belief that I can be physically active when I set goals"					
"I like to receive feedback on my physical activity goals"					
"My physical activity goals are made up of complex tasks"					

E.2 International Physical Activity Questionnaire - Short Form (IPAQ-SF)

We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. The questions will ask you about the time you spent being physically active in the **last 7 days**. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport.

Think about all the **vigorous** activities that you did in the **last 7 days**. **Vigorous** physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Think *only* about those physical activities that you did for at least 10 minutes at a time.

1. During the **last 7 days,** on how many days did you do **vigorous** physical activities like heavy lifting, digging, aerobics, or fast bicycling?

_____ **days per week**

No vigorous physical activities → **Skip to question 3**

2. How much time did you usually spend doing **vigorous** physical activities on one of those days?

_____ hours per day

_____ minutes per day

Don't know/Not sure

Think about all the **moderate** activities that you did in the **last 7 days**. **Moderate** activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

3. During the **last 7 days**, on how many days did you do **moderate** physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking.

_____ **days per week**

No moderate physical activities → **Skip to question 5**

4. How much time did you usually spend doing **moderate** physical activities on one of those days?

_____ **hours per day**

_____ **minutes per day**

Don't know/Not sure

Think about the time you spent **walking** in the **last 7 days**. This includes at work and at home, walking to travel from place to place, and any other walking that you have done solely for recreation, sport, exercise, or leisure.

5. During the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time?

_____ **days per week**

No walking → **Skip to question 6**

6. How much time did you usually spend **walking** on one of those days?

_____ hours per day

_____ minutes per day

Don’t know/Not sure

The last question is about the time you spent **sitting** on weekdays during the **last 7 days.** Include time spent at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading, or sitting or lying down to watch television.

_____ hours per day

_____ minutes per day

Don’t know/Not sure

THIS IS THE END OF THE QUESTIONNAIRE, THANK YOU FOR PARTICIPATING.

E.3 Warwick Edinburgh Mental Wellbeing Scale (SWEMWBS)

Below are some statements about feelings and thoughts.

Please select the answer that best describes your experience of each over the last 2 weeks.

	None of the time	Rarely	Some of the time	Often	All of the time
I've been feeling optimistic about the future	1	2	3	4	5
I've been feeling useful	1	2	3	4	5
I've been feeling relaxed	1	2	3	4	5
I've been dealing with problems well	1	2	3	4	5
I've been thinking clearly	1	2	3	4	5
I've been feeling close to other people	1	2	3	4	5
I've been able to make up my own mind about things	1	2	3	4	5

Note. Permission for use ID: 538092890.

E.4 Goal Motives (4-items)

To what extent do you pursue physical activity goals...

	Not at all 1	2	3	4	5	6	Very much so 7
"Because someone else wants you to"							
"Because you would feel ashamed, guilty, or anxious if you didn't"							
"Because you personally believe it's an important goal to have"							
"Because of the fun and enjoyment the goal provides"							

E.5 General Self Efficacy Scale (GSE)

	Not at all true	Hardly true	Moderately true	Exactly true
1. I can always manage to solve difficult problems if I try hard enough				
2. If someone opposes me, I can find the means and ways to get what I want.				
3. It is easy for me to stick to my aims and accomplish my goals.				
4. I am confident that I could deal efficiently with unexpected events.				
5. Thanks to my resourcefulness, I know how to handle unforeseen situations.				
6. I can solve most problems if I invest the necessary effort.				
7. I can remain calm when facing difficulties because I can rely on my coping abilities.				
8. When I am confronted with a problem, I can usually find several solutions.				
9. If I am in trouble, I can usually think of a solution				
10. I can usually handle whatever comes my way.				

E.6 Exercise Regulations Questionnaire (BREQ-3)

We are interested in the reasons underlying peoples' decisions to engage or not engage in physical exercise. Using the scale below, please indicate to what extent each of the following items is true for you. Please note that there are no right or wrong answers and no trick questions. We simply want to know how you personally feel about exercise. Your responses will be held in confidence and only used for our research purposes.

		Not true for me		Sometimes true for me		Very true for me
1.	It's important to me to exercise regularly	0	1	2	3	4
2.	I don't see why I should have to exercise	0	1	2	3	4
3.	I exercise because it's fun	0	1	2	3	4
4.	I feel guilty when I don't exercise	0	1	2	3	4
5.	I exercise because it is consistent with my life goals	0	1	2	3	4
6.	I exercise because other people say I should	0	1	2	3	4
7.	I value the benefits of exercise	0	1	2	3	4
8.	I can't see why I should bother exercising	0	1	2	3	4
9.	I enjoy my exercise sessions	0	1	2	3	4
10.	I feel ashamed when I miss an exercise session	0	1	2	3	4
11.	I consider exercise part of my identity	0	1	2	3	4
12.	I take part in exercise because my friends/family/partner say I should	0	1	2	3	4
13.	I think it is important to make the effort to exercise regularly	0	1	2	3	4
14.	I don't see the point in exercising	0	1	2	3	4
15.	I find exercise a pleasurable activity	0	1	2	3	4
16.	I feel like a failure when I haven't exercised in a while	0	1	2	3	4
17.	I consider exercise a fundamental part of who I am	0	1	2	3	4

18.	I exercise because others will not be pleased with me if I don't	0	1	2	3	4
19.	I get restless if I don't exercise regularly	0	1	2	3	4
20.	I think exercising is a waste of time	0	1	2	3	4
21.	I get pleasure and satisfaction from participating in exercise	0	1	2	3	4
22.	I would feel bad about myself if I was not making time to exercise	0	1	2	3	4
23.	I consider exercise consistent with my values	0	1	2	3	4
24.	I feel under pressure from my friends/family to exercise	0	1	2	3	4

E.7 The “Exercise and Me” Questionnaire (AFFEXX)

Below, you will find a series of statements that people have used to describe their views, attitudes, and experiences with exercise. The statements are presented as pairs of more-or-less opposites (e.g., “I love exercise” versus “I hate exercise”), separated by a seven-point scale. If the statement on the left is closer to your own views, attitudes, and experiences with exercise, mark 1 (if the statement perfectly matches what you would say), 2, or 3. If the statement on the right is closer to your own views, attitudes, and experiences with exercise, mark 7 (if the statement perfectly matches what you would say), 6, or 5. If your own views, attitudes, and experiences with exercise are in-between these two opposites, mark the mid-point, 4. Remember that the questionnaire asks for your own views, attitudes, and experiences with exercise, not what you think “the right thing to say” is. So, do not be concerned with what others may think or the fact that exercise is recommended as a behavior that promotes health. There is no “right” or “wrong” answer. So, try to be as honest as possible in describing your own views, attitudes, and experiences. Do not spend too much time on any one question. Often, your first, spontaneous response is the one that best describes you. So, work quickly but make sure you respond to all questions. At the end, please, check to make sure that you did not leave any blanks. Thanks for your help!

Exercise is stimulating.	1	2	3	**4**	5	6	7	Exercise is boring.
When my doctor asks if I exercise, I can answer with my head held high.	1	2	3	**4**	5	6	7	When my doctor asks if I exercise, I bow my head in shame.
Exercise is something I dread.	1	2	3	**4**	5	6	7	Exercise is something I look forward to.
Exercise is very dull.	1	2	3	**4**	5	6	7	Exercise is very exciting.
I love that exercise makes me feel stronger.	1	2	3	**4**	5	6	7	I hate that exercise may injure me.
Exercise is an uninviting activity.	1	2	3	**4**	5	6	7	Exercise is a tempting activity.
I feel good to be getting all the great benefits from exercise.	1	2	3	**4**	5	6	7	I feel horrible because I feel like I may get hurt from exercise.
When I exercise, I’d rather be invisible.	1	2	3	**4**	5	6	7	When I exercise, I love showing off.
I feel great exercising in a group.	1	2	3	**4**	5	6	7	I feel intimidated exercising in a group.
Exercise is enjoyable in a group.	1	2	3	**4**	5	6	7	Exercise is not enjoyable in a group.
Exercise makes me feel worse.	1	2	3	**4**	5	6	7	Exercise makes me feel better.
Exercise leaves me feeling exhausted.	1	2	3	**4**	5	6	7	Exercise leaves me feeling energized.

I feel drained after exercise.	1	2	3	**4**	5	6	7	I feel revitalized after exercising.
I would choose exercise over most other activities.	1	2	3	**4**	5	6	7	I would choose most other activities over exercise.
After exercise, I feel discouraged.	1	2	3	**4**	5	6	7	After exercise, I feel encouraged.
Exercise gives me a sense of failure.	1	2	3	**4**	5	6	7	Exercise gives me a sense of accomplishment.
For me, exercise is a relaxing activity.	1	2	3	**4**	5	6	7	For me, exercise is a stressful activity.
Exercise is very tiring.	1	2	3	**4**	5	6	7	Exercise is very invigorating.
Exercise gives me serenity.	1	2	3	**4**	5	6	7	Exercise stresses me out.
Exercise makes me feel drowsy.	1	2	3	**4**	5	6	7	Exercise makes me feel refreshed.
Exercise is something everyone ought to be doing but I am sorry to say that I do not.	1	2	3	**4**	5	6	7	Exercise is something everyone ought to be doing and I am happy to say that I am.
Exercise soothes me.	1	2	3	**4**	5	6	7	Exercise makes me feel tense.
Exercise is interesting.	1	2	3	**4**	5	6	7	Exercise is uninteresting.
When others look at me when I exercise, it makes me feel great.	1	2	3	**4**	5	6	7	When others look at me when I exercise, it makes me feel terrible.
Exercise is near the top on the list of things I like.	1	2	3	**4**	5	6	7	Exercise is near the bottom on the list of things I like.
I enjoy the thought that exercise builds up my body's defences.	1	2	3	**4**	5	6	7	The idea that exercise puts stress on my body scares me.
I love when others watch me as I exercise.	1	2	3	**4**	5	6	7	I hate it when others watch me as I exercise.
Exercise deflates my ego.	1	2	3	**4**	5	6	7	Exercise boosts my ego.
Exercise is low on my priority list.	1	2	3	**4**	5	6	7	Exercise is high on my priority list.
The feeling I get from exercise is awful.	1	2	3	**4**	5	6	7	The feeling I get from exercise is fantastic.
Exercise makes me feel peaceful.	1	2	3	**4**	5	6	7	Exercise makes me feel aggravated.

Exercise worsens my mood.	1	2	3	**4**	5	6	7	Exercise improves my mood.
I love exercising with others.	1	2	3	**4**	5	6	7	I hate exercising with others.
Being a regular exerciser is so gratifying.	1	2	3	**4**	5	6	7	Being an on-and-off exerciser is so embarrassing.
Exercise feels terrible.	1	2	3	**4**	5	6	7	Exercise feels wonderful.
Exercise makes me feel incompetent.	1	2	3	**4**	5	6	7	Exercise makes me feel like I could do anything.

E.8 Goal Motives (10-items)

Please answer honestly the following questions relating to your reasons for pursuing your goal of ………………………………………………………………………………………………… ………………………….

	Not at all			**Somewhat**			**Very much so**
I feel that it is what I am supposed to do so.	1	2	3	4	5	6	7
I may receive praise or other rewards for achieving it.	1	2	3	4	5	6	7
I want others to think I'm competent.	1	2	3	4	5	6	7
I want to feel proud of myself.	1	2	3	4	5	6	7
The goal will give me personally important information.	1	2	3	4	5	6	7
I value the inherent benefits of the goal.	1	2	3	4	5	6	7
I find pursuing the goal interesting.	1	2	3	4	5	6	7
Of the enjoyment or challenge the pursuit of the goal provides me.	1	2	3	4	5	6	7
I would feel ashamed if I didn't do well at the task.	1	2	3	4	5	6	7
I would feel like a failure if I didn't succeed.	1	2	3	4	5	6	7

E.9 Participant Perceptions (Chapter 6)

Please rate your perceptions of the task below:

	Not at all			**Somewhat**			**Very much so**
How challenging is your goal?	1	2	3	4	5	6	7
How important is it to you that you achieve your goal?	1	2	3	4	5	6	7
How confident are you that you will achieve your goal?	1	2	3	4	5	6	7
To what degree do you believe you are going to achieve your goal?	1	2	3	4	5	6	7

E.10 Challenge/Threat Appraisal

The following questions relate to how you felt during the task. Please be completely honest in your responses.

For each statement, indicate the extent to which the statement was true for you during the task:	**Not at all**			**Somewhat**			**Very much so**
I viewed the task as a positive challenge.	1	2	3	4	5	6	7
I thought about what it would be like if I did badly in the task.	1	2	3	4	5	6	7
I viewed the task as a threat.	1	2	3	4	5	6	7
I enjoyed being challenged by the task.	1	2	3	4	5	6	7
I believed that the task could have had positive consequences for me.	1	2	3	4	5	6	7
I thought that the task could have been threatening to me.	1	2	3	4	5	6	7
I thought that the task represented a positive challenge for me.	1	2	3	4	5	6	7
I believed that the task could have had negative consequences for me.	1	2	3	4	5	6	7

E.11 Future Interest

Please answer the following questions about your interest in future participation:

	Not at all			**Somewhat**			**Very much so**
I would be interested in participating in this study again in the future.	1	2	3	4	5	6	7
I would recommend this study to my friends.	1	2	3	4	5	6	7
I would be interested in participating in other studies like this one in the future.	1	2	3	4	5	6	7

E.12 International Physical Activity Questionnaire Long Form (IPAQ)

We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. The questions will ask you about the time you spent being physically active in the **last 7 days**. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport.

Think about all the **vigorous** and **moderate** activities that you did in the **last 7 days**. **Vigorous** physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. **Moderate** activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal.

PART 1: JOB-RELATED PHYSICAL ACTIVITY

The first section is about your work. This includes paid jobs, farming, volunteer work, course work, and any other unpaid work that you did outside your home. Do not include unpaid work you might do around your home, like housework, yard work, general maintenance, and caring for your family. These are asked in Part 3.

1. Do you currently have a job or do any unpaid work outside your home?

Yes
No → **Skip to PART 2: TRANSPORTATION**

The next questions are about all the physical activity you did in the **last 7 days** as part of your paid or unpaid work. This does not include traveling to and from work.

2. During the **last 7 days**, on how many days did you do **vigorous** physical activities like heavy lifting, digging, heavy construction, or climbing up stairs **as part of your work**? Think about only those physical activities that you did for at least 10 minutes at a time.

_____ days per week
No vigorous job-related physical activity → **Skip to question 4**

3. How much time did you usually spend on one of those days doing **vigorous** physical activities as part of your work?

_____ hours per day

_____ minutes per day

4. Again, think about only those physical activities that you did for at least 10 minutes at a time. During the **last 7 days**, on how many days did you do **moderate** physical activities like carrying light loads **as part of your work**? Please do not include walking.

_____ days per week
No moderate job-related physical activity → **Skip to question 6**

5. How much time did you usually spend on one of those days doing **moderate** physical activities as part of your work?

_____ hours per day

_____ **minutes per day**

6. During the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time **as part of your work**? Please do not count any walking you did to travel to or from work.

_____ **days per week**
No job-related walking → **Skip to PART 2: TRANSPORTATION**

7. How much time did you usually spend on one of those days **walking** as part of your work?

_____ **hours per day**

_____ **minutes per day**

PART 2: TRANSPORTATION PHYSICAL ACTIVITY

These questions are about how you travelled from place to place, including to places like work, stores, movies, and so on.

8. During the **last 7 days**, on how many days did you **travel in a motor vehicle** like a train, bus, car, or tram?

_____ **days per week**
No traveling in a motor vehicle → **Skip to question 10**

9. How much time did you usually spend on one of those days **traveling** in a train, bus, car, tram, or other kind of motor vehicle?

_____ **hours per day**

_____ **minutes per day**

Now think only about the **bicycling** and **walking** you might have done to travel to and from work, to do errands, or to go from place to place.

10. During the **last 7 days**, on how many days did you **bicycle** for at least 10 minutes at a time to go **from place to place**?

_____ **days per week**
No bicycling from place to place → **Skip to question 12**

11. How much time did you usually spend on one of those days to **bicycle** from place to place?

_____ **hours per day**

_____ **minutes per day**

12. During the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time to go **from place to place**?

_____ **days per week**

No walking from place to place → **Skip to PART 3: HOUSEWORK, HOUSE MAINTENANCE, AND CARING FOR FAMILY**

13. How much time did you usually spend on one of those days **walking** from place to place?

_____ **hours per day**

_____ **minutes per day**

PART 3: HOUSEWORK, HOUSE MAINTENANCE, AND CARING FOR FAMILY

This section is about some of the physical activities you might have done in the **last 7 days** in and around your home, like housework, gardening, yard work, general maintenance work, and caring for your family.

14. Think about only those physical activities that you did for at least 10 minutes at a time. During the **last 7 days**, on how many days did you do **vigorous** physical activities like heavy lifting, chopping wood, shoveling snow, or digging **in the garden or yard**?

_____ **days per week**
No vigorous activity in garden or yard → **Skip to question 16**

15. How much time did you usually spend on one of those days doing **vigorous** physical activities in the garden or yard?

_____ **hours per day**

_____ **minutes per day**

16. Again, think about only those physical activities that you did for at least 10 minutes at a time. During the **last 7 days**, on how many days did you do **moderate** activities like carrying light loads, sweeping, washing windows, and raking **in the garden or yard**?

_____ **days per week**
No moderate activity in garden or yard → **Skip to question 18**

17. How much time did you usually spend on one of those days doing **moderate** physical activities in the garden or yard?

_____ **hours per day**

_____ **minutes per day**

18. Once again, think about only those physical activities that you did for at least 10 minutes at a time. During the **last 7 days**, on how many days did you do **moderate** activities like carrying light loads, washing windows, scrubbing floors and sweeping **inside your home**?

_____ **days per week**

No moderate activity inside home → **Skip to question PART 4: RECREATION, SPORT AND LEISURE-TIME PHYSICAL ACTIVITY**

19. How much time did you usually spend on one of those days doing **moderate** physical activities inside your home?

_____ **hours per day**

_____ **minutes per day**

PART 4: RECREATION, SPORT, AND LEISURE-TIME PHYSICAL ACTIVITY

This section is about all the physical activities that you did in the **last 7 days** solely for recreation, sport, exercise or leisure. Please do not include any activities you have already mentioned.

20. Not counting any walking you have already mentioned, during the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time **in your leisure time**?

_____ **days per week**
No walking in leisure time → **Skip to question 22**

21. How much time did you usually spend on one of those days **walking** in your leisure time?

_____ **hours per day**

_____ **minutes per day**

22. Think about only those physical activities that you did for at least 10 minutes at a time. During the **last 7 days**, on how many days did you do **vigorous** physical activities like aerobics, running, fast bicycling, or fast swimming **in your leisure time**?

_____ **days per week**
No vigorous activity in leisure time → **Skip to question 24**

23. How much time did you usually spend on one of those days doing **vigorous** physical activities in your leisure time?

_____ **hours per day**

_____ **minutes per day**

24. Again, think about only those physical activities that you did for at least 10 minutes at a time. During the **last 7 days**, on how many days did you do **moderate** physical activities like bicycling at a regular pace, swimming at a regular pace, and doubles tennis **in your leisure time**?

_____ **days per week**
No moderate activity in leisure time → **Skip to PART 5: TIME SPENT SITTING**

25. How much time did you usually spend on one of those days doing **moderate** physical activities in your leisure time?

_____ **hours per day**

_____ **minutes per day**

PART 5: TIME SPENT SITTING

The last questions are about the time you spend sitting while at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading or sitting or lying down to watch television. Do not include any time spent sitting in a motor vehicle that you have already told me about.

26. During the **last 7 days**, how much time did you usually spend **sitting** on a **weekday**?

_____ hours per day

_____ minutes per day

27. During the **last 7 days**, how much time did you usually spend **sitting** on a **weekend day**?
_____ hours per day

_____ minutes per day

THIS IS THE END OF THE QUESTIONNAIRE, THANK YOU FOR PARTICIPATING.

E.13 Participant Perceptions (Chapter 7)

1. How complex do you believe your goal is?						
1 Not at all	2	3	4 Somewhat	5	6	7 Very
2. How important is your goal to you?						
1 Not at all	2	3	4 Somewhat	5	6	7 Very
3. How committed are you to your goal?						
1 Not at all	2	3	4 Somewhat	5	6	7 Very

APPENDIX F: HEALTH SCREEN

Name or Number ....………………

Please complete this brief questionnaire to confirm fitness to participate:

1. **At present,** do you have any health problem for which you are:

(a)	on medication, prescribed or otherwise	Yes	No
(b)	attending your general practitioner	Yes	No
(c)	on a hospital waiting list	Yes	No

2. **In the past two years,** have you had any illness which require you to:

(a)	consult your GP	Yes	No
(b)	attend a hospital outpatient department	Yes	No
(c)	be admitted to hospital	Yes	No

3. **Have you ever** had any of the following?

(a)	Convulsions/epilepsy	Yes	No
(b)	Asthma	Yes	No
(c)	Eczema	Yes	No
(d)	Diabetes	Yes	No
(e)	A blood disorder	Yes	No
(f)	Head injury	Yes	No
(g)	Digestive problems	Yes	No
(h)	Heart problems	Yes	No
(i)	Problems with bones or joints	Yes	No
(j)	Disturbance of balance / coordination	Yes	No
(k)	Numbness in hands or feet	Yes	No
(l)	Disturbance of vision	Yes	No
(m)	Ear / hearing problems	Yes	No
(n)	Thyroid problems	Yes	No
(o)	Kidney or liver problems	Yes	No
(p)	Allergy to nuts, alcohol etc.	Yes	No
(q)	Any problems affecting your nose e.g. recurrent nose bleeds	Yes	No
(r)	Any nasal fracture or deviated nasal septum	Yes	No

4. **Has any,** otherwise healthy, member of your family under the age of 50 died suddenly during or soon after exercise?	Yes	No
5. Are there any reasons why blood sampling may be difficult?	Yes	No
6. Have you had a blood sample taken previously?	Yes	No
7. Have you had a cold, flu or any flu like symptoms in the last month?	Yes	No
8. Have you ever tested positive for COVID	Yes	No

<u>Women only</u>

Are you pregnant, trying to become pregnant or breastfeeding? Yes No

If YES to any question, please describe briefly if you wish (e.g. to confirm problem was/is short-lived, insignificant or well controlled.)

....

APPENDIX G: DEVICE GUIDANCE SHEET (CHAPTER 7)

Please take care of the devices provided during the intervention.

If you have any questions or queries not answered below, please contact the researcher and they will be happy to help.

<u>Fitbit</u>

The Fitbit Inspire 2 should be worn on your wrist.

The Fitbit app can be downloaded from your device's application page with the icon shown to the left.

The Fitbit device is **water resistant**, so do not feel you need to remove the device for activities such as showering or washing up. You may find that removing the device when showering may be kinder to your skin as it prevents water from getting between the strap and your wrist preventing any chance of rubbing.

The Fitbit Inspire 2 has up to 10 days battery life.

When charging the device **ensure that the light on the back** of the device matches up to the **notches on the charger**, otherwise it will not charge. Do not force the device and charger to click. If it is not easily connecting, try attaching the watch in the other direction so that the light and notches match.

<u>Fibion</u>

The Fibion should be worn in the **pocket,** or around the thigh using the strap provided. There should be no need to remove the device from the blue sleeve.

The **<u>Fibion device is NOT water resistant</u>**. Please ensure you remove the device from clothing before washing as this will break the device. Do not wear this device when taking part in water-based activities such as swimming.