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The effectiveness of imagery use in motivating physical activity and exercise

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THE EFFECTIVENESS OF IMAGERY USE IN MOTIVATING PHYSICAL ACTIVITY AND EXERCISE

by

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Copyright statement

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Abstract

Karol Nedza

Title: ‘The effectiveness of imagery use in motivating physical activity and exercise’

The research detailed across these chapters provides a comprehensive exploration of the multifaceted interplay between mental imagery, motivation, and physical activity. The global inactivity levels and their consequences for economic, health and social domains is at this point well documented. Despite the number of interventions and approaches, inactivity is steadily increasing annually. This thesis encompasses the effects of mental imagery in shaping behaviour, the diverse applications of mental imagery in sports and health-related behaviour change, and the emergence of Functional Imagery Training (FIT) as a powerful approach. FIT is discussed as a versatile tool for promoting behaviour change, grounded in cognitive and behavioural theories, and placing a strong emphasis on strengthening the associations between mental imagery and goal-directed actions.

The explorative initial study focused on the correlation between motivational thoughts related to physical activity goals and actual physical activity levels, while highlighting the moderating effect of imagery vividness. Further empirical exploration through an epistemological stance culminates in the assessment of the impact of imagery on physical activity, exercise, motivation, and weight loss, revealing significant findings, particularly the role of vivid imagery as a bridge between motivational thoughts and actionable engagement. The effectiveness of imagery-based interventions, particularly FIT, in promoting goal-based physical activity is reported at different levels with variation in imagery content, type and intensity (small to medium positive effects of imagery). Results show the potential to test imagery as a motivational tool in exercise promotion to enhance behaviour change and to establish the effect size of imagery. The study’s findings are illustrated through practical

applications in various contexts, from injury treatment (with a model of application) to the management of conditions like Postural Orthostatic Tachycardia Syndrome (POTS). The interdisciplinary approach, which integrates exercise, motivational support, and imagery, proves effective in enhancing exercise adherence, quality of life, and symptom management. Further findings focus on practicality and application: the feasibility of utilizing imagery in the absence of visual imagery and its potential for affective responses and motivation, and a qualitative study into exercise professionals' perspectives on motivation and imagery. These emphasise the need for structured training programs to enhance professionals' skills in utilizing imagery as a motivational tool in their work. The conclusions focus on a comprehensive understanding of the intricate relationship between mental imagery, motivation, and physical activity, offering insights, practical applications, and a roadmap for future research and education in this field.

This thesis tested Functional Imagery Training (FIT) as a versatile tool grounded in cognitive and behavioural theories to promote behaviour change in physical activity and exercise, as an individual method or as a part of the multi-disciplinary approach. The findings highlight the potential of vivid imagery as a bridge between motivation and actionable engagement, underlining the significance of imagery-based interventions in various contexts.

Author's Declaration

At no time during the registration for the degree of Doctor of Philosophy has the author been registered for any other University award without prior agreement of the Doctoral College Quality Sub-Committee. Work submitted for this research degree at the University of Plymouth has not formed part of any other degree either at the University of Plymouth or at another establishment.

Ethics was applied for and granted for each study through the Faculty of Health.

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Some chapters from this doctoral thesis have been submitted for publications and/or presented at various conferences.

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Nedza, K., (2023) – Coaching imagery to those with low imagery ability. European Network for Young Specialists in Sports Psychology 2023 (oral presentation)

Table of Contents

List of Tables

Chapter Six

Chapter Seven

Chapter Ten

Chapter Thirteen

List of figures

Chapter Six

Chapter Seven

Chapter Eight

Chapter Nine

Chapter Eleven

Chapter Twelve

1. Thesis overview

The beginning of the thesis focuses on an overview of the physical inactivity issue and outlines the theoretical and philosophical approach taken to address it. Chapter 2 begins by examining the global problem of physical inactivity, emphasizing its significant impact on health and well-being. It introduces the “Manifesto for Exercise Science,” (Smith et al, 2022) which outlines crucial action points for researchers tackling this issue. Additionally, the chapter discusses the limited effectiveness of conventional physical activity campaigns and the challenges related to exercise adherence, motivation, and commitment. It explores the pivotal role of personal trainers and stresses the importance of incorporating theoretical frameworks such as self-efficacy, social cognitive theory, and dual process theory to gain a deeper understanding of physical activity and exercise behaviour psychology. This chapter serves as a foundational introduction, laying the groundwork for subsequent chapters that delve into further evidence such as active interventions designed to address the global inactivity crisis and enhance understanding of the intricate relationship between imagery, motivation, and behaviour change within physical activity. This chapter also forms the basis for the key objectives and aims of this thesis with the overarching aim of finding evidence-based methods of tackling the inactivity crisis. At the end, as all theories share the basis of ‘imagined end states’ as an integral part, it specifically pointed me towards the use of imagery in my thesis.

In Chapter 3, the focus shifts to elucidating the scientific research paradigm integral to the research journey and addressing this overall aim. It encourages alignment between research goals, methodology, and epistemological stance, enhancing the validity, credibility, effective communication, and ethical integrity of the research within the broader academic landscape. Methodology and philosophy have been studied to help me research three key objectives forming three parts of this thesis in the later chapters:

1. To systematically gather and evaluate existing evidence on the techniques in promoting physical activity and behaviour change, especially the use of imagery;
2. To investigate the effectiveness of a novel imagery-based technique, Functional Imagery Training (FIT), in enhancing exercise motivation and adherence among diverse populations.
3. To explore strategies for optimizing the application of FIT for individuals with unique challenges such as visual aphantasia or chronic injuries, and conducting qualitative research to understand individual experiences and preferences, and developing tailored approaches to enhance engagement and effectiveness.

Following the first objective, part 1 of the thesis focuses on gathering evidence on different techniques and theories of improving physical activity and exercise through a literature review and a systematic review. Chapter 4 begins by exploring various evidence-based approaches to promoting physical activity, with a wider approach, while emphasizing its importance for personal health and societal well-being. It examines the task of motivating individuals to engage in regular physical activity, identifying factors such as insufficient knowledge, wavering motivation, and a lack of practical skills as barriers. The chapter explores techniques like goal setting and the person-centred approach, highlighting their potential but also acknowledging limitations. It transitions into discussing multi-sensory imagery as a promising complement to existing methods, aiming to make behaviour change more tangible and concrete, potentially enhancing effectiveness.

Chapter 5 then explores the multifaceted role of mental imagery in influencing behaviour and motivation, beginning in the context of physical activity and sports. It moves to examining the effects of imagery and debates surrounding its underlying processes. The chapter explores practical applications of imagery, especially in sports psychology, and introduces Functional Imagery Training (FIT) as a comprehensive approach grounded in cognitive and behavioural theories. It aims to unravel the intricate interplay between mental imagery, cognition, and behaviour, discussing diverse applications and techniques like FIT to motivate and facilitate positive behaviours.

Following a narrative literature review, Chapter 6 presents a comprehensive review and meta-analysis of existing evidence on the impact of imagery on physical activity, exercise, motivation, and weight loss. It reveals small to medium positive effects of imagery on various outcomes, highlighting its potential in supporting behaviour change. The chapter aligns findings with theoretical models and emphasizes the practical application of imagery interventions, particularly in engaging sedentary populations to meet recommended physical activity levels. It calls for further exploration, particularly in populations not regularly engaged in exercise and in understanding the relationship between cognitive intentions and exercise behaviours. These chapters all serve as the evidence base for my own research and for future interventions.

As a result of imagery ability appearing as a key factor across the reviews, Chapter 7 explores the relationship between motivational thoughts, imagery vividness, and physical activity, revealing significant findings regarding the correlation between motivational thoughts and actual physical activity levels. It highlights the moderator effect of imagery vividness (as a form of ability) and underscores the significance of targeting intention formation and motivational processes in interventions aiming to foster physical activity. The chapter emphasizes the need to integrate imagery components into interventions to enhance effectiveness. Overall, these chapters contribute to understanding the role of imagery in promoting physical activity and behaviour change, providing valuable insights for future research and intervention strategies.

Part 2 of the thesis focuses on testing the effectiveness of Functional Imagery Training (FIT) in enhancing exercise motivation and adherence. Chapter 8 presents a study aimed at assessing the effectiveness of imagery-based interventions in promoting goal-based physical activity (PA) compared to exercise advice alone. The results revealed that while all groups demonstrated increased PA levels over two weeks, only the FIT group maintained this difference after 4 weeks, indicating FIT's advantage in sustaining behaviour change. The analysis also showed that FIT and Imagery groups experienced a reduction in sitting duration over 4 weeks compared to the advice-only group, suggesting the broader impact of discussing personal importance, goal setting, and multi-sensory imagery on non-goal-related behaviours. The study highlighted FIT's potential to boost overall PA motivation more effectively than guided imagery alone and suggested integrating motivational interviewing techniques before introducing imagery-based interventions to enhance efficacy. Additionally, the study underscored the challenges of accurately measuring physical activity and the importance of comparing effect sizes with different control conditions for a robust assessment of effectiveness.

Chapter 9 looks further into FIT's effectiveness in enhancing confidence in successful recovery, motivation to complete prescribed exercises, and adherence to physical therapy treatment. It demonstrates FIT's cost-effectiveness for general injuries, requiring only one session within a 4-week treatment period, and its promise for chronic injuries, albeit requiring more resources. The chapter highlights FIT's potential to reduce healthcare costs and mitigate the risk of acute injuries transitioning into chronic conditions. Furthermore, it showcases FIT's ability to improve imagery vividness over time, suggesting its potential to enhance motivation and behaviour change by progressively developing and controlling vivid imagery scenarios (key finding from part 1). The findings align with the proposed AIMC-PT model, contributing to adherence, motivation, and confidence in physical therapy. Future research proposal should explore the model's elements and processes further, offering physical therapists a valuable tool for psychological support in their patients.

Part 3 of the thesis explores how Functional Imagery Training (FIT) can be optimized and utilized for individuals with unique challenges such as visual aphantasia or chronic injuries, as well as for a wider population through exercise professionals. This aim has been in line with the pragmatic and constructivist approach as one technique might not work for every single person and therefore needs to be adapted and tested. Chapter 10 evaluates a short-term interdisciplinary treatment for individuals with Postural Orthostatic Tachycardia Syndrome (POTS), integrating medication, exercise, and motivational support. The key aspect was integrating FIT into the interdisciplinary technique. The results demonstrate significant enhancements in health satisfaction, physical health, and psychological health for participants in the FIT group. The interdisciplinary approach, coupled with motivational imagery and exercise, proves effective in enhancing exercise adherence and reducing antidepressant medication use. The findings underscore the potential for FIT to be seamlessly integrated as a psychological support component in broader multi-disciplinary interventions for managing conditions like POTS. The study also suggests avenues for future research, including long-term follow-up measurements and large-scale clinical studies, to further inform best practices in managing such conditions.

Chapter 11 investigates the impact of imagery practice on an individual with aphantasia (a lack of imagery) over four weeks. While some improvement in imagery usage and accessibility was observed, it had a negative impact on imagery vividness, contrary to expectations. However, the study suggests the potential for affective responses and motivation through multi-sensory imagery, even in the absence of visual imagery. This research highlights the feasibility of training and utilizing imagery in aphantasic individuals, emphasizing its potential for affective responses and motivation.

Finally, Chapter 12 explores exercise professionals' perspectives and utilization of imagery, revealing its perceived value as a tool for enhancing motivation and exercise adherence. The need of this study lies in line with the future application of imagery through established systems of increasing physical activity and exercise levels. The findings suggest the need for structured training programs to enhance professionals' skills in utilizing imagery effectively. This study provides valuable insights into the knowledge and practices of exercise professionals regarding imagery and motivation, paving the way for future research and educational development in this field.

In conclusion, the findings from the thesis collectively provide valuable insights into the role of imagery and other psychological tools in promoting physical activity and behaviour change. Firstly, intention alone does not always translate into actual behaviour change, highlighting the need for alternative motivational strategies beyond intention. Techniques like imagery play a significant role in bridging the intention-behaviour gap and enhancing motivation for physical activity. The studies highlight the natural use of imagery and its connection to intention and behaviour, emphasizing the importance of addressing individual differences in imagery ability. Training individuals to enhance their imagery ability may be beneficial, particularly for those who do not naturally engage in imagery. Imagery interventions, particularly Functional Imagery Training (FIT), have shown promise in increasing goal-based physical activity when combined with motivational interviewing and goal-setting techniques. The integration of FIT into physiotherapy treatment and its application in clinical conditions like POTS illustrate its potential as a psychological support component, enhancing adherence and improving quality of life. Additionally, fitness professionals recognize the importance of motivation and frequently use imagery as a tool in their practice. However, there is a need for better training and understanding among fitness professionals regarding the effective use of imagery to promote physical activity and behaviour change among their clients. Unexpectedly, the thesis also reveals the significant role of physical activity and health literacy in influencing individuals’ levels of physical activity. Further research is necessary to understand the mechanisms of knowledge sharing and instruction in promoting physical activity behaviour change. Overall, the integration of imagery and other psychological tools into interventions has the potential to have a substantial impact on behaviour change, improving adherence, confidence, and overall treatment outcomes in various contexts.

2. The need for physical activity

“Lack of activity destroys the good condition of every human being, while movement and methodical physical exercise save it and preserve it.” – Plato

2.1. Overview

Physical inactivity is a major public health concern, with significant social and economic costs. Despite efforts to promote physical activity, the statistics remain alarming. In this thesis I will argue that one potential issue is the lack of impact of traditional campaigns, which tend to focus on knowledge rather than behaviour change. Adherence to physical activity plans is also a challenge, with research suggesting the need for psychological skills from professional trainers to help individuals overcome barriers and maintain motivation. I will review theoretical models and frameworks which suggest that interventions need to be multi-factorial and perhaps share a common component.

A recent manifesto for exercise science (Smith et al., 2022) proposes twelve action points for two main purposes: improving the quality and rigour of exercise science, and to reach and engage the public over next five years. The former is the key purpose of this thesis and in order to aim for this standard, the following actions can and should be taken. The starting point is to identify whether there is a replication crisis in the existing literature of this specific field and if so, address it (Ritchie, 2020); reviews and meta-analysis are the most commonly applied method to answer this question. Any new findings and results should also focus on the effect size alongside the null hypothesis significance testing or Bayesian analysis (Orben, 2020 as cited in Smith et al., 2022). We also have the evidence of benefits of exercise increase, but the question of whether there is such a thing as too much also needs to be addressed (Smith & Noret, 2018) in order to identify risks and limitations of being active, or perhaps too active. Furthermore, new findings should also be considered in light of their impact, in this case for the global inactivity and health-related outcomes. Finally, researchers are the ones who should attempt to build the bridges between research and practice, including via student curriculum and placements.

This thesis will also address actions to improve the quality of the research and to engage the public in this science. The impact will be considered regarding to experiments conducted and the level of change in general populations levels of PA and possible further impact. My research will also attempt to follow the overall philosophy of changing "should" to "want" when it comes to physical activity and exercise (Teixeira et al., 2022; the crucial factor of enjoyment), with the general aim to reduce sedentary behaviour alongside increasing other intensities of physical activity and develop a life-course approach to physical activity in public.

2.2. Introduction

Physical inactivity has been considered a global threat for the last two decades (Bull et al., 2004; Kohl et al., 2012). In 2017, the British Heart Foundation (Physical Inactivity Report, 2017) reported that as many as 20 million people (39% population) in the United Kingdom did not engage in minimal levels of recommended physical activity (30 minutes of moderate activity 5 times a week; Lee et al., 2012). In the US, less than 5% of adults participated in any form of physical activity for 30 minutes each day (U.S. Department of Agriculture, 2010). Furthermore, from 17% to 47% of the population (varying between the specific states) self-reported engaging in no leisure-time physical activity during the past month (Centers for Disease Control and Prevention, 2018).

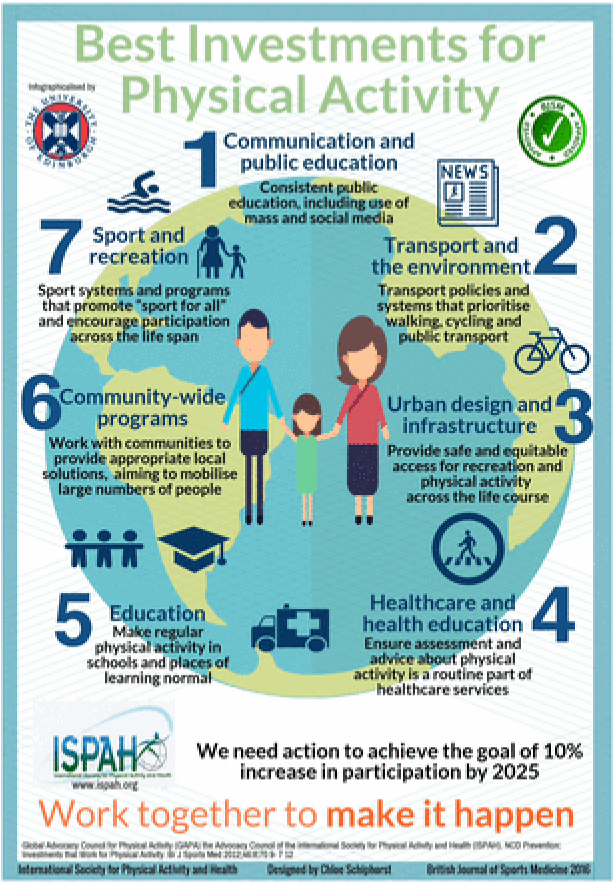
The consequences of physical inactivity are shocking on a global scale: the World Health Organisation (WHO, 2009) estimates that 3.3 million deaths around the world each year are directly due to physical inactivity. Furthermore, a recent meta-analysis (Lee et al., 2012) reported that if physical inactivity was to be reduced by 10 to 25%, 0.5 to 1.5 million deaths would be averted, and the world population's life expectancy would increase by 0.68 years globally. Blair (2009) concluded that physical inactivity is the most important public health problem of the 21st century. By reducing obesity (Wiklund, 2016), physical activity can lead to a reduced risk of type 2 diabetes, cancer, heart and liver disease, stroke and mental health conditions (Obesity Health Alliance, 2017). All the consequences of physical inactivity lead to usage of a large percentage of health funds (Pratt et al., 2014). In the UK alone, the financial cost to the NHS of overweight and obesity-related ill-health was calculated to be £6.1 billion in 2014 to 2015 (Public Health England, 2017) and is predicted to reach £9.7 billion by 2050 (Public Health England, 2017). It is important that we do not only have a single-use view of increasing physical activity in order to reduce obesity, but in much larger spectrum of improving the state of global public health (Das & Horton, 2012).

The physical and psychological benefits of physical activity have been well studied and demonstrated in literature and in media (Warburton et al, 2006; Janssen & LeBlanc, 2010; Singh et al., 2023). Converting inactivity into physical activity could improve health substantially (Lee et al., 2012). However, the concept of 'prescribing' exercise for health improvement is not a modern idea, not even remotely; there are historical records, which describe famous physicians, such as Susruta from India, Hippocrates of Greece or Galen from Rome (Tipton, 2014), who all recommended or prescribed some form of physical activity. This was a regular occurrence till the early 1900s, when exercise, and then sports, specialists took a lead in promoting physical activity, resulting in physicians disappearing from this profession (Berryman, 2010). The intensity of physical activity is inversely and linearly related to mortality (Warburton, et al, 2006) with meta-analysis proposing that even the physical activity expressed by minimal weekly metabolic expenditure can reduce the overall, all-cause mortality by 20 to 30% (Lee & Skerrett, 2001). Furthermore, regular PA can increase life expectancy b 1-2 years at the age of 80 (Paffenbarger et al, 1986) Therefore, there is a linear relationship based on meta-analysis evidence between the amount of exercise and health status, with further improvements if physical activity was to be increased. Furthermore, a recent review has provided summarized evidence for prescribing exercise as medicine in the treatment of 26 different diseases, including psychiatric, neurological, metabolic, cardiovascular and pulmonary ones (Pedersen & Saltin, 2015). The results lead to calls for physicians to prescribe and recommend activity for health improvements as a vital part of health assessment and promotion (Sallis, 2015) with impact at population level and global targets (Lobelo et al., 2014). A recent investigation (Langan & Grosicki, 2021) proposed that one dose of physical activity does not suit all, and professionals need to prescribe the recommended dose of activity based on understanding individual's intended goal and training adaptations.

In the modern era, early specific recommendations came from the Centre for Disease Control and Prevention (CDC; Pate et al., 1995) with a committee of five scientists summarizing all the existing evidence and concluding that each adult should complete 30 minutes of moderate intensity every day. This was later coined into the commonly known '30 minutes, 5 times a week' rule, which was tested in large, cross-country trial (Lear et al., 2017). In response to the statistics above, the recommendations for physical activity and the numerous health-benefits, international and national governing bodies have produced recommendations of physical activity and exercise for the public. More recently, WHO (2020) produced specific recommendations for the public, children as young as 5 years old, elderly adults, those pregnant and those with chronic conditions. WHO recommends that "adults should do at least 150-300 minutes of moderate-intensity aerobic physical activity; or at least 75–150 minutes of vigorous intensity aerobic physical activity; or an equivalent combination of moderate- and vigorous-intensity activity throughout the week, or substantial health benefits."

The National Health Service (2020) in United Kingdom follows very similar guidelines with inclusion of “strengthening activities that work all the major muscle groups (legs, hips, back, abdomen, chest, shoulders and arms) on at least 2 days a week”, “spread exercise evenly over 4 to 5 days a week” and “reduce time spent sitting.” Since their publication, the need of including any exercise shorter than 10 minutes but including higher intensity or resistance has been highlighted for the primary care populations (Yang, 2019). Furthermore in 2020, facing the global pandemic and further deepening inactivity due to lockdowns and closures of any sports and exercise facilities, the British government suggested to ‘exercise inside where possible and outside once a day’ (Public Health England, 2020). Further, specific examples such as walking or gardening outside and home work-outs have been provided by Public Health England and National Health Service (NHS) Fitness Studio.

Following these initial responses, I have looked at the official actions and recommendations from different governing bodies and their approach to the inactivity crisis as the baseline understanding of how the inactivity crisis is being resolved. Official bodies (WHO, CDC, UK government, the World Heart Federation) and key journals (BMJ, the Lancet) responded to the need for physical activity and the call for more exercise; information has been predominantly distributed as pamphlets, posters or infographics. Schiphorst et al. (2016) adapted the key information of investments in the physical activity field into an infographic with the icon of the family in the centre and information clearly distributed on the wheel (Schiphorst et al, 2016). This particular example (Schiphorst et al, 2016) is aimed at the general public with the intention of translating the knowledge and the need for physical activity as investments across educational, social and health domains. The intention is to motivate individuals (and perhaps their families too) to be more active for the information and reasons presented.



Schiphorst, C. (2016). Best Investment for Physical Activity [graphic]. British Journal of Sports Medicine. https://bjsm.bmj.com/content/51/16/1227

However, as soon as these infographics started to be published, their effectiveness has been questioned; Reid et al. (2017) praised the first steps of translating knowledge and official recommendations for public and clinicians, but the further steps of implementation of the physical activity changes remained unclear. Budzynski-Seymour et al. (2021) identified 53 countries currently using the WHO recommendations, with 77 countries using their own ones; in conclusion, the majority of countries indeed use some form of infographics to communicate this information to the public, but there were no associated evaluations. Each organization is focused on producing infographics and guidelines, however the 'true' effectiveness of them is unclear. Polster et al. (2021) investigated the public's responses to the physical activity guidelines with 65% of US adults reported hearing about the guidelines, but only 29% reported a behavioural response as a consequence. This is not a new discovery, Martin et al. (2000) reported that 97% participants reported inactivity as a health-risk factor and that perceived importance has potential of 1.5 odds to meet the criteria. However, this knowledge was not translated into behaviours as the physical activity, measured by the accelerometer, reported that in fact only 3.2% of the participants met the national guidelines, 97% did not (Tudor-Locke et al., 2010).

Furthermore, the infographics needed a platform and with development of mass media and social media, this became possible. A recent systematic review (Pinheiro et al., 2022) analysed the economic value of physical activity mass media across 25 studies in high-income countries. The conclusion was that 'we have very little to little confidence that the results are reliable for decision making.' Smith et al. (2019) argued that infographics are only effective when designed and applied for a specific purpose and with a specific population in mind "the disabled adults, organisations and Health Practitioners thought an infographic could communicate complex information in an affordable, understandable and engaging manner to large numbers of people."

The assumption of the infographics' effectiveness in mass media comes perhaps from the larger fundamental assumption and the development of behaviourist approach within psychology and economy. In other words, the assumption is that the delivery of the knowledge via mass channels results in successful PA and exercise behaviour, however there was no change in behaviour change despite majority of the people knowing what the requirements are. The evaluation of the economic utility decision-making model, especially the rational choice view, provides a possible answer here. This model, which proposes that the human beings make conscious, foresighted and calculated decision based on the existing knowledge, was heavily criticised with several choice problems when rational logic was lost (Kahneman & Tversky, 1979). In other words, when the public is informed of the need to do more exercise and be less sedentary, they face the decision to be active or inactive, which forces a decision based on the awareness of this problem and the benefits (exercises and physical activity reduce the long-term risk of diseases or premature death). However, as we know from the Nobel-winning work by Tversky and Kahneman (1979), people make mistakes when gains are not so clearly beneficial and emotionally perceived as losses. People are more likely to make irrational decisions if the timeline of the gains is extended and current risk or losses over-represented. This resulted in the common assumption developing in recent years (Hallal et al., 2012) that the traditional public health approach relying heavily on evidence and empathic communication has not been a success. Lancet's (Isakson, 2021) editorial summarized this issue and concluded that not enough work has been done in the last two decades, resulting in no improvement of physical activity. This further points towards a complex interplay between awareness, motivation, and action in addressing physical inactivity, highlighting the need for innovative strategies beyond traditional, unsuccessful public health approaches to effectively motivate and sustain physical activity among diverse global populations.

2.3. Physical activity increase and adherence to exercise

As concluded, the infographics rely on the assumption that humans make informed decisions, based on exposure to previous knowledge, which is a rather simple cause-effect assumption. Therefore, my next step after reviewing the current actions was to analyse what appears to be a multi-faceted and multi-factorial nature of increased physical activity. In overview, the current literature has been looking at interventions to increase physical activity, specifically the predictors or predispositions of engaging in physical activity, active interventions and long-term adherence to these interventions.

Bauman et al. (2012) suggest that individual-level factors such as age, sex, health status, self-efficacy, and previous physical activity are consistent correlates of physical activity. Age and health status may play a role in determining an individual's ability and desire to engage in physical activity. Additionally, self-efficacy and previous physical activity experiences may influence an individual's confidence and motivation to participate in physical activity. Allender et al (2006) provide insight into reasons why individuals participate in physical activity. Weight management, social interaction, and enjoyment are common motivators for participating in sports and physical activity. Young girls may be motivated to participate in physical activity to maintain a slim body shape, while older individuals may view physical activity as a way to stave off the effects of aging and to provide social support. However, challenges to identity, such as lacking confidence or competence in core skills or appearing overly masculine, may act as barriers to participation in physical activity. Overall, understanding individual predispositions and motivations for physical activity can help inform interventions designed to increase activity levels. Kohl et al. (2012) argues that a systems approach, which considers the complex interactions among the correlates of physical inactivity and focuses on populations rather than solely individuals, is needed to increase physical activity worldwide. This approach takes into account not only individual-level factors, such as age, sex, and health status, but also broader social and environmental factors, such as access to facilities, social norms, and policy. Such an approach may lead to more effective and sustainable interventions that promote physical activity on a global scale. The evidence across this literature shows a much more complex and system-based approach to physical activity, in comparison to the knowledge system described earlier as the key response from all the governing bodies.

The effectiveness of physical activity interventions in improving health outcomes is a topic of ongoing research. Shrestha et al. (2019) conducted a systematic review and found that interventions were effective in reducing non-occupational sedentary behaviour in the short to medium term, but not on longer-term outcomes. However, the quality of evidence was low to very low. This suggests that interventions may have some potential benefits, but further research is needed to determine the optimal strategies for sustained behaviour change. Marshall et al. (2022) also investigated the effects of physical activity interventions and found that they had trivial effects on physical health but had small but significant effects on mobility outcomes. Interestingly, yoga interventions yielded larger effects than other forms of physical activity, particularly in the domain of mental health. These findings highlight the potential benefits of incorporating different types of physical activity into interventions and tailoring interventions to individual needs.

It is important to note the difference between physical activity and exercise according to Casperson et al (1985) that “physical activity is defined as any bodily movement (…) in daily life can be categorized into occupational, sports, conditioning, household, or other activities. Exercise is a subset of physical activity that is planned, structured, and repetitive and has as a final or an intermediate objective the improvement or maintenance of physical fitness.” In other words, physical activity levels are made of one’s holistic movements levels, where exercises are more structured, often prescribed, methods of movement with a clear goal. Similarly to overall PA, few people conduct regular health-orientated exercises (Martin & Dubbert, 1985) and majority will fail to adhere to those plans within first few months. The type of exercise prescribed also has an effect on adherence (Perri et al, 2002).

The scientific literature, discussed above, emphasises a multifaceted approach to increasing physical activity, recognizing a range of individual-level factors such as age, health status, and self-efficacy, alongside broader systemic factors including access to facilities and social norms. Despite the potential of interventions to reduce sedentary behaviour and improve health outcomes in the short to medium term, sustained long-term behaviour change remains elusive, underscoring the need for tailored, diverse physical activity interventions. Across these studies, the topic of motivation as a key factor in starting and adhering to an exercise plan has been repeated, unsurprisingly. Research has shown that lack of motivation to attend the gym or sports centre is a significant barrier to physical activity (Bauman et al., 2012; Trost et al., 2002). Therefore, to increase long-term exercise adherence, it is necessary to increase motivation. Huberty et al. (2008) found that increasing motivation is a key strategy to ensure participants adhere to the long-term plan and continue exercising after completing a program. This is particularly important given the low levels of physical activity worldwide despite the number of gym memberships.

Exercise identity also plays an important role in promoting exercise adherence (Cooke et al., 2020; Strachan et al., 2013) found that exercise identity strength varied among individuals and that understanding these variations could improve exercise promotion strategies. While starting an exercise plan is often easy, sticking to the plan or intentions can be difficult. Reljic et al. (2018) found that dropout rates from high-intensity interval training were relatively high, indicating that maintaining motivation over a period of time is a challenge. Commitment is therefore essential for maintaining long-term exercise adherence. Dishman (1982) noted that commitment is a significant predictor of adherence to exercise programs. Individuals who are committed to an exercise plan are more likely to continue with it despite barriers and challenges. While motivation may be high at the beginning of a program, commitment is necessary to maintain motivation and continue exercising regularly.

In conclusion, motivation and commitment are key factors in starting and adhering to an exercise plan. Increasing motivation is essential for ensuring long-term exercise adherence, while exercise identity and commitment are important for maintaining motivation over a period of time. Addressing these factors in exercise promotion programs may improve adherence and increase physical activity levels.

2.4. Professional trainers (PTs)

As discussed earlier, the prescription of exercise and physical activity has left the medical field, where it was present for centuries. Instead, there are professionals whose main purpose is to enhance motivation to engage in physical activity and instruct appropriate exercises for individuals across a growing number of gyms and sports centres. Working with a fitness professional, such as a trainer, can increase an individual's strength performance and perceived exertion (Ratamess et al, 2008), change one's attitude towards exercises through problem-solving techniques (McClaran, 2003) and increase exercise in a behavioural weight-loss program (improvement of adherence through PTs and monetary benefit; Jeffery et al., 1998).

With 19,000-25,000 registered professionals, this makes personal trainers, gym, or class instructors the most frequently used professionals without any psychological training (in contrast to applied and/or sports psychologists). The courses to become a personal trainer in UK (YMCA Prospectus, 2023; PT Academy, 2023) involves anatomy knowledge, communication skills, programming exercises, giving advice and business skills. However, there is no psychology-based component as such, where Gavin (1996) reported that personal "trainers may engage in and take responsibility for behaviours that fall beyond their legitimate domains of competence and influence. These include such activities as giving advice to individuals about nutrition, lifestyle, and psychological agendas." This early qualitative evidence highlights the fact that these professionals might work beyond their knowledge and qualification on regular basis. Furthermore, motivation appears to be at the core of the professional-client domain through service relationships (McGuire, 2001) and these psychological skills, such as motivation skills, empathy, social skills are crucial in maintaining individuals' loyalty and adherence to the program. Melton et al. (2011) proposed that courses and programs "should devote additional time toward the development of future fitness trainers' affective qualities."

Personal trainers typically begin by assessing the client's current fitness level, including their physical abilities and limitations. They design personalized exercise programs based on the client's goals, preferences, and physical abilities. Personal trainers are skilled in providing motivation and support to their individuals. They encourage individuals to set achievable goals and celebrate their successes, no matter how small. Trainers continuously monitor their individuals' progress and make necessary adjustments to their exercise programs. This adaptability is crucial for maintaining motivation and competence. If a client becomes proficient in one activity, the trainer can introduce new challenges to keep the training engaging and effective. This ongoing support helps individuals stay committed to physical activity for life. This would be a model of successful behaviour change through exercise professionals.

There is limited literature and evidence on professional trainers and their psychological and/or affective skills, however the existing evidence in sports and exercise suggests that coaches use and encourage athletes through psychological tool. These sports professionals are usually trained within the sports environment and often trained in mental skills to some degree. Therefore, there is a need to investigate what professional and personal trainers use in their practice to motivate their individual clients to exercise and adhere to the program, and how we can provide further training for them in using psychology-based tools.

2.5. Theoretical framework for physical activity

The economic decision-making model helped to explain possible impact, or lack of it, of infographics on physical activity levels; there are theories explaining the promotion of and decision making around physical activity, which will be discussed as a theoretical framework underlying physical activity behaviours. Marcus et al. (1996) summarised the theories and techniques available at the time, including that those who invest more in their health are more likely to make positive physical activity (PA) decisions, the role and importance of self-efficacy, reasoned action (with correlation between intentions to exercise and exercise behaviours; Godin, 1993) and planned behaviour. Furthermore, operant conditioning, social cognitive, decision theory, the transtheoretical model, relapse prevention, and motivational interviewing, all serve as mechanisms of explaining physical activity behaviours.

Rhodes et al (2019) conducted the most recent historical reflection and analysis of theories and frameworks in PA research. The research investigated four theoretical frameworks that have been used to understand and promote physical activity. The first framework is social cognitive theory (Luszczynska & Schwarzer, 2015), which was inspired by the work of Atkinson (1957), Kerlinger (1966), Locke (1968), and applied in the health setting by Rosenstock and Charles (1974). It centres on the idea that individuals form expectancies of behavioural outcomes, including the importance of those outcomes. This approach incorporates concepts from various research paradigms, particularly those of expectancy value and reasoned action, has garnered significant support within the literature (Ajzen, 1991; Fishbein & Ajzen, 1977; Head & Noar, 2014). Within this framework, various expectancies, including attitudes, self-efficacy, and perceived behavioural control, play pivotal roles in shaping an individual's intentions to partake in physical activity (Ajzen, 1991). This approach has gained prominence as evidenced by its extensive application in numerous studies, including the influential theory of planned behaviour by Ajzen (1991; Hagger et al., 2002). This theory effectively connects the dots between attitudes, social norms, perceived control, individual intentions, and the actual engagement in physical activity (Ajzen, 1991; Hagger et al., 2002). As a comprehensive framework, it holds immense significance for both comprehending and devising interventions for physical activity behaviours. This is particularly highlighted in the work of other researchers such as Cardinal, Rhodes, Beauchamp, Jackson, Biddle, Conner, Norman, Plotnikoff, Trinh, and Nigg (Cardinal et al., 2012). In summary, this theory suggests that self-efficacy, outcome expectations, and social support are important predictors of physical activity behaviour.

The second theoretical framework is rooted in humanistic theory (Rhodes et al, 2019), which underscores the significance of personal growth, self-actualization, and intrinsic motivation in shaping physical activity behaviour. Early humanistic theorists presented a stark contrast to the mechanistic view of human behaviour proposed by behaviourism, asserting that humans possess intrinsic needs and are not solely driven by external rewards or punishments (Goldstein, 1995; Maslow, 1943; Rogers, 1961). They contended that human actions are inherently motivated by an innate desire for personal growth and self-realization, often termed as self-actualization (Goldstein, 1995; Maslow, 1943; Rogers, 1961). One noteworthy theory that emanates from this humanistic perspective, and is applied to elucidate physical activity, is self-determination theory (SDT) developed by Deci and Ryan (Deci & Ryan, 1985; 2000). SDT postulates that individuals are inherently inclined toward growth and are driven to establish a harmonious sense of self within their social environments. This theory comprises five distinct mini-theories, each delving into various facets of motivation: causality orientations theory, goal contents theory, cognitive evaluation theory, basic psychological needs theory, and organismic integration theory (Deci & Ryan, 1985). Collectively, these mini-theories scrutinize individual differences, types of goals, environmental conditions, psychological needs, and intrinsic predispositions that influence motivation (Deci & Ryan, 1985). SDT suggests that individuals who satisfy their needs for relatedness, autonomy, and competence are more self-determined in their motivation, which, in turn, leads to elevated levels of physical activity, enhanced health, and overall well-being, as opposed to those with externally regulated or amotivated orientations (Deci & Ryan, 1985).

The third framework is dual process theory, which suggests that there are two distinct modes of thinking: a reflective, conscious mode and an automatic, unconscious model (Rhodes et al, 2019). Dual process frameworks categorize behavioural determinants into reflective (deliberative) and non-conscious (automatic) processes. Reflective processes include established social-cognitive variables, while non-conscious processes involve less-understood factors like habits and automatic evaluations. These frameworks integrate with hedonic motivations to explore how feelings during physical activity influence future behaviour. This theory proposes that different factors influence each model and that interventions should target both modes to promote behaviour change. Finally, the socioecological framework suggests that behaviour is influenced by multiple levels of factors, including individual, social, environmental, and policy factors.

Overall, Rhodes et al. (2019) highlights the importance of understanding the underlying mechanisms that drive physical activity behaviour and the need for multi-level interventions that target multiple factors simultaneously. The COM-B model (West & Michie, 2020), provides a framework that incorporates these different levels of influence on behaviour change The COM-B model for behaviour change identifies three key components for any behaviour (B) to occur: capability (C), opportunity (O), and motivation (M); these components are not independent and interact with each other (West & Michie, 2020). Capability refers to whether individuals have the knowledge, skills, and abilities required to engage in a specific behaviour, including individual's psychological capability (knowledge, psychological strength, skills) and physical capability (physical strength, skill, stamina). Opportunity refers to external factors that make the execution of a behaviour possible. It comprises physical opportunity (environmental factors like time, location, and resources) and social opportunity (influenced by cultural norms and social cues). Motivation encompasses the internal processes that influence decision-making and behaviours. It consists of reflective motivation (planning, goal-setting, evaluation) and automatic motivation (desires, impulses, habits, inhibitions). The COM-B model recognizes that successful behaviour change requires modifying one or more of these components. Willmott et al. (2021) identified that COM-B explained 31% of variance in PA behaviours, with capability and opportunity being the mediators of motivation.

Biddle et al. (2007) proposed that theories of exercise and physical activity behaviour can instead be organised into five classes according to a classification framework: belief-attitude theories, competence-based theories, control-based theories, stage models and hybrid models. The first class is belief-attitude theories, which focus on the cognitive antecedents of behavioural intentions. The theory of reasoned action (Fishbein & Ajzen, 1975) and the theory of planned behaviour (Ajzen, 1985) are examples of this class. This framework would suggest that a person who intends to exercise regularly may believe that exercise is important for maintaining good health and reducing the risk of chronic diseases. They may also have a positive attitude towards exercise and enjoy the physical and mental benefits that it provides. In this case, the belief-attitude theory suggests that a person's intention to exercise is based on their cognitive beliefs and attitudes towards exercise.

Competence-based theories, on the other hand, emphasize an individual's judgment of their capability to perform the target behaviour. These frameworks, exemplified by Bandura's construct of self-efficacy (Bandura, 2004), focus on an individual's belief in their own ability to perform a behaviour successfully. Bandura's social cognitive theory posits that self-efficacy influences a person's goal-setting, effort, and persistence in the face of obstacles. In addition, self-efficacy is influenced by outcome expectations, or the perceived consequences of performing a behaviour, as well as by sociostructural factors such as social support or access to resources. Health promotion (as an extension of the health belief system; Bandura, 2004), based on Bandura's social cognitive theory, incorporates self-efficacy as a central component in predicting health behaviour. Both models (health promotion and theory of planned behaviour) suggest that individuals who have high self-efficacy for a particular behaviour are more likely to set goals for themselves, make plans to achieve those goals, and persist in the face of challenges. Additionally, the model proposes that sociostructural factors such as social support, access to resources, and the presence of competing demands can either facilitate or hinder the translation of intentions into behaviour.

Control-based theories refer to the notion that humans have the intrinsic desire or goal to experience themselves as the initiator and regulator of their actions. The currently highly influential self-determination theory (SDT; Deci & Ryan, 1985) attributes this desire to a basic psychological need for autonomy. SDT proposes that individuals develop their motivational approach for a given activity based on how well participation in that activity meets their basic psychological needs for autonomy, competence, and relatedness (Mears & Kilpatrick, 2008). In other words, if a person feels in control of their actions and experiences a sense of autonomy, they are more likely to be motivated to engage in a behaviour. For example, a person who feels they have the autonomy to choose their workout routine and schedule may be more motivated to exercise regularly than someone who is forced to follow a rigid exercise plan. Overall, control-based theories suggest that individuals are more likely to engage in a behaviour if they feel they have control over it and if it meets their basic psychological needs.

Stage models, such as the transtheoretical model (TTM; Prochaska & DiClemente, 1983), view behavioural change as a process that moves one closer to the goal from pre-contemplation, through contemplation, preparation, action to maintenance. A person who is in the pre-contemplation stage of the transtheoretical model may not be aware of the benefits of exercise or may not be interested in changing their behaviour. In contrast, a person who is in the maintenance stage of the model has successfully adopted an exercise routine and is working to maintain it over time. The TTM framework also recognizes that effective interventions should be tailored to the individual’s stage of change. Hybrid models, such as the health action process approach (Schwarzer, 1992), combine the stage concept with motivational variables and post-decisional variables to predict intention, with the addition of implementation intentions (Gollwitzer, 1999). The health action process approach combines the stage concept with motivational variables and post-decisional variables. A person who is motivated to exercise (e.g., through a belief-attitude theory or a competence-based theory) may use implementation intentions to increase their likelihood of following through on their intention to exercise.

It is important to notice the uniqueness of the theories, frameworks and models presented in this chapter and furthermore to observe the aspects that each might not have considered as important enough to be included. the theories and models perhaps fail to describe particular factors or a more holistic image of the PA behaviour. Some of the unexplained and unaccredited-for factors include an interplay of psychological, social, and environmental factors (Economic Decision-Making Model), the emotional and environmental influences on physical activity (Social Cognitive Theory), focusing on autonomy and growth, over external and emotional states (Self-Determination Theory), lack of time per stage (Transtheoretical Model of Stages of Change) and an individual variation in response to interventions (COM-B model). In contrast, many of the models, including the Theory of Planned Behaviour, Health Promotion Model, and Self-Determination Theory, place a strong emphasis on cognitive factors such as attitudes, beliefs, and intentions as key drivers of behaviour. Furthermore, that the behaviour change is the process that individual goes through; the frameworks often explore the relationship between intention and actual behaviour, recognizing that individuals may intend to be physically active but not follow through. Finally, models like the Theory of Planned Behaviour and the Health Action Process Approach incorporate goal setting and action planning as strategies for behaviour change. Overall, these models acknowledge the multifaceted and complex nature of human behaviour, considering various factors that may interact to influence physical activity.

In conclusion, Brand and Cheval (2019) summarized that all the models across five classes discussed above share a common theme originating from the cognitive theories as basis for their development:

> "All these models have one core attribute in common, stemming from origins of cognitive theorizing in psychology: They all emphasize the importance of imagined end states (behaviours or goals) and the energization of action resulting from them to such an extent that the experience of situated factors (e.g., momentary affect linked to the situation; Ekkekakis, 2017) is overlooked." (Brand & Cheval, 2019, p. 2)

Transitioning from the common theme of cognitive theories emphasized by the models across various classes, with a certain level of similarity – self-efficacy being one of them, it is essential to explore how these models and their cognitive underpinnings intersect with the promotion of physical activity. My aim is to explore how these models help me to understand the behaviour change in physical activity with the imagined end states and how their uniqueness and similarities contribute to understanding of this process.

2.6. Conclusion

In conclusion, the global inactivity crisis is undeniably one of the most significant challenges we face today, affecting our health, longevity, and the financial well-being of societies worldwide. As outlined in this chapter, current methods of addressing this crisis, such as infographic campaigns or simple exhortations to increase exercise, have shown limited success and are not in line with the scientific evidence. To address this issue, a more holistic approach to behaviour change is necessary. The wealth of behavioural theories and frameworks presented earlier offer valuable insights into the complexities of human motivation and action. Moreover, recognizing the urgency of the inactivity crisis, it becomes clear that a concerted effort involving a diverse group of professionals is necessary. However, for these professionals to make a meaningful impact, they must first gain a comprehensive understanding of behaviour change processes. This chapter has shed light on the importance of equipping individuals from various fields with the knowledge and tools required to promote physical activity effectively. In the next chapter, I will review the philosophical approach I take in analysing and answering the objectives of this thesis, before I conduct any formal reviews and empirical studies.

3. Philosophy of methodology and research

"If you insist on strict proof (or strict disproof) in the empirical sciences, you will never benefit from experience, and never learn from it how wrong you are." – Karl Popper

3.1. Research aims

In the last chapter I identified the evidence ranging from the current global situation, through promoting physical activity and theoretical mechanisms of increasing physical activity, which revealed a common feature – the existence of mentally imagined end states. Therefore, the primary goal of this comprehensive research is to explore the use of imagery in the realms of exercise (as structured and measurable physical activity), motivation, and rehabilitation. The overarching aim is to understand the effectiveness of imagery techniques, the variables that influence its success, and the potential integration of specific methods. This doctoral work will aim to address three objectives:

1. To systematically gather and evaluate existing evidence on the techniques in promoting physical activity and behaviour change, especially the use of imagery.
2. To investigate the effectiveness of a novel imagery-based technique (Functional Imagery Training; FIT) in enhancing exercise motivation and adherence among diverse populations.
3 To explore strategies for optimizing the application of this technique for individuals with unique challenges such as visual aphantasia or chronic injuries and conducting qualitative research to understand individual experiences and preferences, and developing tailored approaches to enhance engagement and effectiveness.

As a doctoral candidate, it has become increasingly clear to me that being aware of and articulating my chosen scientific research paradigm is a fundamental aspect of conducting my doctoral thesis. This awareness holds immense significance for several key reasons. First and foremost, identifying and clarifying my research paradigm ensures that my research aligns cohesively with my overarching research goals. It serves as a guiding framework, helping me stay on course and avoid any inadvertent digression from my intended research objectives. It is essential that my chosen paradigm resonates with my research questions and objectives, creating a seamless connection between my research aims and methodologies. Moreover, each research paradigm carries distinct methodological preferences and considerations. For instance, a positivist paradigm often emphasises quantitative research methods, while an interpretivist approach leans towards qualitative techniques. By explicitly stating my research paradigm, I can select and employ research methods that are most suitable for my specific research inquiries. This alignment between my paradigm and methodology enhances the effectiveness of my research design and safeguards against methodological inconsistency. Furthermore, my research paradigm profoundly influences my epistemological perspective – how I perceive knowledge and reality. Clearly defining my paradigm helps me maintain consistency in my approach to data collection, analysis, and interpretation. It ensures that my research methods and processes remain congruent with my chosen paradigm's foundational assumptions about the nature of knowledge and reality. Beyond the technical aspects, articulating my research paradigm in my thesis communicates transparency and rigor to my readers. It fosters an environment of trust and credibility, allowing readers to evaluate the coherence between my research methodology and paradigm. This transparency, in turn, bolsters the validity and credibility of my research findings, as it allows my audience to assess the appropriateness of my chosen methods within the context of my paradigm. Therefore, all the analysis code and data are available here: https://osf.io/tbekp/?view_only=b7497391850a4f31805d4ec558c8abfd

Additionally, my doctoral research is not isolated but contributes to broader academic conversations and interdisciplinary discourse. Clearly stating my research paradigm facilitates effective communication and collaboration across disciplines. It enables other researchers to comprehend my work within the framework of their own paradigms, making interdisciplinary dialogue more accessible and productive. Moreover, defining my research paradigm also carries ethical implications. Certain paradigms, such as critical or feminist approaches, place a strong emphasis on ethical considerations and social justice. By acknowledging and adhering to the ethical principles associated with my paradigm, I can ensure the ethical integrity of my research and uphold the values that underpin my chosen approach. In summary, the process of elucidating my scientific research paradigm in my doctoral thesis is not merely a formality but an integral aspect of my research journey. It guarantees the alignment of my research goals, methodology, and epistemological stance. This transparency enhances the validity and credibility of my research, fosters effective communication with fellow researchers, and ensures that my research maintains ethical integrity and relevance within the broader academic landscape.

3.2. Overview

This chapter provides a synopsis of philosophical and methodological approaches used in the following chapters of this thesis. A mixed method approach was selected due to searching and analysing a variety of evidence in order to answer the overarching question. The choice of mixed methodology dictated the process of research through my doctorate studies to be logical, deductive reasoning to reduce the likelihood of red herring or ignoratio elenchi in my argument.

The first step was to systematically review and objectively synthesise the evidence regarding the research question I have approached throughout this research. Meta-analysis (chapter 6) was defined as “a method by which one attempts to integrate findings quantitatively from several research studies related to a common general topic" (Grover, 1993, p. 1). Three key actions to conduct the meta-analysis and the overall review of the evidence are: asking the right question, generalizability to the general population and variation in criterion variables and parsimony. Meta-analysis is an objective way of combining evidence, but it also has another, under-explored epistemic virtue (Kovaka, 2022). The rationale for this meta-analysis comes from Smith et al. (2022) as the medium of synthesising evidence, including effect sizes, to analyse the replication crisis in psychology.

To further explore the knowledge of this field, I conducted an observational study (chapter 7) in order to scientifically measure the relationships between factors of imagery (Conroy & Hagger, 2018) in realistically valid environments, with no experimental manipulation. Naturalistic observation is the key fundament of all scientific knowledge of nature (Shapere, 1982; Norris 1985). These steps allowed me to build the fundaments of knowledge based on empirical evidence.

In my later research (chapters eight to ten), I tested implementing an imagery-based experimental manipulation in the form of interventions for general population. The philosophy of intervention-based research is rooted in the belief that research should be action-oriented and that it should aim to improve the lives of individuals and communities. Schiefelbusch (1981) defined interventions as acts of assistance with scientifically systematic and humanistic nature. Intervention implies that practitioners and researchers are competent to impact others' lives in order to achieve a more desirable state. Additionally, existing knowledge dictates that we know when and how we should intervene, we can then test the impact of such intervention, in line with the need of understanding the impact of our work (Smith et al., 2022). Finally, the person in need has the right to access such intervention.

The methodology of interventions involves a cyclical process of planning, implementing, and evaluating interventions, with a focus on understanding the effectiveness of the intervention and the underlying mechanisms that contribute to its success or failure. Interventions may be systematically analysed into operational components, such as a theoretical model (chapter nine) or programs implemented by the policy-makers and stake-holders decisions. Overall, the philosophy and methodology of intervention-based research thus involve a commitment to improving the lives of individuals and communities through rigorous and collaborative research that is informed by real-world problems and issues.

Specific clinical population sampling (POTS; chapter ten) and case study research (chapter eleven) are the most appropriate methods in understanding of the unique experiences and perspectives of individuals or groups within this particular context of imagery, motivation and adherence. Case study research involves an in-depth examination of a particular person, their history and phenomenon, in this case lack of imagery, with a focus on understanding the complexity of the situation and the interactions between different factors. Whereas interventions on specific populations involve a similarly pragmatic philosophy, with a focus on understanding the experiences of individuals who may be marginalized or excluded from general research due to specific health requirements. Additionally, the involvement of student-run clinics helps research to cross the bridge to the industry, including university placements. The Mixed method approach in this case will provide scientifically rigorous evidence on the effectiveness of the implementation and in-depth knowledge of human factors and experiences.

Qualitative methodology (chapter twelve) involved in-depth understanding of exercise professionals’ knowledge on practice and imagery under the ontological (reality is complex and subjective, shaped by multiple perspectives and social contexts), epistemological (knowledge is socially constructed and subjective, and that it is produced through interaction and dialogue between researchers and participants), and axiological (value-laden research is respectful, inclusive, and ethical) assumptions. Additionally, as a researcher I have also acknowledged my role and impact as a researcher through reflexivity. The philosophy of qualitative methodology thus involves a commitment to understanding the complexity of human experiences, engaging in respectful and presenting the accessed data as an observer.

3.3. Scientific research paradigm

Scientific research philosophy refers to a researcher's cognitive decision-making process when it comes to choosing research strategies, defining problems, collecting and processing data, and analysing results. According to the literature, it's important for a researcher to have a clear understanding of the paradigms or worldviews that provide them with philosophical, theoretical, instrumental, and methodological foundations (Žukauskas et al., 2018). Many factors influence a researcher's scientific research paradigm and philosophy, including their mental model, worldview, beliefs, and attitudes towards the perception of reality. A researcher's beliefs and values are crucial in providing solid arguments and terminology to ensure that the results obtained are reliable. Additionally, a researcher's position can significantly affect the outcome of the research (Wiersma, 1984). In summary, the scientific research paradigm helps define scientific research philosophy.

Gliner et al. (2011) describe the scientific research paradigm as an approach or way of thinking about research, its process, and its implementation method. It is not a methodology but rather a philosophy that directs the research process in a particular direction. Easterby-Smith et al. (2012) discuss the three main components of the scientific research paradigm as ontology, epistemology, and methodology (Žukauskas et al., 2018). Holden and Lynch (2004) suggest that the choice of methodology should align with a researcher's philosophical position and the social science phenomenon being analysed.

3.4. Ontological phenomenology

Hitchcock and Hughes (as cited by Žukauskas et al., 2018) define ontology as “the theory of existence, interested in what exists, and is based on assertions of a particular paradigm about reality and truth.” Other literature (Žukauskas et al., 2018) agrees upon a theory about the nature of reality. According to Denzin and Lincoln (2008) the majority of the ontological questions are “what are the things in reality?” and “how did it really happen?” Phenomenology is a qualitative research methodology that involves exploring and describing the subjective experiences of individuals and it has become a stable name in physical activity literature (Standal, 2014). In the context of research on motivation, exercise, and physical activity, ontological phenomenology can act as a framework for understanding how individuals interpret and give meaning to their physical experiences. By exploring the subjective experiences of individuals alongside the quantitative research, I was able to gain insight into how individuals understand and motivate themselves to engage in physical activity.

The research of exercise and physical activity also involves individuals with multiple interconnected factors underlying the activity, living in a habitual state and in communities which may or may not encourage the behaviour or its change, similar to primary care patients (Sturgiss & Clark, 2020). Therefore, I must take a philosophical tenet through the mixed methodology that is in line with the ontology of complexity that identifies the harmony of context and mechanisms (Greenhalgh & Papoutsi, 2014), especially in the later stages of my research, with the analysis of the components of the system versus the sum of its parts. Critical realism is an ontological stance which states that human perceptions and in-take of reality can close to actual reality, but not the same, and that humans can create “accounts of reality” (Sturgiss & Clark, 2020). Critical realism can be used to explain outcomes and phenomena in natural settings as individuals discuss their experience in specific situations

(Sekaran & Ubundi, 2013). Additionally, the concept of critical realism incorporates the idea of emergence, which highlights the synergistic interaction among components of a complex process, resulting in an outcome that is 'more than the sum of its parts'. Critical realism acknowledges that interventions and systems are made up of 'emergent mechanisms' that help explain the results (Sturgiss & Clark, 2020). In other words, this stance allows me to answer the questions on the complexity of the physical activity, motivation and imagery systems and their uniqueness.

3.5. Epistemology

Epistemology is closely related to ontology, as the answers to the research questions depend on the ontological assumptions about the nature of reality so therefore helping shaping the questions of creating knowledge (Sale et al., 2002; Cohen et al., 2007; Denzin & Lincoln, 1998; as cited by Žukauskas et al., 2018). According to Brewerton and Millward (2001), epistemology refers to the scientific examination of what separates evidence-based, reasonable assurance from subjective opinion. Moon and Blackman (2014) proposed that epistemology is concerned with “all aspects of the validity, scope and methods of acquiring knowledge.”

In line with ontological critical realism, constructionist epistemology in particular challenges the assumption of one objective ‘truth’, waiting to be discovered (Moon & Blackman, 2014), instead it emerges from humans’ interaction with the world and its realities. The value of constructionist research is in generating contextual understandings of a defined topic or problem. The philosophy of conducting a meta-analysis involves a commitment to rigor, transparency, and objectivity, in order to minimize bias and ensure that the results are as robust and reliable as possible. In terms of the meta-analytical aim of objectively synthesizing the evidence, the researcher’s decisions and perception of the topic will have an influence; furthermore, I have to accept the assumption that objectivism in meta-analysis resides in the data analysis, however subjective factors can influence the decisions in the data collection and research design.

The pure constructivists and objectivists in research both might violate the epistemological logic of justification (assumption that epistemology and methodology are distinctive, and that former does not entirely dictate the former; Johnson and Onwuegbuzie, 2004). Pragmatism, as a philosophy trend, considers practical thinking and action ways as the main, and the criterion of truth is considered for its practical application. Furthermore, it attempts to reach a middle ground between dogmatism and scepticism, and advocates for philosophical dualism, rejected by both groups. Johnson and Onwuegbuzie (2004) advocate pragmatism as the philosophical partner for mixed method research for the following reasons: "offers a practical and outcome-oriented method of inquiry that is based on action and leads, iteratively, to further action and the elimination of doubt; and it offers a method for selecting methodological mixes that can help researchers better answer many of their research questions." Therefore, the pragmatic critical approach in research involves a combination of two epistemological perspectives: pragmatism and critical theory. Pragmatism emphasizes the practical implications of research and encourages researchers to focus on real-world problems and the potential applications of their findings. Critical theory, on the other hand, emphasizes the importance of power dynamics and social inequality, and encourages researchers to consider how these factors may shape research questions, methodologies, and interpretations.

In summary, to obtain and create knowledge through mixed methodology of this research, I will take a pragmatic critical stance with assumptions of constructivism regarding the realities observed, rather than the real 'truth'. De Loo and Lowe (2011) show that combinations of research methods should not be made based on a "whatever works" attitude, since this approach ultimately is still infused with ontological and epistemological considerations that researchers have and should try to explicate.

3.6. Mixed method research

A combination of quantitative and qualitative analysis as part of the overall mixed methodology in research on exercise and physical activity can provide a more comprehensive understanding of the topic. While quantitative research provides numerical data on the frequency, duration, and intensity of physical activity, it may fail to capture the complexity of human experiences and practices, and the social and cultural factors that influence the particular behaviour. Whereas the qualitative research can provide a rich understanding of the experiences and perspectives of individuals. Including thematic approaches can reduce the over-reliance on the quantitative evidence and enable me to capture the "soft-core views and experiences" (Jogulu & Pansiri, 2011). The mixed method approach combines philosophical paradigms, by allowing inductive and deductive perspectives, and furthermore allows me to both generate theory and test the hypothesis out of singular study (Jogulu & Pansiri, 2011).

Mackenzie and Knipe (as cited by Žukauskas et al., 2018) state that appropriate research methodology is the paradigm and the research question that should determine which data collection and analysis methods (qualitative/quantitative or mixed) would be the most appropriate for research. In this way, the researchers do not become "the researchers of quantitative, qualitative or mixed methods," but they adapt the data collection and analysis method that is most suitable for specific research. Furthermore, following from the epistemic discussion above, the split between constructivist (predominantly qualitative methods) and objectivist (quantitative methodology) stances is theoretically based on incompatibility thesis (Howe, 1988). Where Johnson and Onwuegbuzie (2005) propose the mixed methodology as firstly possible, and as an alternative to these two philosophical stances.

Greene et al (1999; as cited by Johnson and Onwuegbuzie, 2004) identified and proposed the five key rationales for conducting mixed methods research (Initiation, Expansion, Development, Complementarity and Triangulation). Triangulation is the attempt to confirm the results by applying different methods, where complementarity suggests that results from one method can enhance or clarify the results from another method, and development that results from one method can go as far as shaping another method. Initiation of new insights as a result of mixed methods can stimulate new further questions and expand the breadth and range of the research by using different methods for different scientific enquiries. Across my doctoral thesis, as I understood the role of each of those principles, I initiated the research question by discussing the current evidence for the concept of using various psychological tools to promote physical activity. The expansion was through looking for any additional tools or factors, which can be included (e.g. confidence in rehabilitation context) and development of specific method (e.g. FIT). Finally, I was able to test how FIT complimented the multi-disciplinary method in clinical settings and I reflected on the results generated by different methods and interventions by integrating different sources of information, research findings, and theoretical frameworks to support my discussion on psychological tools for promoting physical activity (triangulation).

The rationale above is transparent in the later stages of my research, as the mixed methodology produced a greater insight into the experiences of the participants, resulted in more research questions and results from different methods either enhances the findings or challenges some aspects of conclusion. The process of mixed methods I will be using has a dominant, sequential status – predominantly quantitative research of observations will lead to the qualitative research as a reflection of experiences and practices (Jogulu & Pansiri, 2011; De Silva, 2011). As I intend to use different methods, I need to be aware and careful of how the results are combined and what conclusions and questions arise as a result (Emerald Publishing, 2023).

3.7. Sampling

Applying mixed methodology required different techniques of sampling due to the different nature of data and process. At the beginning (chapters seven to nine), voluntary sampling was used due to being more cost-effective and efficient than random sampling. Recruiting participants through the university participation pool, community organizations, social media, or online forums reduced the recruitment costs, while increased the speed and size of recruitment. This method was in line with inclusivity, especially in interventions (all voluntary participants got some degree of support through interventions) and the generalizability of findings (recruiting participants from the population of those who are active or want to be more active). Additionally, voluntary sampling through media has a diversity aspect as it can also allow for the recruitment of underrepresented groups through reaching out the larger population, including ethnic minorities or individuals with disabilities.

In the later stages of my research, I set out to investigate specific populations (chapters ten to twelve); therefore, purposeful sampling in research on exercise and physical activity was required. Purposeful sampling involves selecting participants who meet specific criteria that are relevant to the research question, such as clinical diagnosis, non-imagery phenomena or specific professions. This approach can be particularly beneficial in research on exercise and physical activity, as it allowed me to obtain and gather the in-depth understanding of the experiences and perspectives of individuals who engage in specific types of exercise or who face particular barriers to physical activity, who do not have any visual imagery during exercises and who prescribe exercises and monitor individuals in physical activity.

3.8. Conclusion

In summary, across this research and doctoral enquiry, I am taking a pragmatic and critical approach throughout this thesis and research, with deductive reasoning from the effectiveness of general application to specific populations and reasons for using this particular method. Ontologically, I am predominantly led by critical realism to capture reality by broad and critical examination of the knowledge in human world. My epistemic stance is orientated around constructionism, to obtain meaning from interplay between myself as a researcher and the object of this doctoral work. To apply the findings and conclusion of this work, I will use ontological phenomenology and pragmatic, critical theory. In conclusion, understanding and articulating the scientific research paradigm is an integral aspect of my doctoral journey. It ensures the coherence of my research, influences methodological choices, aligns with my epistemological stance, fosters transparency, and enables effective interdisciplinary communication. Moreover, it carries ethical implications, ensuring the ethical integrity of my research. Thus, defining my research paradigm is not a mere formality but a cornerstone of my research journey.

Part 1

Following the overview of the inactivity crisis and clarifying my scientific research paradigm, the first part of this thesis embarks on a journey to unravel the intricate relationship between imagery, physical activity and behaviour change. At its core, the research in this section seeks to address a pressing concern; while recognising the urgency of this issue, the overarching intention behind the research is to identify and explore innovative strategies for motivating individuals to adopt and maintain regular physical activity routines. Central to this aim is the exploration of the role of mental imagery in influencing behaviour and motivation, particularly within the context of physical activity and sports. By delving into existing literature and conducting systematic reviews, the research aims to gather evidence on the effectiveness of imagery interventions in promoting behaviour change. Moreover, the research seeks to understand the underlying processes responsible for the observed effects of imagery, shedding light on its potential mechanisms of action.

Through this exploration, the research across the following chapters will explore the theoretical insights and practical applications. By investigating the feasibility and effectiveness of techniques like Functional Imagery Training (FIT), grounded in cognitive and behavioural theories, the research aims to provide actionable insights for intervention strategies aimed at enhancing physical activity engagement. Furthermore, the research aims to explore the potential of imagery interventions in addressing unique challenges faced by individuals with conditions such as visual aphantasia or chronic injuries, thus promoting inclusivity and accessibility in physical activity promotion efforts. Ultimately, the overarching intention behind the research in Part 1 is to contribute to the development of evidence-based intervention strategies that can effectively promote physical activity and behaviour change, thereby mitigating the global burden of physical inactivity and improving public health outcomes.

4. Promoting physical activity

"I have always believed that exercise is not only a key to physical health but to peace of mind." Nelson Mandela

In this chapter, I take a narrative approach in reviewing the current evidence on the promotion of physical activity as a vital component in maintaining an active and healthy lifestyle and the possible consequences if physical activity were increased. In previous chapter I summarised the frameworks and theories of behaviour change, and a number of conclusions have been produced. The models place varying emphasis on cognitive factors, including attitudes, and intentions, as drivers of physical activity behaviour and behaviour change itself is recognised as a process that individuals go through, involving stages from pre-contemplation to maintenance. Goal setting is a fundamental aspect of many models, such as the Theory of Planned Behaviour and the Health Action Process Approach, emphasising the importance of setting specific goals as a strategy for behaviour change. Furthermore, goal setting aligns with the idea of "imagined end states" mentioned as the common theme of all models and explored in greater detail in the next chapter. Alongside an individual's stage of change, the uniqueness of individuals is a recurring theme in several models, such as Self-Determination Theory, which highlights the role of autonomy and personal growth in motivation and therefore behaviour change. To effectively apply these models, a tailored or individualized approach is essential, which can enhance the feasibility and effectiveness of these models.

Furthermore, people might face barriers in their behaviour change such as lack of knowledge, motivation, and skills. To overcome these barriers and follow the recommendations from the models, there are a number of approaches, including individuals needing to possess a level of physical activity literacy (PAL), which includes knowledge and skills about physical activity and its benefits. Goal setting is a commonly used technique in promoting health behaviour change, including physical activity. Motivational interviewing (MI) is a client-centred communication technique that aims to explore and resolve ambivalence about behaviour change. It is a powerful tool for facilitating behaviour change by enhancing intrinsic motivation and confidence. Finally, imagery, sometimes referred to as visualisation, is a technique that involves creating and producing vivid sensory experiences in the mind. In this chapter, I will explore the principles, techniques, and research behind these approaches and how they can be applied in promoting physical activity.

4.1. Baseline intervention - Physical Activity Literacy

In light of the findings in Chapter 2, it is paramount to address motivation, exercise identity, and commitment in designing exercise promotion programs aimed at enhancing adherence and ultimately elevating levels of physical activity. This holistic approach aligns with the concept of Physical Activity Literacy (PAL), which encompasses motivation, confidence, and competence to engage in physical activities throughout one’s lifetime (Cairney et al., 2019). Physical Activity Literacy (PAL; Cairney et al, 2019) or Physical Literacy (PL) refers to an individual’s ability to be physically active throughout their lifespan. According to the International Physical Literacy Association, PAL “is the motivation, confidence, physical competence, knowledge, and understanding to value and take responsibility for engagement in physical activities for life.” Therefore, the knowledge aspect of PAL is in line with infographics creation and application described earlier in Chapter 2, however successful and efficient literacy involves multiple factors such as motivation, competence and accountability. Belanger et al., (2018) identified that those with higher levels of Physical Competence and Motivation and Confidence as two domains of PAL, had increased odds of meeting physical activity guidelines and sedentary behaviour guidelines. However, limited consideration has been given to the role PAL plays in promoting positive health behaviours; Cairney et al., (2019) support the idea that measures related to motor competence, motivation and positive affect work in an integrative manner to produce differences in PA and subsequent health outcomes in children.

Looking specifically at the knowledge aspect, Buja et al., (2020) conducted a systematic review to determine whether health literacy (the degree to which individuals can find, understand, and use information and services to inform health-related decisions and actions for themselves and others) can influence people's levels of physical activity. The review found that most of the observational studies considered in the review consistently reported a positive association between physical activity and health literacy. This means that individuals who could make a decision based on the information were more likely to have an active lifestyle compared to those with lower levels of health literacy. Therefore, the study highlights the importance of improving individuals' literacy to enable them to make informed decisions about their lifestyle and levels of physical activity. Regarding the health perceived consequences of physical inactivity, Bohlen et al. (2022) conducted a meta-analysis examining longitudinal associations between perceived consequences (including health-related, physical, social, self-evaluative, affective, psychological, weight, and time-related) and PA in adults. They found significant, but small, effect sizes for the psychological, affective, and health consequences affected by the PA behaviours. The study highlights the importance of examining the role of individual perceptions of the consequences of PA in predicting long-term behaviour change, and the need for more standardized approaches to measuring and reporting these perceptions in research. Therefore, the role of literacy in PA increase and adherence can be organised into assessment of person's knowledge and their confidence and capacity of utilising that information. This view allows me to treat the PAL method for increasing PA as a baseline intervention without any active psychological skills or methods being utilised. This serves as an important aspect for the comparison purposes in future experiments as some research highlights the overestimation of the effect when compared to the waitlist (Cunnigham, Kypri & McCambridge, 2013). Therefore, in the experiments, a baseline intervention group might be more scientifically beneficial than a wait list control group. The research on PAL shows the importance of enhancing individuals' knowledge and understanding of physical activity for effective behaviour change. As such, interventions that target specific components of physical activity literacy may be more effective than those that take a general approach.

4.2. Goal setting

Any change in current behaviour can be viewed as an individual's aim or a goal. In this instance, Locke et al. (1981) defined a goal as "what an individual is trying to accomplish; it is the object or aim of an action". Goal setting is frequently used in a variety of interventions for health-related behaviours, including physical activity, diet, smoking cessation, and medication adherence (Michie et al., 2018, as cited by Swann et al, 2021). It is often used in conjunction with other behaviour change techniques, such as self-monitoring, feedback, and reinforcement, to enhance the effectiveness of interventions. Unsurprisingly, goal setting is also a technique commonly used by personal trainers (PTs) as part of their training and education with individuals (McClaran, 2003). Goal setting is viewed as a crucial component of behaviour change because it helps individuals to define and work towards a specific objective. Goals give people something to strive for and provide a clear direction for behaviour change efforts; therefore, goal setting being an essential components of fitness professionals' curriculum. Garstang et al. (2022) identified through a systematic review and meta-analysis that specific goals had a positive, large effect on PA levels; yet non-significant effects on psychological outcomes (e.g., motivation and mood), creating a valid field of research for future investigation of the link between goals, cognition and behaviours. Furthermore, Coote et al. (2012) demonstrated that using goal setting and planning can successfully influence well-being in depression patients. The current, extensive evidence suggests that goal setting is an effective strategy (Swann et al, 2022). McEwan et al. (2016) conducted a meta-analysis of 45 studies and 52 controlled interventions, which all concluded a medium effect size (d = .55).

However, other research has produced mixed response to this particular method; goal intentions has been found to account for only 28% of the successful behaviour change behaviours (Gollwitzer & Sheeran, 2006). According to Swann et al. (2022), setting goals can have negative effects such as stress, anxiety, and perceived pressure. Latham and Locke (2006) as well as the later paper (Locke & Latham, 2002) have pointed out that these negative effects can occur as a result of goal-setting. Therefore, it is important to consider the potential negative consequences of setting goals when using this approach in health-behaviour change interventions. Additionally, Drach-Zahavy and Erez (2002) suggest that specific and challenging performance goals may limit the opportunity for individuals to learn and develop their own strategies for meeting physical activity guidelines. The focus on achieving immediate performance outcomes could lead to the neglect of exploring alternative ways of exercising or finding individual preferences for physical activity. It is important to consider the balance between setting specific goals and allowing individuals the opportunity to explore different strategies and modes of exercising to achieve long-term behaviour change.

Nowack (2017) has extensively reviewed current issues and best practices in goal intentions, goal striving, and goal flourishing to maximize coaching success with individuals through an individual change model (Enlighten, Encourage, and Enable). In practical terms, this suggests that coaches should focus on enlightening individuals about the importance and benefits of setting and striving towards their goals. They should encourage individuals by providing emotional support, guidance, and motivation. Lastly, coaches should enable individuals by helping them develop the necessary skills and strategies to achieve their goals effectively. Swann et al. (2020) has produced an updated review of goal-setting theory in physical activity promotion and concluded that “goal-setting theory has evolved beyond performance goals as a one-size-fits-all approach.” Swann et al argue that practitioners and researchers should assess skill, knowledge, ability, commitment, and perceptions of task complexity in the process of setting new goals. Practitioners and researchers should, in practical terms, assess various factors when setting new goals. These include evaluating an individual’s skill level, knowledge, ability, commitment to change, and perceptions of task complexity.

Swann et al.’s (2020) approach recognizes the importance of tailoring goals to an individual’s unique circumstances and capabilities. While goal setting is a valuable strategy in health-related interventions, including those aimed at increasing physical activity levels, it is essential to consider potential limitations of simply setting goals. Traditional goal-setting approaches in physical activity promotion often employ a one-size-fits-all model, setting identical objectives for individuals with diverse abilities and needs. This generic approach may not consider the unique characteristics and preferences of each person, potentially limiting its effectiveness. Moreover, traditional goal setting tends to concentrate primarily on behavioural outcomes, overlooking the crucial psychological aspects like motivation, self-efficacy, and mood. This omission can hinder long-term behaviour change and lead to negative psychological effects, such as stress and demotivation. Additionally, it may discourage individuals from exploring various physical activities or finding those that align with their interests and preferences.

4.3. Person-centred approach and Motivational Interviewing

Carl R. Rogers, a pioneering psychologist, is best known for developing the person-centred approach to counselling and psychotherapy during the mid-20th century (Yao &

Kabir, 2023). His work dating as early as 1940s emphasized creating a therapeutic relationship characterized by attitudes of empathy, unconditional positive regard, and congruence. Rogers believed in the innate capacity of individuals to grow, self-actualize, and find solutions to their problems. He introduced the non-directive method, where therapists listen actively, reflect individuals' feelings, and create a safe space for self-exploration.

Rogers' approach challenged traditional therapeutic hierarchies and promoted client empowerment. His work extended beyond therapy, influencing fields such as education, conflict resolution, and personal development. Carl R. Rogers and his colleagues, recognizing the expanding scope of their client- centred, student- centred, and group- centred approach, adopted the term "person- centred " to better encapsulate their work, acknowledging that therapeutic relationships involve both the client and therapist. This shift highlights the broader applications of the approach. Rogers' work showcased the potential for the person-centred approach to empower individuals and groups, reversing traditional hierarchies and encouraging professionals to work towards conflict resolution and positive social change, aligning with democratic principles (Kirschenbaum, 2015; Rogers, 1967, 1986). His efforts earned him a nomination for the Nobel Peace Prize in 1987, further emphasizing the impact of this revolutionary approach (Rogers et al, 2013). This approach was a start for a number of formal methods based on the person-centred philosophy.

Motivational Interviewing (MI; Miller & Rollnick, 2012) is deeply rooted in the person-centred approach and it is a commonly applied method that has enhanced motivation and physical activity. MI has been developed as a psychological therapy since 1980s, in parallel with imagery being developed in sports performance. MI has its origins in addiction research and has evolved into a widely recognized and effective therapeutic approach for behaviour change. Developed in the early 1980s by William R. Miller and Stephen Rollnick, MI emerged as a response to the limitations of traditional addiction treatments. The founders were dissatisfied with confrontational and coercive methods commonly used in addiction therapy and sought to provide a more client-centred and empathetic approach that would be more effective in motivating individuals to change addictive behaviours (Miller & Rollnick, 2012).

MI is a behaviour change technique delivered in a person-centred, empathic communication style that aims to elicit and strengthen intrinsic motivation for behaviour change by exploring and resolving ambivalence. Rollnick and Miller (2012) defined MI as "a directive, client-centred counselling style for eliciting behaviour change by helping individuals to explore and resolve ambivalence." This approach is particularly person-centred, rather than guided and led by the therapists or the researcher; this combined with Rogerian empathic attitude has resulted in its uniqueness of the approach, which elicits one's motivation to resolve the discrepancy and ambivalence. In other words, conversation aims to elicit motivation for behaviour change by resolving ambivalence with practitioner expressing empathy, developing discrepancy, "rolling with resistance," and supporting self-efficacy (Miller & Gramzow, 2016).

The MI approach involves engaging in a collaborative conversation with the person, exploring their personal values, beliefs, and goals, and using open-ended questions, reflective listening, and affirmations to support their motivation for change. Through motivational interviewing, a personal trainer or health professional can help individuals set goals that are personally meaningful and aligned with their values, rather than simply imposing external goals that may not be relevant to the person's life circumstances or priorities. By using an empathic approach to understand and support a person's motivation for change, motivational interviewing has been shown to be effective in promoting behaviour change in a variety of settings, including physical activity promotion.

MI emerges as a promising alternative to address the goal setting limitations. Unlike traditional goal setting, MI takes a personalised approach, recognising individual uniqueness and tailoring interventions accordingly. It places a strong emphasis on the psychological aspects of behaviour change, emphasizing intrinsic motivation, self-efficacy, and the confidence to make positive changes. MI also aims to minimize negative effects like resistance or defensiveness by fostering an empathetic, non-judgmental atmosphere. Furthermore, it encourages individuals to express their preferences, values, and interests regarding physical activity, promoting autonomy and the exploration of various options. By thoroughly assessing an individual’s current behaviours, motivations, and barriers, MI ensures that goals are relevant and achievable within the individual’s context. In summary, transitioning from traditional goal setting to Motivational Interviewing offers a more individualized, psychologically-focused, and effective approach to promoting physical activity.

MI also incorporates the Transtheoretical Model (Prochaska & DiClemente, 1983), commonly known as the Stages of Change Model, which recognises that behaviour change is a process that occurs in stages. This model tailors interventions to the individual’s current stage of readiness for change, making it particularly relevant in addiction treatment where individuals often move through various stages before achieving lasting change. Miller and Rollnick (2012) have also clearly stated that MI is not the related to the Transtheoretical Model of Change, proposing that it is a conversation style and approach. However, as MI relies on the aspect of self-determination to change being evoked as a part of the approach, other literature (Markland et al., 2005) proposed that Social Determination Theory (SDT; Deci & Ryan, 2012) can provide this theoretical support. Both, MI and SDT, rely on the assumption that humans have the innate tendency and need for personal growth toward psychological integration. Furthermore, MI focuses on social-environment factors and person's autonomy at the core of the intervention, which are also suggested in SDT. Further theoretical support comes from the Affective-Reflective Theory of physical activity (ART; Brand & Ekkekakis, 2021). ART suggests that avoiding short term negative affect outweighs the long-term adherence to the goal, therefore individuals need support from the practitioner in evoking higher cognitive reflections when a negative affective reaction is present. As ART proposes one stage to include individual's expression of changes and their desire to do so, perhaps hesitation too, MI provides the solutions (Apodaca & Longabaugh, 2009) as the practitioners in MI are trained to actively listen for "change talk" in the client's statements (any language or expressions that indicate a readiness or intention to change). They must use their skills to assess the client's readiness to progress. If they sense readiness and openness to change, they can then move to the next phase in the conversation. Finally, the MI emphasises the use of specific MI techniques like reflective listening and affirmation to support and enhance the client's commitment to change. These techniques help the client feel heard, respected, and understood, which, in turn, can motivate them to explore their ambivalence and make a commitment to change.

Rubak et al. (2005) reviewed the effects of MI on lifestyle problems and diseases, finding that it had a significant and clinically relevant effect in approximately 75% of the studies on diabetes/asthma, smoking cessation, weight-loss/physical activity, alcohol abuse, psychiatrics/addiction in comparison to just advice giving, with a very similar effect on physiological and psychological measures. Healthcare providers such as psychologists and physicians obtained an effect in approximately 80% of the studies, while other healthcare providers obtained an effect in 46% of the studies. The study also found that brief encounters of 15 minutes using MI produced an effect in 64% of the studies. Anshel and Kang (2008) demonstrated the effectiveness of MI as a behaviour change technique for police officers to adhere to an exercise regime, with significant improvements in physical fitness and lipid profile scores. Kose and Yildiz (2020) found that MI was effective in improving the health of overweight and obese adolescents, with a decrease in body mass index values and an increase in the quality of life scale points. However, Ismali et al. (2019) found that enhancing MI with additional behaviour change techniques was not effective in reducing weight or increasing physical activity in those at high risk of cardiovascular disease. Despite this, the overall evidence suggests that MI can be an effective tool for behaviour change, particularly when used by healthcare providers such as psychologists and physicians, and in brief encounters. MI can also be effective in improving health outcomes in overweight and obese adolescents.

However, like any method, MI has its limitations. One notable challenge is resistance and ambivalence from individuals. Many individuals with addiction issues have mixed feelings about change, and this ambivalence can hinder progress (Rollnick & Miller, 1995). Additionally, sustaining motivation for change long-term and beyond the therapy session can be difficult (Lundahl et al., 2010). Individuals may leave therapy feeling motivated but struggle to maintain that motivation in their daily lives. Furthermore, MI’s effectiveness can vary among individuals, and not all individuals may respond optimally to this approach (Hettema et al, 2005).

As discussed, majority of the models of behaviour change share the imagined state of the goal, therefore, to further enhance the effectiveness of MI and address these limitations, the incorporation of multi-sensory imagery techniques can be invaluable. More evidence comes from the review of addiction research and cravings (May et al., 2015), training individuals to use imagery for functional goals can have a motivational effect on the behaviour change. Multi-sensory imagery allows individuals to vividly imagine both the positive outcomes of change and the negative consequences of maintaining the status quo. This technique can make the pros and cons of change more tangible, helping individuals resolve their ambivalence more effectively (Miller & Rollnick, 2012). Moreover, multi-sensory imagery can assist individuals in sustaining motivation beyond the therapy session. While MI primarily focuses on enhancing motivation during the therapeutic encounter, multi-sensory imagery provides individuals with tools to maintain motivation between sessions. By encouraging individuals to create mental images of their desired future, complete with sensory experiences, multi-sensory imagery can create a similar neurological response as perception of an actual event (Kosslyn et al., 2001). Individuals can use these mental images as powerful reminders of their goals and the positive emotions of change, helping them stay motivated over time. To address the variability in MI's effectiveness among individuals, multi-sensory imagery can be customised to suit different learning and cognitive styles. Visual, auditory, or kinaesthetic imagery exercises can be selected based on a individual's preferences and strengths (Pearson & Kosslyn, 2015).

4.4. Conclusion

In this chapter, I have explored quite broadly the critical issue of promoting physical activity through psychological methods and approaches, highlighting the profound impact it can have on individual and societal health, longevity, and financial well-being. However, I also recognized the challenges I might face in motivating people to engage in regular physical activity, ranging from a lack of knowledge and motivation to practical skills. To overcome these barriers, I explored various psychological techniques. Additionally, I focused on the practice of goal setting, a commonly employed technique in health behaviour interventions, including physical activity promotion. While goal setting holds great promise, I also discussed its potential limitations, such as stress and the risk of neglecting individual preferences. Furthermore, I examined the person-centred approach and Motivational Interviewing (MI) as powerful tools for enhancing intrinsic motivation and confidence in individuals. These techniques are rooted in empathy and collaboration, aiming to resolve ambivalence about behaviour change. I acknowledged their historical development and the influence of humanistic psychology in their creation. MI, in particular, has shown promise in various settings, including addiction treatment and physical activity promotion, offering a more personalized and psychologically-focused approach to behaviour change.

As I transition into Chapter 5, which specifically explores the integration of multi-sensory imagery techniques in promoting physical activity, it becomes evident that a more holistic approach is needed. The limitations of traditional methods like goal setting and the challenges of sustaining motivation over time call for innovative strategies. Multi-sensory imagery emerges as a promising complement to MI, or more likely the extension and improvement of the little imagery already applied in MI, offering individuals a tool to vividly imagine both the benefits of change and the consequences of inaction. This technique can make the abstract concept of behaviour change more concrete and tangible, potentially enhancing the effectiveness of MI.

5. Imagery interventions in sports and exercise

"Imagination is the beginning of creation. You imagine what you desire, you will what you imagine, and at last, you create what you will." – George Bernard Shaw

As discussed in chapter 2, Brand and Cheval (2019) reported that all physical activity models across different classifications had one shared, underlying component – imagining the end goal and the motivation associated with it. Therefore, through this chapter I will explore and evaluate imagery, its common use in sports and exercise and identify methods, which I can apply further in the later experiments. Mental imagery is commonly referred to as the use of words and pictures in books, films, paintings to describe the ideas or situations (Cambridge Dictionary). Psychologists (Chan & Cameron, 2012) explain imagery in the form of mental images, which are cognitive constructs of hypothetical events or reconstructions of past ones. Imagery is further defined as the "cognitive generation of sensory input … recalled from experience or self-generated in a non-experienced form" (APA dictionary). Therefore, throughout this thesis, visualisation or visual imagery will only be used in reference to evidence using the visual modality of imagery only. Due to the range of definitions, I propose the following definition: Imagery is a conscious, mental action of generating or recalling multi-sensory scenarios from either first- or third-person perspective', to be applied throughout this thesis.

5.1. Guided Imagery

Guided imagery involves quasi-perceptual visualisation of specific mental images by evoking multi-sensory, perceptual and memorial information (Morris et al, 2005 as cited in Giacobbi et al., 2016), which closely resembles the actual perception of some scene, event, or object, but with a complete lack of any external stimuli (Giacobbi et al., 2018). Furthermore, visualisation is a commonly used term to describe imagery ('the act of visualizing something or someone (= forming a picture of it in your mind)' Cambridge Dictionary); however, it refers almost explicitly to visual imagery. Therefore, throughout this thesis, it will be used in reference to visual imagery only. Cumming and Ramsey (2008) also added that imagery involves a combination of different modalities with the absence of the actual perception. It is also important to highlight the importance of consciousness in and awareness during generating imagery as the distinction from dreaming (White & Hardy, 1998).

5.2. Generating Imagery

The very first study, investigating the level of vivid imagery in a well-powered sample of hundred men, measured the ability to imagine their breakfast in two groups: scientists and non-scientists (Galton, 1880; Brewer & Schommer-Aikins, 2006). Scientists displayed a complete lack of, or very feeble, mental imagery, in this comparison. However, scientists' abilities to the side, it is the very first mention of measuring imagery ability in a controlled environment. Shortly after, James (1890, as cited by Wakefield et al., 2013) concluded that 'sensation and imagination are due to the activity of the same centres of the cortex' therefore was first to propose that imagination and sensation share the same centres in the brain.

Shepard (1978) suggested that the generation of mental images involves similar internal structures as those used in perception. The research (Kosslyn, 1975) was predominantly based on the easiness of noticing characteristics on large or small maps in one's mind. This is known as the structural theory of imagery, which proposes that the same structures used in perception are used to generate mental images. Kosslyn et al. (1999) summarized the existing evidence that mental imagery and perception utilize the same two pathways, ventral and dorsal. Furthermore, deficits in one of the pathways often lead to parallel deficits in both perception and imagery, with minor exceptions. Additionally, auditory and motor imagery also activate cortical areas involved in auditory perception and motor control, respectively. The study also found that early visual cortex areas can be activated during some types of mental imagery. Furthermore, imagery of emotional events can cause physiological changes, such as activating the autonomic nervous system and amygdala.

Finke (1980) built on this evidence suggesting that mental images are being ‘functionally equivalent’ to physical objects or events. Finke (1989) conducted further investigation of the imagery used for creating new objects and mental interpretation. This resulted in the five principles of mental imagery. It is important to notice that four out of five are based on the assumption of ‘equivalence’: Implicit Encoding, Perceptual Equivalence, Spatial Equivalence, Transformational Equivalence, and Structural Equivalence. The concept of the Functional Equivalence Theory (TEF) proposes that generating imagery is not as simple as accessing stored representations in the memory, but instead engaging in a process of perceptual simulation that activates the same neural structures involved in actual perception. TEF has also been supported by neuroimaging evidence of imagery sharing some neural pathways and mechanisms with perception (Farah, 1984; Kosslyn, 1994) and motor movements (Decety & Ingvar, 1990; Jeannerod, 1994, 2001).

Jeannerod (2001) proposes that imagery matches not only the neural pathways of the perception, but also of the behavioural, motor movements. Ehrsson et al. (2003) found that imagery of specific body parts leads to activation of the corresponding motor representations in the brain through the imagery of voluntary movement of fingers, toes, and tongue activating those specific motor representations. Munzert et al. (2009) reported an activation of primary motor cortex during motor imagery, providing evidence for the involvement of motor areas in the brain during imagery. Additionally, the consistency of mental imagery practice has been argued to play an important role in maintaining behavioural performance over time (Driskell et al., 1994 as cited by Conroy & Hagger, 2018). This suggests that mental imagery is not just a cognitive process, but it also involves a neural basis for mental imagery effects. This supports the idea that the same brain areas involved in the unconscious planning and execution of movements are activated when we consciously internally represent an action through imagery (Lotze & Halsband, 2006). Importantly, mental imagery shares neural and behavioural similarities to actual movement execution, making it an effective tool for motor learning and performance enhancement.

Mental imagery involves the creation of vivid sensory experiences in the absence of external stimuli, and it has been shown to activate brain areas involved in both motor control and perception. The functional equivalence theory posits that mental representations of actions are functionally equivalent to the corresponding physical actions, and this theory has been challenged by research showing that the effects of mental imagery on behaviour are more likely due to a behavioural matching process between imagery and action. Overall, mental imagery has been found to have positive effects on various aspects of behaviour, including motor performance, emotional regulation, and goal-directed behaviours.

5.3. Lang's (1979) Bio-informational model

The bio-informational model proposed by Lang (1979) suggests that mental imagery, emotional memory, and physiological responses are interrelated and work reciprocally. According to this model, when a person engages in mental imagery, it activates the same neural and physiological pathways that are involved in actual experience. In turn, this activation of the physiological pathways associated with emotional experience leads to the reactivation of emotional memories. The model suggests that the more vivid and emotionally engaging an image is, the more likely it is to activate emotional memories and physiological responses that are associated with that experience. This means that mental imagery has the potential to reinforce emotional memories and physiological responses and, over time, create stronger reciprocal relationships between them. This model has been used to explain a wide range of emotional and physiological phenomena, such as anxiety, phobias, and post-traumatic stress disorder.

5.4. Prospective imagery

Evidence from the effectiveness of mental imagery behavioural outcomes has highlighted the role of mental imagery in facilitating effective behavioural regulation by strengthening links between thought and goal-directed action (Pham & Taylor, 1999 as cited by Conroy & Hagger, 2018). Renner et al. (2019) summarised mental imagery as a crucial aspect of the 'prospective brain', a functional network that allows us to anticipate and plan for the future (Moulton & Kosslyn, 2009; Schacter et al., 2008). The concept of the 'prospective brain' refers to a functional network in the brain that enables us to anticipate and plan; this ability relies heavily on mental imagery, which allows us to simulate possible future scenarios. Such mental images can evoke strong emotional and neurophysiological reactions, as observed in studies by Ji et al., (2016). Additionally, when we simulate future events through imagery, we can impact subjective probability ratings of these events occurring, as demonstrated by Raune et al. (2005). These features of mental imagery can have an impact on the motivational aspects of future behaviours, such as the anticipated reward and pleasure associated with simulating engagement in positive future events. Anticipated emotions can, in turn, drive decision-making (Lerner et al, 2015) and goal-directed behaviours (Lazarus, 1991; Bagozzi, et al, 2000; Zinchenko et al, 2015). The prospective brain and mental imagery, therefore, play crucial roles in shaping our motivation and behaviour, providing a valuable tool for personal development and goal achievement.

5.5. The effects of imagery

A recent meta-analysis (Conroy & Hagger, 2018) identified a number of imagery effects such as post-imagery behaviours, intentions, perceived control, attitude and physiological measures. But on the other hand, it also raised a debate about which factors or processes account for imagery effects. They proposed that applying imagery may facilitate behaviour change via non-conscious channels, bypassing volitional factors linked to behaviour change (Chen & Chaiken, 1999). This explanation is in line with the behavioural impact of imagery discussed earlier.

Additionally, the effects of imagery are also consistent with dual process accounts of action (Hagger et al., 2017; Strack & Deutsch, 2004). Dual process accounts propose that there are two different cognitive processes involved in action and imagery, namely associative and propositional processes. The associative process is characterized by a direct and automatic link between perceptual and motor representations in the brain. It is activated during actual physical movement and during imagery, and it involves the simulation of perceptual and motor representations. On the other hand, the propositional process involves the use of abstract symbols, rules and strategies to plan and execute movements, as well as imagine them. Dual process accounts suggest that during action, both the associative and propositional processes are activated, with the associative process being dominant. During imagery, however, the propositional process is dominant, and the associative process is less activated. This means that while imagery can produce similar motor and perceptual representations as actual physical movement, the propositional process also allows for cognitive control, the ability to manipulate and change the content of the imagery. Conroy and Hagger (2018, p. 19) concluded that "imagery interventions may help modify habits which obstruct health-related behaviour change (e.g., setting time in advance for daily physical activity) and by making health-promoting prompts salient and accessible (e.g., recalling benefits of not smoking when considering buying cigarettes)."

5.6. Practical application of imagery

The major contribution to the application of mental imagery comes from the last four decades of research conducted in sporting environments. The use of imagery as one of the methods became widely available and reported, especially in sports psychology research and practice. Orlick & Partington (1988) found that 99% of the Canadian Olympic team used imagery; therefore, sports was a natural resource for investigating imagery. Athletes tend to use imagery at every stage of training and competition environments for a range of various activities, such as skills and performance practice, cognitive manipulation and rehabilitation (Martin et al., 1999; Dredigier et al., 2006). Furthermore, mental imagery is not just a natural phenomenon, but observers (Hall & Rodgers, 1989) reported that coaches in fact often actively encourage athletes to use imagery to help facilitate the improvement and learning of skills. The value of mental imagery as a performance enhancing technique became well recognized by athletes, coaches, and sport psychologists (Martin & Hall, 1995) and the use and benefits of imagery are frequently reported (e.g., Gregg et al., 2005; Nordin & Cumming, 2008). Morris et al. (2005, p. 1) claimed that "almost all elite athletes use imagery and that most sport psychologists apply imagery in working with athletes". Furthermore, the amount and level of imagery increases with sports level and athlete's experience (Barr & Hall, 1992; Cumming & Hall, 2002; Hall et al., 1998; Salmon et al., 1994 as cited in Cumming & Ramsey, 2009).

5.6.1. Motivational effects of imagery

Throughout his work with athletes, Paivio (1985; as cited by Cummings & Ramsey, 2009) noticed that imagery not only serves the cognitive purposes of learning skills, but also had a large motivational impact on athletes; these functions being relatively independent. This was the first report of imagery being used for motivational purposes and its possible effect. Hall (1998) further divided the motivational purpose, suggested by Paivio, into three domains: motivational specific; motivational general arousal; and motivational general mastery; with each of these serving different purpose for the athlete.

Motivational reasons for athletes to use imagery were enhancing motivation, changing thoughts and emotions and regulating physiological responses (Munroe et al., 2000). As examples: motivational specific function is focused on understanding what it takes to achieve the goal, motivational general arousal function relates to regulating emotions and activation levels, and motivational general mastery function is mostly related to the mental composure and toughness. Further research (Martin et al., 1999 as cited in Cummings & Ramsey, 2009) also supported motivational general arousal imagery as being focused on necessary information about the physiological and emotional response of the performer in order to stimulate the activation. Lang (1977, 1979) proposed this ‘response proposition’ as the behaviours and the subsequent feedback that the individuals experience. Bandura and Walters’s (1977) self-efficacy theory provides further explanation for motivational imagery, which may fulfil a source of self-efficacy called ‘physiological and affective states’ via the activation levels. If there is a discrepancy between activation level and outcome, self-efficacy may decrease. In summary, it is possible to observe the multi-level motivational nature of imagery use in sports environment.

In a tribute to Lang’s work, Ji et al. (2016) discussed the use of mental imagery as a powerful tool for emotional simulation of reality. They highlighted the historical development of imagery use in behaviour therapy, where cognitive techniques proved to be more effective than pharmacology in treating disorders such as OCD and PTSD. In this context, imagery was employed as a desensitization, flooding, and exposure therapy modality. They also emphasized the importance of both stimulus and response in imagery training, where verbal comments and responses were considered equally important as the stimuli used. Finally, the authors pointed out that the vividness and controllability of mental imagery are crucial factors in determining its effectiveness in behavioural outcomes.

As the concept of applied motivational imagery and specific empirical research (Martin et al., 1999) has been discussed, Martin's applied imagery model being the first model of applied imagery for athletes is an important milestone in imagery development. They proposed a four-element model: imagery situation/environment (e.g. game, off-pitch), imagery function (as one of the five types according to Paivio, 1985; Hall et al., 1998; Martin et al, 1999), imagery ability and the desired outcome. The situation dictates the imagery function, and then this function leads to the desired outcome with the latter causation being moderated by the imagery ability. The crucial element in Martin et al.'s (1999) model was indeed imagery ability being a critical variable that could moderate the use of imagery by athletes, and that the beneficial effects of imagery rely on one's ability to imagine, rather than solely on the imagery type or situation.

5.6.2. The role of the imagery ability

Researchers (Williams et al., 2015; Guarnera et al., 2016; Cumming & Eaves, 2018) encourage a use of different measures in the assessment of imagery ability, such as vividness and controllability. Vividness can be assessed indirectly via self-report questionnaires that gauge the subjective perception of the quality of static and dynamic images, while controllability can be measured through objective criteria such as mental rotation and spatial transformation of the imagined objects (Roberts et al., 2008). The use of these measures has been explored in various experimental paradigms, and the results suggest that imagery plays an important role in solving spatial tasks (Hall et al., 1985). However, individuals may display high abilities in one type of imagery task and less or no ability in others. Image vividness depends on the sensory modalities of the stimulus being imaged, capacity of cognitive processes, and individual differences (Bywaters et al., 2004). Controllability depends on differences in cognitive demands and neural pathways recruited (Carroll, 1993; Pearson et al., 2013; Castellanoet al., 2015). Assessing an individual’s imagery ability is crucial in applying imagery effectively. Moreover, understanding individual differences in imagery ability can help identify potential barriers to the effectiveness of imagery-based interventions and guide the development of strategies to overcome these barriers (Williams et al., 2015). Individual differences have the potential to impact the effectiveness of imagery-based interventions, which is a concept worth exploring.

The claim of Martin et al.’s (1999) model was that indeed imagery ability is a critical variable that moderates the use of imagery and therefore its effects as measured by the outcomes. However, a full moderation effect of imagery ability has been questioned in reference to empirical evidence (Nordin & Cumming, 2008; Gregg et al. 2005) and scientific methodology (Baron & Kenny, 1986 as cited in Koehn et al. 2016). The additional factor has been years of experience, as reported above - more experience means more imagery practice and therefore higher ability to use imagery (Gregg et al., 2005). In contrast, other empirical research (Williams & Cumming, 2012) has provided evidence for full mediation model of imagery ability between skills imagery and performance, which lead to the conclusion that perhaps motivation imagery is represented by a full mediation effect, where cognitive (e.g. motor) imagery only revealed a partial one (Koehn et al. 2016). In other words, the type of imagery used (motivational imagery of the outcome or motor imagery for performance) can influence whether the imagery ability is a full or partial mediator. However as the complexity of the models above only increases with that debate, more research is required.

The debate above has been a part of a larger discussion in sports psychology field about the relationship of various constructs, such as imagery type, imagery ability, imagery effectiveness, or imagery function (Callow & Hardy 2001; Hall et al., 1998; Martin et al., 1999; Murphy et al., 2008). Cummings and Williams (2013) reviewed Martin's original model of applied imagery in sports and designed a revised one of deliberate imagery use. Evaluation includes the first steps of the model of Situation and Individual, which both contribute to determine the Function of imagery and then later the Type. The model of deliberate imagery incorporates evidence that imagery content can serve different or multiple function (e.g., Bernier & Fournier, 2010; Evans, et al., 2004; MacIntyre & Moran, 2010; Murphy, et al., 2008; Nordin & Cumming, 2005a, 2008).

Furthermore, Personal Meaning also acts as a bridge between function and type of imagery. Aligned with the previous debate of moderation vs mediation, Imagery ability acts as a moderator and mediator between type and outcome. The purpose of this model is to stretch the application beyond professional athletes, to dancers, rehabilitation cases and exercises, in order to directly impact the affective, behavioural, and cognitive outcomes achieved through imaging. The foundations and mechanisms of this model are important to be further tested, such as the role of personal meaning in imagery effectiveness. Finally, the complete lack of imagery ability, or severe lack of one or more senses, should be explored as possible evidence in this debate and Martin's model and later adaptations.

5.6.3. Interventions testing the role of imagery

Evans et al. (2004) suggest that imagery interventions have the potential to be effective with athletes: an individualized imagery intervention in elite rugby resulted in increasing participants' ability (clearer and more structured ability), emotional control (anxiety and confidence) and motivation. Imagery interventions can improve penalty kick performance and vividness of imagery, in comparison to a practice-only control (Rhodes et al., 2020). Simonsmeier et al. (2021) has recently summarized the evidence from fifty-five studies using imagery in a sports context in a meta-analysis. The overall effect of imagery interventions was medium (d = 0.43), which according to Cohen's benchmarks (1988) indicates moderate strength of the imagery on measured outcomes as a magnitude of difference between the conditions. Interventions based on imagery enhanced motor performance, motivational outcomes, and affective outcomes.

In line with the role of imagery ability explained before, they found that the effectiveness of imagery was related to the intensity of the imagery training; this supports the moderator role of imagery ability via mental training. This is consistent with previous literature (as cited by Cummings & Ramsey, 2009) demonstrating significant enhancement in the frequency of athletes' imagery post imagery intervention (Callow et al., 2001; Cumming et al., 2004; Cumming and Ste-Marie, 2001; Evans et al., 2004; Munroe-Chandler et al., 2005; Rodgers et al., 1991). Imagery ability itself has also been found to improve over time (Calmels et al., 2004b; Cumming and Ste-Marie, 2001; Rodgers et al., 1991) and imagery sessions found to be more systematic and detailed (Evans et al., 2004; Rodgers et al., 1991). Furthermore, the literature demonstrates that when imagery is experienced with all the senses, there is a greater improvement in performance, regardless of external distractions (Holmes & Collins, 2001; Callow et al., 2006; Guillot et al., 2005 as cited in Morone et al. 2022).

In summary of sports-based research, Cummings and Williams (2012) proposed imagery as a mental technique that can be refined with practice and utilized in many ways. It is a well-known performance-enhancing strategy and extensively used in applied fields, particularly sport, dance, and exercise psychology (for a review, see Cumming & Ramsey, 2009; Murphy et al., 2008; Weinberg, 2008). Similarly, the British Psychological Society hosts a division of sport and exercise psychology due to similarities and overlap in work and techniques between sports and exercises. One of the needs of creating revised models of deliberate imagery (Cummings & Williams, 2013) was to apply imagery to the wider population including regular, non-athlete exercisers. This is also where imagery can be and has been applied as a psychological method or tool.

Early studies (Martin & Hall, 1995) have pointed towards the use of imagery for intrinsic motivation and for higher goals being set. Most studies described above were conducted in the entirely sports performance environment. However, some also reported a gap in research of imagery use where motivational support for general population was also suggested (Hausenblaus et al., 1999). Hall (1995) opened the field of imagery for general population of exercisers and was the first to propose that they may use imagery as a powerful motivator in exercise as in sport. He argued that regular exercisers may imagine themselves participating in exercise, enjoying their workouts, and achieving their desired exercise goals. This led development of research into imagery in exercisers; Hausenblaus (1999) recruited 144 volunteer aerobic exercisers: the majority of the participants reported using exercise imagery (75.7%). Furthermore, they designed and tested a scale to measure imagery by retaining three factors of imagery as a scale construction: Energy (e.g., “When I imagine exercising, it relieves my stress”), Appearance (e.g., “I imagine losing weight by exercising”) and Technique (e.g., “I imagine doing the patterns/steps”). The three factors illustrated and provided the tools to test the multidimensional use of imagery by exercisers. Furthermore, Cooke et al. (2019) identified that exercise imagery can be used to improve exercise role identity, which serves as an important construct in the promotion of exercise adherence (Strachan et al., 2013); this evidence contributes to the self-determination theory discussed earlier.

In comparison to a medium-sized effect of imagery on sports performance, imagery application for health-based behaviours has resulted in a range of effect sizes from large (Andrade et al., 2016; Razon, 2012), through small (Conroy et al., 2015; Knäuper et al., 2011) to anecdotal (Adams et al., 2015; Hagger et al., 2012a) effects. The most recent meta-analysis (Conroy & Hagger, 2018) revealed small effects sizes of imagery on psychological outcomes and larger ones for behavioural and physiological outcomes. A recent study on facilitating engagement in activities as a part of depression treatment (Renner et al., 2019) called imagery the motivational amplifier for the desired behaviour. Issues with imagery interventions were proposed by Callow and Hardy (2005) as concerns about confounding variables (e.g. imagery ability), flawed research designs (e.g. lack of manipulation checks), lack of empirically tested theories underpinning the intervention and not differentiating between functions of imagery.

5.7. Imagery with PETTLEP

The development of different imagery techniques has brought additional evidence towards these mechanisms between behaviour and perception and is based on the idea that there is a functional equivalence between motor imagery and actual motor performance (Holmes & Collins, 2001). PETTLEP (Holmes & Collins, 2001) includes seven elements of imagery: Physical, Environment, Task, Timing, Learning, Emotion, and Perspective, and this is where it receives its name from. Scott et al. (2022) reviewed the existing two decades of evidence and concluded that PETTLEP does indeed improve sports performance and provides more control over the imagery experience. Interestingly, Wakefield et al. (2013) identified that the effectiveness of PETTLEP mechanisms relies on the similarity between the experience or feeling of imagery and the actual action, rather than a hypothetical relationship between different psychological processes at the representational level. This behavioural matching is believed to be the underlying mechanism for PETTLEP effects. This proposes that the brain uses similar neural processes and pathways when performing a physical movement as when mentally rehearsing that same movement. As a result, mental imagery can help enhance motor performance by strengthening neural connections and improving motor planning and coordination (Munzert et al., 2009). Research suggests that personalised imagery interventions are more effective than generic ones in producing a closer behavioural match between imagery and action.

While PETTLEP was initially developed as an imagery intervention to improve sports performance, its principles have been applied to other areas of psychological work, such as rehabilitation of neurological injuries and re-learning the motor imagery (Sun et al., 2016; Bek et al., 2021). Furthermore, Pearson et al. (2015) identified the pivotal role that imagery plays in many mental disorders and proposed to utilize imagery in clinical treatment. The neuro-biological mechanisms of behaviour and perception with imagery provide the proposition of how imagery can influence other aspects, rather than just the initial intention of sports performance.

The above discussion highlights the potential of imagery techniques to learn from the PETTLEP model to enhance sports performance and influence other aspects, such as rehabilitation and mental health. By understanding the neurobiological mechanisms underlying behaviour and perception with imagery, I can explore the broader applications of imagery interventions beyond their initial intention.

5.8. Functional Imagery Training

Motivation is a complex cognitive state that involves various factors such as personal meaning and emotional arousal. Imagery has been shown to be an effective tool in regulating motivation, especially in addiction and goal pursuit. The Elaborated Intrusion Theory of Desire by Kavanagh et al. (2005) suggests that the influences of substance-related mental imagery can trigger and maintain addictive processes. And vice versa, imagery of the substance absence and the benefits of that can help to promote positive control of the substance use (May, et al, 2015). In other words, if the goal is to reduce substance use, the imagery of that future can have beneficial impact. In relation to the goals, the use of mental imagery in goal pursuit has also been studied extensively – Schultheiss and Brunstein (1999) found that using goal imagery exercises helped align individuals' implicit motives (like the need for power and affiliation) with their commitment to explicit goals and their performance in achieving those goals. Without goal imagery, implicit motives and explicit goals were not as strongly connected. Furthermore, mental contrasting, a metacognitive strategy, has been found to be a cost-effective way to regulate goal pursuits autonomously (Oettingen, 2012). It helps individuals identify what they want and commit to pursuing their priorities while constructively dealing with setbacks (Oettingen & Reininger, 2016).

Functional imagery training (FIT) combines several elements of existing evidence, including goal setting, multi-sensory guided imagery, mental contrasting, and motivational interviewing. FIT has been found to be more effective than MI alone in various domains, such as smoking cessation and weight loss (Andrade et al., 2016; Solbrig et al., 2018). FIT is grounded in cognitive and behavioural theories, including dual process accounts of action and imagery, social cognitive theory, and goal-setting theory. It works by helping individuals create multisensory representations of desired outcomes and develop flexible, adaptive action plans that are rehearsed in imagery. FIT also encourages individuals to identify and address potential obstacles and self-limiting beliefs through mental contrasting and motivational interviewing.

The different theories mentioned above can explain FIT's effectiveness in various ways. For example, the dual process accounts of action and imagery theory suggest that FIT helps individuals engage in goal-directed behaviour by strengthening the association between mental imagery and goal-directed action. Social cognitive theory emphasizes the importance of self-regulation and self-efficacy in achieving behaviour change, which FIT addresses through mental contrasting and motivational interviewing. Goal-setting theory emphasizes the importance of setting specific, challenging goals and developing action plans, which FIT supports through multisensory imagery and flexible, adaptive action plans.

In conclusion, FIT is a promising motivational intervention that combines various evidence-based techniques to enhance motivation and goal pursuit. Its theoretical background is grounded in cognitive and behavioural theories, and its effectiveness can be explained through various lenses. As all of the elements and mechanisms of FIT are effective in its own ways, the effectiveness of them combined is an unexplored aspect, such as goal-setting and change talk through the MI, mental contrasting and development of multi-sensory imagery. Future research can further explore the mechanisms of action of FIT and its application in different populations and domains.

5.9. Setting out to test these psychological techniques

In conclusion, physical activity literacy, goal setting, motivational interviewing, mental imagery, and functional imagery training are all psychological tools that have shown promise in promoting physical activity. Practical use of mental imagery, such as incorporating multi-sensory guided imagery and mental contrasting, may be particularly promising in helping individuals overcome barriers and increase motivation for physical activity. However, more research is needed for a number of reasons: (a) to test the overall effectiveness of mental imagery, (b) to improve accessibility of these evidence-based interventions, (c) to fully understand their effectiveness and how they can best be utilized in promoting physical activity behaviour change and (d) to explore the long-term effect of imagery on adherence. Functional imagery training, which combines multiple evidence-based techniques including mental imagery, goal setting, and motivational interviewing, has also shown promising results in increasing physical activity behaviour. As such, continued exploration and testing of these psychological tools is necessary to fully harness their potential in promoting physical activity and improving overall health and well-being.

Therefore, the further exploration and testing of these theories and techniques is the predominant goal of thesis. Initially, I have set out to systematically synthesise all the existing evidence of imagery on physical activity and exercise. Later I explored the link between imagery, cognition, and behaviour, with the role that imagery ability plays there. Then I tested the novel method of implementing motivational interviewing and imagery, called Functional Imagery Training, and specifically I focused on the role person-centred approach in evoking behaviour change in comparison to physical literacy condition. The key element of this application was testing the feasibility and effectiveness of applying imagery into the populations in need of motivation and adherence, such as rehabilitation and POTS patients, and with those who might not have vivid imagery ability. Finally, I explored the current knowledge and use of imagery by the professionals.

5.10. Conclusion

Concluding this chapter, I have explored the realm of mental imagery, highlighting its pivotal role in shaping behaviour and motivation, especially concerning physical activity and health-related behaviour changes. Through an extensive investigation into imagery effects, dual process accounts, and practical applications in sports psychology, I have unravelled the intricate relationship between imagery, cognition, and behaviour. The literature review has gone through the historical origins of imagery, through the sports application research and neuroscience evidence of imagery and perception sharing neuroscience pathways.

As I transition to the methodology presentation, the foundational knowledge acquired in this chapter sets the stage for the empirical research ahead. Building upon these insights, I will outline the research design, data collection methods, and analysis techniques to rigorously assess the application of Functional Imagery Training (FIT) and guided imagery in general. This methodology aims to evaluate FIT’s feasibility and effectiveness in motivating behaviour change, particularly in individuals who may not have strong imagery abilities. Supported by this theoretical framework and evidence from the literature, I am well-prepared to design and conduct empirical studies, providing valuable insights into the real-world application of imagery techniques. As I embark on the methodology phase, I do so with a solid understanding of the theoretical foundations and a dedication to advancing our understanding of imagery's role in promoting health and well-being.

6. Imagery use in motivating exercise, physical activity and weight loss: A systematic review and meta-analysis.

I progressively learned throughout the literature search and review that imagery is commonly used by professional athletes to maintain motivation and more recently is increasingly being used to encourage physical activity in the general population. The key topic of this thesis focused on answering whether imagery can be applied to the general population and if so, what factors its effectiveness can depend on. Therefore, the next step was to gather and synthesise all the evidence in the literature in a systematic and organised manner to be able to analyse the impact of the specific factors, in comparison to narrative review in the previous chapters. I focused on selecting the general population in non-sport and non-athletic environments, rather than enhancing performance and technique through imagery. Consequently, the following systematic review assesses the quantity and quality of evidence for imagery use (as a conscious action of generating or recalling multi-sensory scenarios) to enhance physical activity and exercise behaviours and further investigates the types of imagery used.

6.1. Overview

As presented in Chapter 2, the UK faces a significant challenge, with 39% of its population, or 20 million individuals, failing to meet recommended minimal physical activity levels of 30 minutes of moderate activity five times weekly (British Heart Foundation, 2017). Meanwhile, in the US, a staggering 200 million people do not meet these activity requirements, and 83 million report being entirely inactive, leaving just 5% of Americans achieving 30 minutes of daily physical activity (Centers for Disease Control and Prevention, 2022). The inactivity crisis is clear and furthermore, the physical and psychological benefits of physical activity have been presented in the previous chapters and demonstrated in literature and in media (Warburton et al., 2006; Jannsen & LeBlanc, 2010). Evidence-based interventions have an opportunity and, perhaps, an obligation, to increase physical activity through scientifically tested approaches. This is crucial in leading to the well-established physical and psychological benefits associated with PA, such as a reduced risk of type 2 diabetes, cancer, heart and liver disease, stroke and mental health conditions (Obesity Health Alliance, 2017). Addressing these health issues is of utmost importance as they contribute to significant financial costs to healthcare systems (the cost to NHS is predicted to reach £9.7 billion by 2050; Public Health England, 2017). Thus, promoting physical activity via scientific evidence in the general population has become an urgent priority and today's most pressing imperatives.

6.2. Definition of imagery for this review

As presented in the previous chapter, psychologists (Chan & Cameron, 2012) explain imagery in the form of mental images, which are cognitive constructs of hypothetical events or reconstructions of past ones. Imagery is further defined as the "cognitive generation of sensory input … recalled from experience or self-generated in a non-experienced form" (APA dictionary). Therefore, in line with this thesis, visualisation or visual imagery will only be used in reference to papers using visual modality of imagery only. Due to the range of definitions, I will use the following definition for the review and meta-analysis: 'Imagery is a conscious action of generating or recalling multi-sensory scenarios from either first or third person perspective.'

6.3. Imagery use

Morris et al. (2005) claim that "almost all elite athletes use imagery and that most sport psychologists apply imagery in working with athletes." Athletes tend to use imagery at every stage of training and competition environments for a range of various activities, such as skills and performance practice, cognitive manipulation and rehabilitation (Martin et al., 1999; Dredigier et al., 2006). Early studies (Martin & Hall, 1995) have also pointed towards the use of imagery for intrinsic motivation and for higher goals being set - all of these studies were conducted in the entirely sports performance environment. However, some also reported a gap in research of imagery use where motivational support for the general population was also suggested (Hausenblas et al., 1999). Therefore, this review is focused on the general population, rather than the sports environment.

Motivational support via imagery use might be one of the key factors in efforts to increase physical activity in general population. Based on Paivio's (1985) proposal that imagery has both cognitive and motivational functions. At the motivational level, imagery has been applied in various forms and environments. Early studies (Martin & Hall, 1995) followed Paivio's model and instructed participants to strictly imagine a specific visual stimulus from different perspectives; this mental rehearsal was believed to evoke motivation for action. Later literature focused on applying scripts of imagery scenarios, such as the visualisation of actions and including one's future self in them in aim to further improve motivation (Andersson & Moss, 2011). Visualising one's own goals and barriers as discussed in motivational interviewing sessions is another aspect of imagery use (Solbrig et al., 2018). These methods focus predominantly on participants creating their own specific, personalised scenarios. Another approach is to still rely on personally-important scenarios, but recalling memories rather than envisaging a future self – positive and negative memories served as motivational intervention (Biondolillo & Pillemer, 2015).

Overall imagery use has been applied in a number of behaviour change interventions, from reducing dangerous driving (Hamilton et al., 2019), promoting climate change behaviours (O'Neill et al., 2013) and in cognitive-behavioural therapy to promote behaviour change (CBT; Saulsman et al., 2019). Recently, imagery has been found to act as a motivational amplifier in promoting motivation and engagement for rewarding activities (Renner et al., 2019). In the domain of health and exercise, Andersson and Moss (2011) showed that imagery increased the frequency of post-intervention exercise in a general non-athletic population. This change is supported by Elaborated Intrusion Theory (May et al., 2012) as imagery of the benefits of adherence to an exercise plan create a desire to exercise.

A recent meta-analysis by Conroy & Hagger (2018) regarding imagery interventions and health-related outcomes identified low to medium, yet statistically significant, effects of imagery interventions for health behaviour, intentions and physiological outcomes, such as weight loss or BMI. They applied strict inclusion criteria, only selecting intervention studies focused on changing a health-related behaviour, therefore missing a number of papers reporting qualitative or observational studies of imagery, and also including some interventions that did not target exercise. Therefore, this review will take a scoping stance, while maintaining the systematic standards to ensure that all evidence can be presented. This means that the purpose of this systematic review is to identify, include and analyse any evidence from either interventions, observational studies (including correlational studies) or qualitative studies and present this evidence in a narrative nature. My aim is to identify the evidence of imagery use for motivating exercise behaviour and physical activity in the general population, to determine which forms of imagery are most effective, and how imagery can best be used to increase exercise. It is important to highlight here that only studies investigating the general population were included while any professionally athletic samples were not to be included. This action is crucial to limit the specific effects of athletic population (athletes' personality traits, engagement in training plans and built resilience; Rhodes et al., 2020), which may not be transferable to the general population. This will ensure this systematic review focuses on increasing exercise adherence and that the results are applicable to general population interventions.

6.4. Objectives

This systematic review of exercise-based studies and meta-analysis of interventions addressed and attempted to answer the following four questions:

(1) What is the evidence that imagery interventions help promote exercise adherence?

(2) Is imagery use effective in leading to weight loss with or without exercise/physical activity?

(3) Are there any differences in effectiveness between different imagery techniques and methods?

(4) How are interventions delivered and reported and what is the quality of those actions?

6.5. Methods

This systematic review was conducted in accordance with Cochrane (Higgins & Green, 2011) and PRISMA (Moher et al, 2015) guidelines for systematic reviews.

6.5.1. Search methods

An extensive online search for papers was conducted through several databases, available online and in paper format, including Cochrane Library CENTRAL, Web of Science, Wiley Online Library, Scopus, SAGE journals, Science Direct, PubMed and PsycINFO (up to 3rd November 2017). Key terms used for searching the relevant papers were: imagery, motivation, exercise, fitness, weight loss; combinations of these terms were applied (imagery, motivation, exercise OR imagery, motivation, fitness OR imagery, motivation, weight loss). There were no restrictions on dates or journals for the selection process. The systematic review was registered at Prospero (Ref. CRD42019125014).

As recommended by Garner et al. (2016) an update of the systematic review was performed to identify any potential papers published during the process of search and write-up (conducted on 8th January 2020). The same procedure as the previous search was followed; combinations of same key terms across 8 databases above were used to obtain papers.

6.5.2. Selection criteria

Papers from all databases were collected in reference database software, which allowed removal of any duplicates. The papers were then analysed by their title and abstract for relevance to the research questions. Any studies irrelevant to the field of imagery use, involving use of imagery for performance purposes or sports related uses were removed. The final set of papers were analysed in full-text.

6.5.3. Control criteria

To control for this method of selection criteria, 10% of papers were randomly selected from the pool of papers irrelevant to this topic and the entire papers were read in full to ensure no relevant papers have been excluded due to this method. This was conducted to ensure that the inclusion criteria were not biased or allowed any papers to be falsely excluded.

6.5.4. Contacting the corresponding authors

Corresponding authors of all selected full-text papers were contacted requesting any unpublished or recently submitted articles and manuscripts, which were relevant to the research question and this field. The motivation behind this method was to obtain a holistic image of the research addressing this particular question and field. All the papers received through this method were checked for duplicates with the selected papers and assessed for relevance. All papers were analysed according to the same methods as papers collected in the first stage.

6.5.5. Hand-search of reference lists

Cochrane (Horsley et al., 2011) identified evidence supporting checking of the reference lists alongside with recommendations for the review authors. Charrois (2015) suggested that hand-searching of reference lists should be performed in addition to database searches. All reference lists of the accepted papers were analysed for the relevance to the research questions. Those selected as possibly relevant were obtained in full-text and analysed in the same way as papers accepted in the earlier stages.

6.5.6. Data collection and analysis

Field and topic. Studies with no relation to imagery, exercise or motivation were excluded from the study. For the study to be included in this review, it had to demonstrate evidence of imagery use in exercise or in a physical activity environment.

Study design. This study aimed to gain understanding of the whole evidence available in literature with a narrative approach, in comparison to a more standard procedure of including only interventions or RCTs, therefore observational studies, interventions or qualitative studies were not excluded from this review. This approach was selected to produce as entire image of the evidence as available.

Population. Studies using athletes or sports professionals were excluded from the research; for the study to be included it had to involve the general population or at least a non-professional sample.

6.5.7. Data extraction

Information was extracted from each paper by the first author and into a form with a column for each specific piece of information. The extracted data included study characteristics (country of origin, study design, allocation method, sample size, drop-out rate), participants' characteristics (age, sex and ethnicity), outcomes (measures, key findings and the results of the statistical tests) and intervention characteristics (materials, procedures and conditions).

Effect size in interventions was calculated from pre- and post-measures of behavioural outcomes (e.g. metabolic expenditure, the duration of exercise, exercise behaviour), secondary psychological outcomes (intention to or motivation to exercise) and weight loss for both conditions. Variables have been grouped under the terms of: physical activity (metabolic expenditure, the duration of exercise, exercise behaviour), intentions (intention to exercise or planning of action), motivation (intrinsic, external or general motivation outcomes) and weight loss (waist measurement or weight in kilograms).

6.5.8. Quality assessment

Intervention studies (Cochrane). The risk of bias in the intervention studies was assessed with the Cochrane's Risk of Bias (Higgins, & Green, 2011). The tool focuses on assessment of six biases: Random sequence generation, Allocation concealment, Blinding of participants and personnel, Blinding of outcome assessment, Incomplete outcome data and Selective reporting; they were scored as low risk, high risk or unspecified if there was no mention of it in the full text.

Qualitative studies. Hannes (2011) produced an in-depth report for analysing the quality of the qualitative papers and summarised the number of materials available. Lockwood et al. (2015) produced a 10-point 'Appraisal Checklist for Qualitative Research' which was used in this study to assess the quality of the qualitative papers collected for this paper.

6.5.9. Data analysis

The mean, SD and range of each variable in the extracted data was calculated and a number of graphs were produced for visual presentation of the effect size, year of publication, sample size and effect size. No inferential statistical tests were performed on the extracted data. The data and the corresponding code are available in Chapter 6 folder via this link: https://osf.io/tbekp/?view_only=b7497391850a4f31805d4ec558c8abfd

6.5.10. Meta-analytic procedure

The pre- and post-means and standard deviation for each condition were extracted from each study for each variable of the intervention. This data was analysed using the *R* (R Core Team, 2018) *metafor* package (Viechtenbaeur, 2010) to calculate the standardised mean change (SMC; as a measure of standardised effect size), confidence intervals, risk ratios and to produce the appropriate plots. I also followed a coding schedule to group the variables (physical activity, intentions, motivation and weight loss) to present the evidence for each variable.

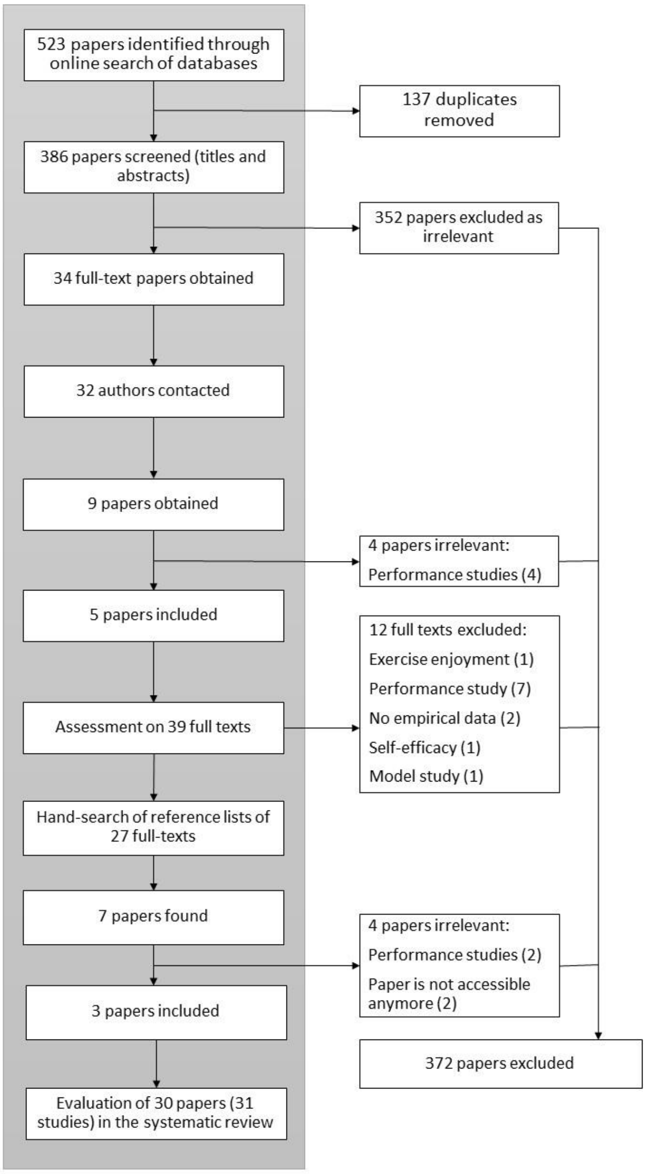
6.6. Results

All papers were analysed by the relevance criterion (subjective analysis of title and abstract) to identify whether they are relevant to the question ‘What evidence is there that supports imagery and motivation to improve adherence to exercise and/or weight loss?’

The selection process of inclusion and exclusion of papers can be seen in Figure 1; the reasons for exclusion are presented on the right hand side for each stage. 10% of the irrelevant papers (N=35) were randomly selected (randomisation software) and the entire papers were analysed to ensure the effectiveness of the selection method. All 35 papers revealed no relevance to the research question, the research topics included non-imagery interventions, physical rehabilitation, medical research, sport performance and apps. One paper included two individual studies, both relevant to the question, and both were included in this review; therefore the total number of studies was 31. Four of these studies were also included in Conroy & Hagger’s (2018) meta-analysis, while 27 are novel to this analysis.

Figure 1.

A flow chart representing the paper search, selection and exclusion process.



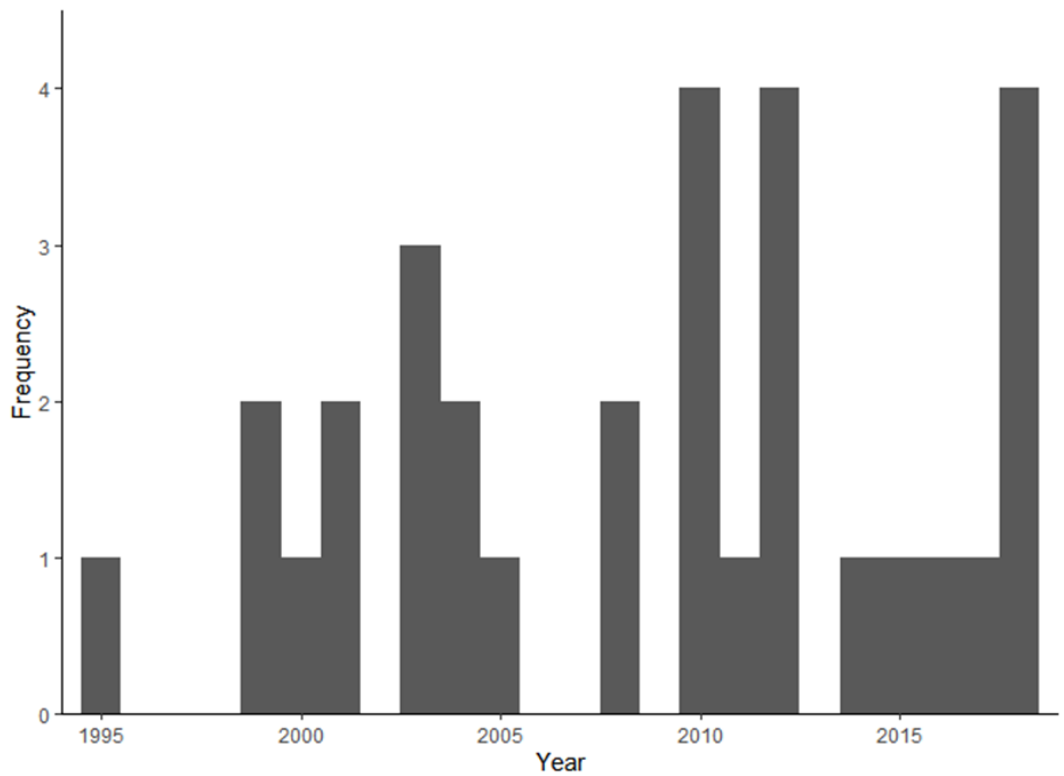
6.6.1. Characteristics of Included Studies

Types of studies. Within the 31 selected studies, 12 were intervention studies (Randomised Clinical Trials and interventions), 17 were observational studies and two were qualitative studies.

Year and country of study. No year of publication restrictions were applied. All studies selected for this analysis were published between 1997 and 2018 (Figure 2). Studies were conducted across 6 countries: Canada, Germany, United Kingdom, United States and New Zealand. One study reported no information about the country, where data collection and research were conducted.

Figure 2.

The distribution of years of publication (N=31).



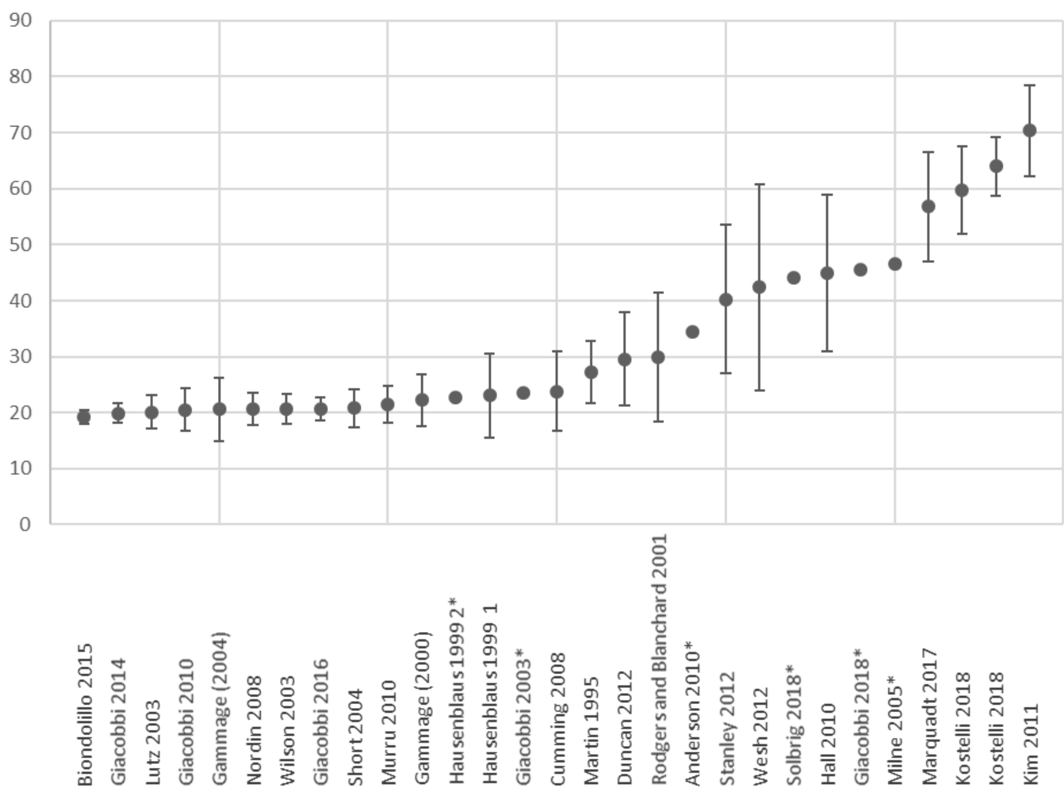
Samples. The total number of participants was 6575 (2196 males, 4377 females, 2 unknown) across all 31 studies. The majority of the studies (N=22) used predominantly more females than males. Lobato et al (2014) suggested that females are more likely to be influenced by individual decision (higher level of altruistic behaviours) and interpersonal relationships (friends, family and a researcher) to take part in the study.

Age. Figure 3 represents means and standard deviations (SDs are represented as whiskers of each mean) of sample age for each study. Most studies used relatively young samples (<30 years old), but three studies had a particularly older sample (≥60 years old) and two reported no information on the age of the participants.

Full details of each study design, characteristics and findings can be found in Appendix A.

Figure 3.

*Means and standard deviations of sample's age in each study (N=29, two studies did not report participants' mean age; *no SD reported)*



6.6.2. Interventions

Design. Seven interventions used Randomised Clinical Trail (RCT) design with the others (N=5) being a general intervention design, including one study using an intervention delivered on peer-to-peer level. There was a lack of reporting on blinding (see section on quality of reporting) in half of the studies (N=6); only one study used a single-blind design and five were not blind due to the researcher delivering the intervention. Full description of all studies can be found in Supplementary Materials Appendix A.

6.6.3. Methodological Quality

Twelve intervention studies were assessed for the methodological quality and risk of bias according to PRISMA guidelines (Table 1). Three studies presented low risk of bias with three studies presenting a high risk of bias. The remaining six studies (50%) presented a lack of particular information to assess the particular risks (Random sequence generation, Allocation concealment and Blinding of participants and personnel). No studies presented high risk of selective reporting and incomplete outcome data.

Table 1

The assessment of risk of bias in interventions studies

	Random sequence generation	Allocation concealment	Blinding of participants and personnel	Blinding of outcome assessment	Incomplete outcome data	Selective reporting
Anderson 2011	+	+	+	+	+	+
Biondolillo 2015	+	?	+	+	+	+
Chan 2012	+	?	?	+	+	+
Duncan 2012	+	+	+	+	+	+
Giaccobi 2014	?	-	-	+	+	+
Giaccobi 2016	?	-	-	+	+	+
Giaccobi 2018	+	?	-	?	+	+
Kim 2011	+	?	+	+	+	+
Marquadt	+	-	-	+	+	+
Martin 1995	?	?	+	+	+	+
Murru 2010	+	?	?	+	+	+
Solbrig 2018	+	+	+	+	+	+

+ Low risk of bias, - high risk of bias, ? unspecified

Most interventions used self-report measures so blinding of outcome assessments were all low risk of bias. In all studies participants were inevitably aware of the intervention they had allocated to receive, and in all but one the researcher delivered the intervention, and therefore was aware of the conditions. Allocation concealment was rarely reported, therefore it presents the highest risk from all six biases. Despite the low risks of biases in incomplete outcome data and selective reporting, some studies reported high drop-out and exclusion rates. Full details of bias assessment are presented in Supplementary Materials Appendix B.

6.6.4. Quality of Intervention Descriptions

Interventions studies were assessed by the quality of report. The descriptions of interventions were assessed by the adapted version of a checklist (Borek et al., 2015) on the basis of the primary report and any additional referenced descriptions; they were found to be mainly incomplete. The majority of the papers presented a certain lack of details in the report to various degrees; missing information included characteristics of the sample, randomisation method, allocation concealment, whether and how blinding was applied and details about the intervention materials and delivery.

Table 2

Observational studies reviewed (N=17) with country of data collection, research design, mean age, sex, ethnicity and number of participants at baseline.

Study	Country	Study design/ Allocation method	Mean age (SD)	Sex	Ethnicity	N at baseline and drop-out
Cumming (2008)	UK	Correlational	23.8 (7.09)	65 M, 97 F	N/S	162
Gammage (2000)	Canada	Cross-sectional (observational)	22.22 (4.54)	264 M, 312 F	N/S	577
Gammage (2004)	Canada	Cross-sectional (observational)	20.6 (5.6)	235 F	N/S	235
Giacobbi 2010	Canada and US	Correlational	20.55 (3.88)	211 M, 147 F	287 Caucasians, 24 African Americans, 21 Asian Americans, 12 Hispanics, 9 Native Americans, and 5 not reported.	358

Hall 2010	Canada	Independent sample comparison (observational)	44.88 (14.00)	218 M, 252 F	N/S	470
Hausenblas 1999 (Study 1)		Descriptive	23.08 (7.46)	11 M, 133 F	N/S	144
Hausenblas 1999 (Study 2)	Canada	Cross-sectional (observational)	22.74 (N/S)	12 M, 466 F	N/S	478
Kostelli 2018	UK	Correlational	59.73 (7.73)	168 M, 144 F	296 White, 6 Asian, 2 Mixed ethnicity, 7 chosen not to report	299 (312 Missing=9 Outliers=4)
Lutz 2003	US	Correlational	20.14 (2.94)	71 M, 70 F	N/S	141
Milne 2005	Canada	Correlational	46.63 (N/S)	147 M, 183 F	N/S	330
Nordin 2008	UK	Correlation	20.69 (2.95)	69 M, 86 F	N/S	155
Rodgers and Hall, 2001	Canada	Observation (prediction) (repeated measures within-subjects, no manipulation)	30 (11.5)	144 M, 97 F	N/S	243
Rodgers and Munroe 2001	Canada	Correlational and regression	N/S	36 M, 575 F	N/S	611 Analysed as two samples (388, 223)
Short 2004	N/S	Mixed-method–questionnaire and content analysis	20.78 (3.45)	214 M, 281 F	N/S	497
Stanley 2012	UK	Correlational	40.29 (13.29)	157 M, 193 F	N/S	350
Wesch 2012	UK and New Zealand	Prospective observational (observational)	42.41 (18.44)	57 M, 33 F	N/S	90
Wilson 2003	Canada	Cross-sectional (observational)	20.71 (2.69)	165 F	N/S	165

6.6.5. How were the included interventions designed and delivered?

Intervention content and delivery.

The majority of the studies (N=10) used a brief script design; the scripts were delivered in approximately five minutes. I conducted categorisation of the imagery techniques based on their similarities of their content:

1. Future-oriented imagery:
    - Imagery of specific future events and successful achievement of each step and reaching the final goal.
    - Imagery of events and experiences associated with the positive outcome, followed by imagery of the events and experiences associated with the obstacles.
    - Imagery of themselves in the future as either a hoped-for possible self or a feared possible self.
2. Self-related imagery:
    - Visualizations of the future self and self being strong.
    - Imagery of having exercise identity consistently.
3. Past-oriented imagery:
    - Imagery of specific positive or negative experiences from the past.
4. Becoming active imagery:
    - Imagery of being active, becoming an active person, engaging in the steps of becoming active, and a combination of these.
5. Specific exercise imagery:
    - Imagery of cardiovascular exercise.
    - Imagery of simple chores (preparation) and walking in different environments.
    - Imagery of self-selected cardiovascular exercise using a multi-sensory approach.
6. Action-specific imagery:
    - Imagery of a specific action related to physical activity.
7. Food-craving and exercise imagery:

- Imagery of cravings and specific foods, followed by imagery of the full exercise - from warm-up to doing the exercise to cool-down.

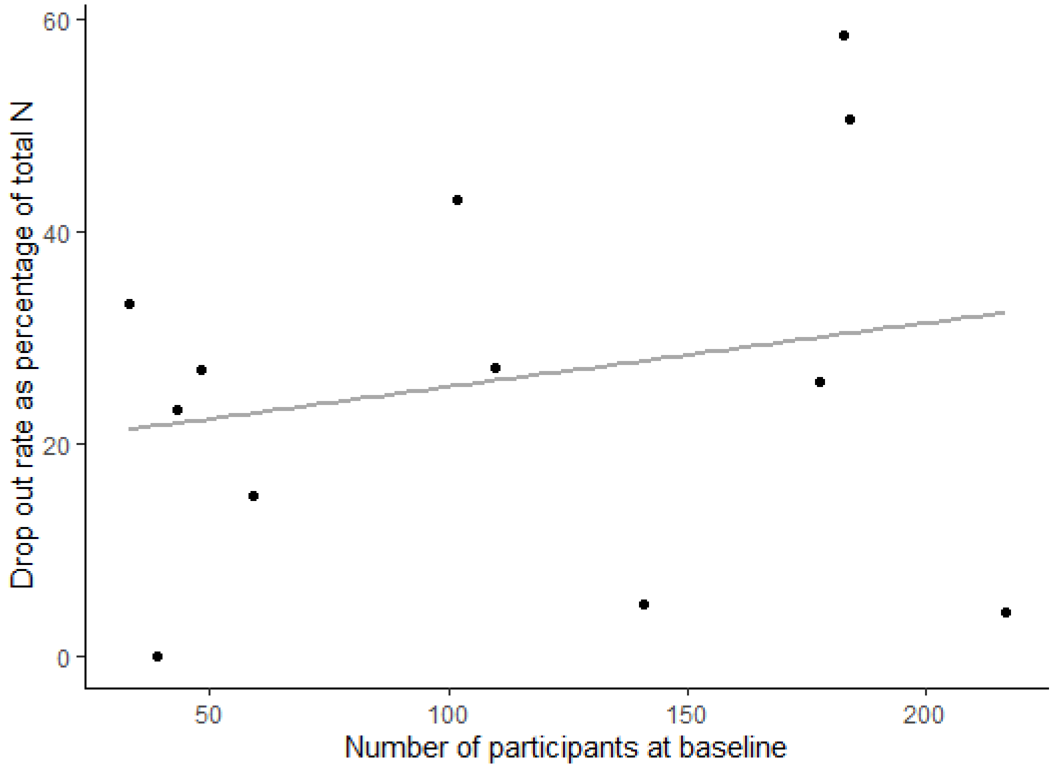
In format of the delivery, one study (8) used a CD with 14 tracks (one for introduction, two with relaxation instructions and 11 with imagery intervention). Most studies delivered the imagery content on individual basis, rather than group-based design, either via face-to-face, paper materials or audio-only delivery. One study (6) analysed the difference between face-to-face and telephone-based delivery (there was no difference between the methods of delivery). Four interventions did not use a control condition (three studies used more than one imagery condition for comparison purpose and one study used a repeated measures design with no control).

Measures. Physical activity and exercise behaviour was assessed via numerous measures. The aspects of motivation, exercise and physical activity measured in the interventions included physical activity, Leisure Time Exercise Questionnaire (LTEQ), minutes of exercise, energy expenditure (MET), exercise intention, action planning, Exercise Motivation Scale (EMS), intrinsic motivation and obligatory exercises. The impact of imagery on weight loss was only analysed and discussed in a small number of studies; two RCTs (Marquadt et al., 2017; Solbrig et al., 2018) reported a weight loss of 2.15kg over 50 weeks and 6.44kg over 12 months, respectively. Two further studies reported taking measurements of weight and calculations of BMI, however one (Giacobbi et al., 2016) reported no change in BMI over the time and other (Giacobbi et al., 2014) reported no analysis of weight change.

Participants, recruitment and drop out. The sample sizes varied among the studies from N=33 split between two conditions to N=107. The drop-out rate varied greatly between the studies, from 0 (no drop out reported) to 59% (M=26.3%, SD=18.38). The relationship is shown in Figure 4. The correlation between sample size and percentage of drop-out rare is moderate and non-significant (r=0.22, p= 0.49, n=12).

Figure 4

The total number of participants and drop-out rate in percentage with a linear trend line ($y = 0.1055x + 18.86$, $R^2 = 0.1197$).



6.6.6. Key findings

Key findings from a majority of the studies (N=9; 1-3, 5-10) suggest that imagery improves physical activity over a period of time (ranging from 4 to 8 weeks). In particular guided imagery and approach imagery had the strongest results when compared to other imagery techniques or control group. One RCT reported a significant effect of guided imagery on weight loss over 6 and 12 months (12). Two studies reported no significant difference between imagery group and control in physical activity (4, 11) at 4 and 8 weeks. One study has also shown that controlling for imagery ability does not affect the size of the effect, therefore individual's ability to imagine should not be a barrier in imagery-based interventions or programs.

6.6.7. Analysis of effect size (meta-analysis)

Means and standard deviations for pre- and post-measures for each condition were used to calculate the effect size for each condition and final effect between these two conditions. One study (Giacobbi et al., 2018) was excluded as it offered the same treatment either face-to-face or over the phone; therefore no effect for the treatment could be analysed or calculated, only the delivery platform of the same method was manipulated. The data from weight loss studies have been inputted in reverse (according to Cochrane's guidelines) to show the effect of weight loss, rather than a gain.

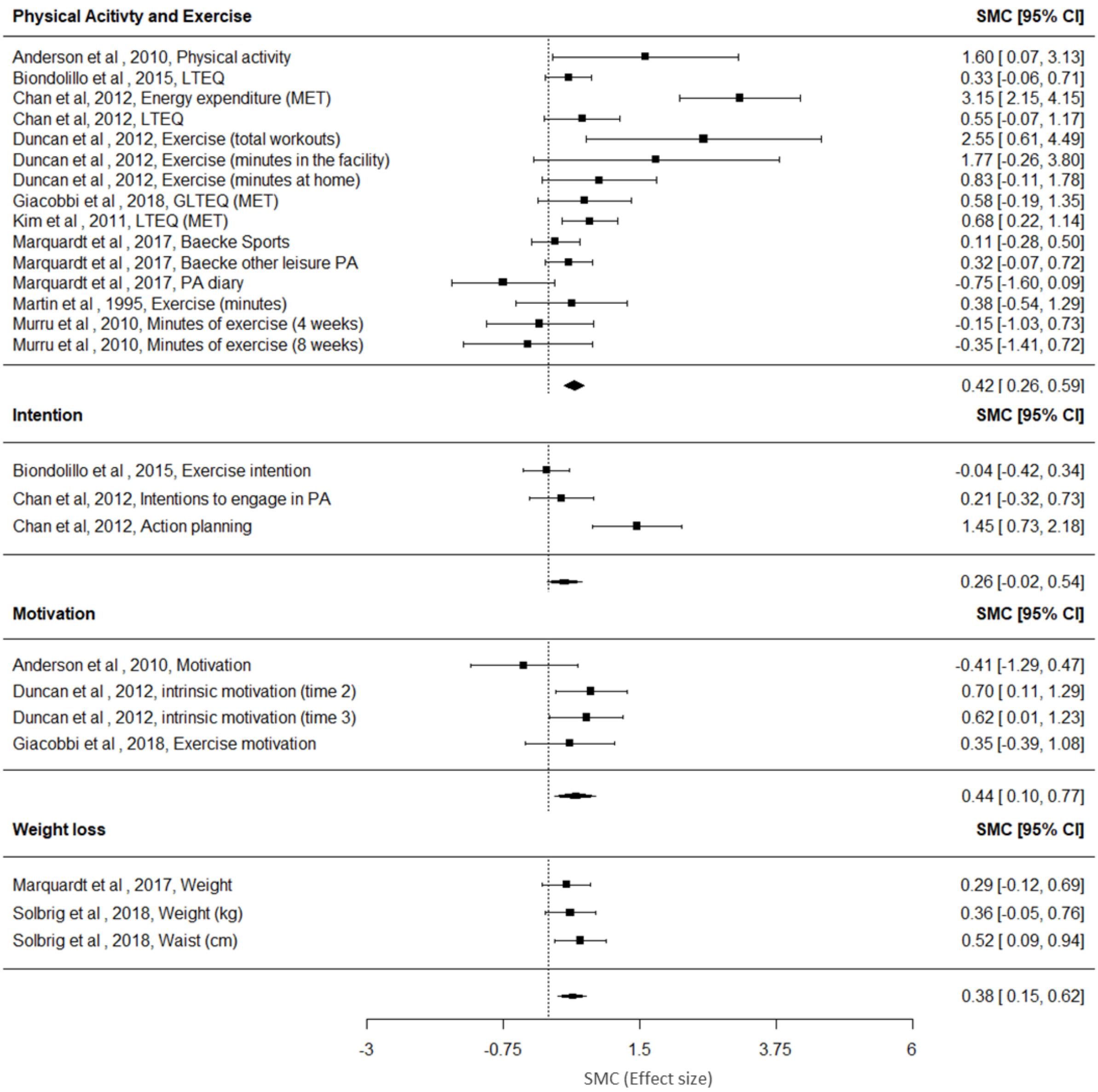
Figure 5 demonstrates the distribution of the effect sizes for all grouped factors in all studies. The overall averaged mean changes vary from 0.26 to 0.42. The factor of physical activity and exercise has the largest variance of the standardised effect sizes from very large (SMC = 3.15; Chan & Cameron, 2012) to negative effects (SMC = -0.75; Marquardt et al, 2017). In comparison, all three other factors represent more concise (less spread) effect sizes, however similar overall sizes.

The analysis revealed medium overall averaged effect sizes of imagery interventions on post-intervention physical activity and exercise behaviours (d = 0.42, 95% CI [0.26, 0.59]). Furthermore, analysis revealed small overall averaged effect sizes of imagery interventions on post-intervention intentions (intention to exercise and planning action) (d = 0.26, 95% CI [-0.02, 0.54]). There was a medium overall averaged effect sizes of imagery interventions on post-intervention motivation (intrinsic, exercise-related and general) (d = 0.44, 95% CI [0.10, 0.77]). Similar to physical activity, motivation displayed some distribution of effects sizes; including Anderson et al (2010) reporting negative effects.

Figure 5

The forest plot for Physical Activity and Exercise measures

SMC = Standardised Mean Change, CI = Confidence intervals, PA = physical activity, G/LTEQ = Godin Leisure-Time Exercise Questionnaire, MET = Metabolic Equivalent of Task.



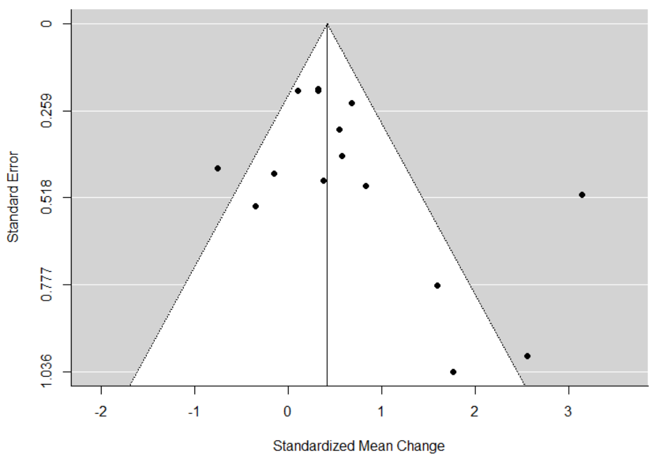
Data extracted for the weight loss trials has been reversed to show the effect of decrease ('loss') of this variable, rather than the increase over time. The analysis revealed medium overall averaged effect sizes of imagery interventions on post-intervention weight loss (d = 0.38, 95% CI [0.15, 0.62]).

6.6.8. Publication and small study size biases (PA and exercise)

Figure 6 shows an uneven distribution of effect size against study standard error (Egger's z = 2.87, p < .01). Funnel plots containing the data from several studies are expected to be symmetrical around the mean effect size when there is no bias in publication. Therefore, an asymmetrical plot such as this would suggest a biased study sample (Egger et al., 1997; Dubben & Beck-Bornholdt, 2005), with negative effects not being published. This becomes more visible when focused on the lack of studies in the bottom left corner indicating a lack of published papers with no effects, but two studies reported to the very right expressing high mean change. According to Sterne et al (2011), "heterogeneity, reporting bias, and chance may all lead to asymmetry" in the funnel plot.

Figure 6

Asymmetrical distribution of the effect size (eta squared) against the study standard error in the intervention studies (N=15) displays a possible selective reporting or publication bias.



6.6.9. Observational studies

The second category of papers reviewed were observational studies; a lack of experimental manipulation was the difference between interventions and observational studies. Seventeen such studies have been identified through this search.

Design. Almost half of the studies used a correlational analysis design (N=8, 47%). There were four cross-sectional studies (24%), two descriptive studies (12%), one prospective observational design, one predictive (regression) study and one independent sample comparison study. The key defining difference between the studies above and intervention studies in the previous section is a lack of any experimental manipulation. All details can be found in Table 2.

Measures. Most of the studies used self-report scales to measure specific imagery types based on their purpose (appearance, health and energy) and measures of exercise behaviours, such as leisure-time exercise behaviour, positive affect of exercise, time spent practicing, motivation, intention to exercise and rehabilitation adherence. One study used obligatory exercise measure.

Participants. There were a total of 5027 participants (1448 males, 3575 females, 4 unknown) across 17 observational studies. The samples were reasonably young (M_{AGE} = 29.2) with the lowest average age of 20.1 and highest of 59.7 (one study did not report the participants' mean age). Overall, the majority of the studies (N=15) failed to specify the sample characteristics beyond age and sex.

Quality assessment. All observational studies included reasonably large sample sizes (mean sample size = 296), therefore the statistical tests such as Pearson's correlation were well powered. In terms of the design quality, Hammer et al., (2009) proposed criteria for avoiding pitfalls on observational studies: using a sample representative of the target population; checking for and reporting of potential measurement error; avoidance of confounding factors; and high quality data collection. On these criteria, the main weakness of these studies is their tendency to focus on the younger half of the population, with sample means of all but two studies being below 45 years, and the use of self-reported data for the amount of exercise.

6.6.10. Key findings

There is consistent evidence across a number of studies suggesting that those who engage in exercise regularly use imagery (energy, appearance and technique) more frequently than low frequent exercisers, with appearance imagery being the most common one. There are moderate correlations between imagery use (and different imagery factors) and various variables such as leisure-time exercise behaviour, physical activity, motivation and rehabilitation adherence. One study (Stanley et al., 2012) reported that 13.8% of the variance in self-reported exercise behaviour responses was explained by the set of predictors (energy imagery, autonomous motivation and intention to exercise).

On the other hand, it is important to notice that in a number of studies imagery contributed to the prediction of behavioural intention but not exercise behaviour itself. A further study (Rodgers et al., 2001) reported that obligatory exercises (the negative feeling to exercise) can be predicted from participants' frequency of imagery. In other words, participants who imagine themselves more often might be vulnerable to excessive exercises or addictive behaviours.

6.7. Qualitative studies

Two qualitative studies (Giacobbi et al, 2003; Kostelli et al., 2018) have been identified throughout the search for this systematic review to help answer the research questions.

Table 3

Qualitative studies reviewed with country of data collection, research design, mean age, sex, ethnicity and number of participants at baseline.

Study	Country	Design and analysis	Mean age (SD)	Sex	Ethnicity	Sampling strategy	N
Giacobbi 2003	Canada and US	Semi-structured interview with ground theory data analysis	23.50 (N/S)	16 F	N/S	N/S	16
Kostelli 2018	UK	Focus groups with thematic analysis	64 (5.2)	20 M 17 F	36 Caucasians, 1 mixed ethnicity	Purposive sampling	37

6.7.1. Assessment of quality (qualitative studies)

One study met all and the other met seven of the ten criteria within the Appraisal Checklist for Qualitative Research (Lockwood et al, 2015); see table 4.

Table 4

Quality Assessment for both qualitative studies according to Appraisal Checklist for Qualitative Research (Lockwood et al, 2015).

Appraisal Checklist for Qualitative Research (Yes/ No/ Unclear/ Not Applicable)	Giacobbi	Kostelli
1. Is there congruity between the stated philosophical perspective and the research methodology?	Yes	Yes
2. Is there congruity between the research methodology and the research question or objectives?	Yes	Yes
3. Is there congruity between the research methodology and the methods used to collect data?	Yes	Yes
4. Is there congruity between the research methodology and the representation and analysis of data?	Yes	Yes
5. Is there congruity between the research methodology and the interpretation of results?	Yes	Yes
6. Is there a statement locating the researcher culturally or theoretically?	No	Yes*
7. Is the influence of the researcher on the research, and vice- versa, addressed?	No	Yes
8. Are participants, and their voices, adequately represented?	Yes	Yes
9. Is the research ethical according to current criteria or, for recent studies, and is there evidence of ethical approval by an appropriate body?	No	Yes
10. Do the conclusions drawn in the research report flow from the analysis, or interpretation, of the data?	Yes	Yes

6.7.2. Key findings

Giacobbi et al (2003) identified that 50% (N=8) participants reported using appearance imagery such as ‘imagine your body’, ‘losing weight’ or ‘visualise obese self in the past’. 31% (N=5) participants reported using imagery for exercise self-efficacy, such as ‘image perseverance leads to confidence’ and ‘I think about how far I can make it’.

Kostelli et al (2018) investigated two groups of older adults (active and non-sufficiently active). The thematic analysis showed motivation, memory, and planning as the most common imagery functions, and scenery and reward images as the most commonly reported imagery content. Different to younger participants, older adults reported use of unique types of imagery, such as scenery to improve particular aspects, such as memory.

6.8. Discussion

The key purpose of this review has been to synthesise the entire existing evidence of imagery affecting physical activity, exercise, motivation, and weight loss in one holistic model. As a part of this process, I analysed the average effect sizes for measures grouped into factors and conducted the risk analysis of the interventions.

I found small and medium averaged positive effects of imagery on physical activity, exercise, intentions and motivation. The effect size of imagery effect on physical activity and exercise is consistent with previous meta-research (Conroy & Hagger, 2018) and provides new evidence regarding intentions, motivation and weight loss. Content of the instructed imagery varied from experiencing the exercise or action, through bringing a past experience to future events (positive and/or negative).

Three studies reported a lack of significant difference between the groups for the primary measures (e.g. exercise behaviour), but showed some effect in secondary measures (higher intrinsic motivation) or the effect of time or interaction of time by group. These findings invite caution in both whether and/or how imagery worked; a potential explanation is that imagery does not have such great impact on exercise behaviour, however the alternative explanation is that the success of imagery relies on the materials and delivery applied. In addition, the measure of physical activity and exercise and its quality varied between the studies; therefore there is a need for a single, universal measure.

I found small-to-medium negative effect of imagery interventions on weight. Furthermore, RCTs found some strong evidence that imagery can indeed support participants in reducing weight over 6 or 12 months (Marquadt et al, 2017; Solbrig et al, 2018), therefore it is both an effective tool and has long-term application. This finding has to be accepted with caution as a number of studies reported measuring weight but failed to report the actual values.

In a number of interventions, there has been evidence that imagery contributed to the prediction of behavioural intention, but not exercise behaviour itself. I concluded that the thoughts and motivation to exercise are increased as a direct result of imagery, but the model of imagery and exercise behaviour is not as simple or straight-forward. A wide range of factors affecting exercise behaviour and physical activity have been identified. Imagery can increase exercise-related self-efficacy (Duncan et al., 2011). Coote and Tenenbaum (1998) found that imagery can be used efficiently as a coping task, rather than a distraction task, in exertion tolerance. Stanley and Cumming (2010) identified imagery to be successful in enhancing the enjoyment coming from the exercise. Duncan et al. (2012) identified the integrated regulation (one of the exercise domains) to be significantly increased over a period of 8 weeks of guided imagery intervention. They proposed that internalizing the reasons to exercise is key to increasing exercise behaviour. Earlier studies identified integrated regulation to be a predictor of exercise frequency (Duncan et al., 2010). Therefore, I conclude that the link between imagery and exercise behaviour is moderated by exercise-related and psychological factors. The ‘gap’ between intentions/planning and exercise behaviour needs to be investigated.

The observational and qualitative studies showed that imagery is being used in exercise and physical activity environments for motivational purposes. There were a number of correlations between imagery use (including different imagery factors) and leisure-time exercise behaviour, motivation and rehabilitation adherence. Furthermore, those who engage in exercise regularly use imagery (energy, appearance and technique) more frequently than low frequent exercisers (strong evidence from a number of studies), with appearance imagery being the most common one. The non-experimental nature of these studies allows no manipulation therefore no control or measure of any confounding variables, such as personality and imagery ability. Additionally, the majority of non-experimental studies recruited regularly from an active population, rather than from a more sedentary or general population.

Some findings beyond the research questions are also worth reporting. In one study, the performance imagery condition practiced longer than others, therefore performance imagery could contribute to increased exercise behaviour (Martin & Hall, 1995), but the chosen exercise was golf practice which does not fit in the modern standards of moderately active 30 minutes 5 times a week recommendations (Lee et al, 2012).

The findings from the studies align with various theoretical models and frameworks related to exercise behaviour and motivation. The evidence supports the role of imagery in influencing exercise-related factors, such as self-efficacy, enjoyment, and integrated regulation. This is consistent with the Social Cognitive Theory, which emphasizes the importance of self-efficacy and outcome expectations in driving behaviour change. The findings also align with the humanistic theory, which focuses on intrinsic motivation and personal growth in physical activity. The observed correlations between imagery use and exercise behaviour, motivation, and adherence suggest that imagery plays a role in shaping individuals' cognitive processes and attitudes towards exercise. Furthermore, the findings are in line with the dual process theory, which posits that different cognitive processes are involved in action and imagery. The positive correlations between imagery and exercise behaviour support the idea that imagery can enhance the associative processes involved in motor planning and coordination, potentially leading to increased exercise engagement. Additionally, the socioecological framework is relevant as the studies highlight the use of imagery in exercise and physical activity environments, reflecting the influence of social and environmental factors on behaviour.

Importantly, one study investigated obligatory exercise behaviour, also referred to as "excessive exercise" or "exercise dependence", and is defined as one's obligation to exercise, which has also been linked with eating disorders (Steffen & Brehm, 1999). They identified that imagery accounted for 24-26% of the variance in obligatory exercise, which indicates a potential negative impact of imagery on one's physical and mental health. There was only one individual study that focused on this aspect of imagery use, therefore further research is required to understand the mechanisms underlying such negative consequences.

6.8.1. Publication bias

I investigated publication bias by visually analysing the funnel plot for physical activity and exercise and by using Egger's regression model and found evidence for publication bias. This claim is sensitive to a number of reasons, which limit the confidence of this bias. (a) studies with no significant results were still published (N=3), (b) it is impossible to rule out coincidence in this number of studies and (c) a low number of studies was highlighted as a caution in analysing publication bias (Debray et al, 2018). The publication bias and factors presented above should be a motivation for future research to resolve this issue.

6.8.2. Applications of the findings

The success and effectiveness of imagery interventions, especially those involving guided or approach imagery was demonstrated in several studies. This evidence should be further applied as a method to engage more of the sedentary population to achieve the minimal activity requirements. This is the most important finding of this systematic review.

Future research can focus on filling out the gaps highlighted in this review, such as differences between intentions and behaviours, effect of individual differences (personality) and the negative effects of imagery use. Furthermore, the evidence of imagery interventions on weight loss, intentions and motivation (<5 studies each) should be expanded to increase the reliability of imagery on these factors.

6.8.3. Limitations

Variation among the studies. This systematic review has taken a wide and rather open approach to identifying any evidence which could contribute to this knowledge; therefore, various study designs such as RCTs, single blind interventions, observational, correlational and qualitative designs were included in this review. The complexity of the factors themselves and variation among the studies adds the difficulty into concluding a clear evaluation of the studies.

A lack of reported elements. Considering the main aim of the systematic review is to draw a conclusion from data gathered from the published papers, therefore the quality of the review relies predominantly on the quality of reporting in the selected papers. Therefore, under-reporting or selective reporting are a huge threat to the systematic reviews. Several reports lacked information and details; despite the PRISMA and Cochrane assessment applied in this review, the risk assessment might be too coarse to analyse how complete these reports are; the term ‘low risk’ is perhaps forgiving and coarse in capturing the quality. This point supports the movement of research towards more open and transparent process of literature.

No moderator coding. Conroy and Hagger (2018) used moderator coding to highlight the specific factors around the relationship between imagery and physical activity. This meta-analysis analysed the effect sizes for each variable, but did not code each specific factor, which limits the evidence.

Further methods to identify grey literature. Grey literature refers to any research produced by organisations outside of traditionally commercial or academic institutions and not necessarily peer-reviewed (Adams et al, 2016); this may include reports, government documents or evaluations. Conn et al. (2003) found that published data contains results more likely to be statistically significant and with one third larger effect size, than grey literature. Our main action to identify any grey literature was contacting all of the authors of the included studies with request for any other literature, not available online. There are more methods to identify the grey literature (Adams et al, 2016), which can be explored.

6.8.4. Future suggestions

Population. Most studies recruited from populations of regular exercisers or from population, who is already looking for a change in their behaviours. More research with samples of those not regularly active (including obese and sedentary) need to be further conducted.

The cost of the interventions. The cost of delivery should be a factor reported by the papers, as the effect and improvement should be compared against the cost and time of delivery (costs of writing 5-minute script vs. a trained researcher with several hours of compulsory training and practice). This factor will contribute to application of the method and allow researchers to conduct cost-effect analysis as a part of meta-analysis.

6.8.5. Conclusions

The primary goal of this review and meta-analysis was to synthesise all of the evidence of imagery use affecting physical activity and the holistic image of this literature has been presented through the report. There is mixed evidence for whether and why imagery use improves motivation to engage in physical activity and exercise behaviour. However, some studies produced strong evidence (especially guided imagery at 4 to 8 week interventions) for imagery to be successful in enhancing physical activity and helping members of general public to achieve the minimal PA levels recommended by health institutions. Other populations (sedentary, obese, or inactive), costs of interventions and model of intention, motivation and behaviour should be explored. In summary, this review identified variation of the imagery effect, potentially dependent on the type, quality, duration, and materials of such imagery. It also highlighted the potential risk of publication bias in this particular field and the gap between the cognitive intentions and exercise behaviours.

6.9. Chapter summary

In addition to the findings and limitations discussed above, this research has laid the foundation for my future investigations to further advance the understanding and application of imagery in motivating physical activity and exercise behaviour change. Based on the conclusions and reflections drawn from this study, I will address the following five areas in my future research:

Exploring the Link Between Cognitive Motivation and Behaviour. I aim to delve deeper into the cognitive processes underlying motivation and their influence on behaviour change. By investigating factors such as self-efficacy, outcome expectations, and goal setting, I intend to gain a comprehensive understanding of how imagery impacts behaviour. Longitudinal studies will be conducted to examine the temporal relationship between cognitive motivation, imagery use, and sustained physical activity engagement.

Testing the Application of Imagery in Various Settings. Building on the findings of this research, I will explore the effectiveness of imagery interventions in diverse settings. This will involve conducting studies in open-recruitment interventions, community-based interventions, and clinical settings. By examining the feasibility and effectiveness of imagery interventions across different contexts, I aim to develop tailored and contextually appropriate interventions that can effectively motivate individuals to engage in physical activity.

Ensuring Quality Reporting. I am committed to ensuring the transparency and replicability of my research in this field. To achieve this, I will strive for thorough and detailed reporting of the interventions and results. Clear descriptions of the imagery techniques used, the duration and intensity of interventions, and the measurement tools employed will enhance the scientific rigor and comparability of my studies. I will incorporate control groups and randomization in experimental designs to strengthen the evidence base.

Including Additional Populations, such as Physiotherapy Clinics. I recognize the importance of extending the application of imagery interventions to specific populations, particularly those undergoing physiotherapy. My future research will investigate how imagery can support physical therapy interventions and promote adherence to prescribed exercises. By exploring the effectiveness of imagery in rehabilitation settings, I aim to enhance patient outcomes and contribute to the field of physical therapy.

Extending Qualitative Analysis to Exercise Professionals. In my future research, I will delve into the perspectives and experiences of exercise professionals in implementing imagery interventions. Through qualitative interviews or focus groups, I aim to gain insights into the challenges, facilitators, and best practices in incorporating imagery techniques into exercise programming. This knowledge will inform the development of training programs and guidelines for exercise professionals, enabling them to effectively integrate imagery into their practice.

By addressing these research avenues, I aim to build upon the findings of this study and contribute to the advancement of imagery-based interventions for physical activity and exercise behaviour change. My research endeavours will contribute to the development of evidence-based strategies and interventions that can effectively motivate individuals to engage in regular physical activity, ultimately leading to improved health and well-being. The further chapters address these points.

7. Regression model of imagery, motivation and physical activity

"First, it is an intention. Then a behavior" wrote Brendon Burchard, but as I learned in the systematic review, imagery can enhance the former one, but doesn't always affect the latter. There is contradictory evidence about the relationship between imagery of and engagement in physical activity (PA), with some literature suggesting small to medium correlation between these variables. Studies vary in the way that they assess imagery, so I aimed to clarify this by measuring sensory imagery vividness. Additionally, observational studies in the previous chapter demonstrated that imagery can also occur in an untrained and unprompted nature in those who exercise regularly. Therefore, I set out to explore what happens during 'then' and analyse this relationship through the empirical study combining all three variables – motivational thoughts about exercise, the exercise behaviours and one's imagery vividness. According to Rohrer (2018), observational data can be applied to analyse a new phenomenon and provide evidence for future research of such.

7.1. Overview

Multisensory mental imagery of actions has been used in sports since the recognition of the motivational benefits of visualisation (Paivio, 1985). Early research was predominantly focused on visualisation, perhaps due to everyday use where 'imagery' implies visual imagery, however in the last two decades the multisensory nature of physical activity imagery has been further examined.

7.1.1. Existing evidence

Those who exercise more regularly have been found to use imagery for one of the three reasons: motivation, appearance and health (Hausenblaus et al., 1999; Gammage et al., 2000). The most common reason (45%) for the imagery use was for motivational purposes

(Short, 2004). In their Applied Model of Imagery Use, Martin et al. (1999) identified a number of relationships between cognitive and motivational imagery and athletes' cognition and behaviour, such as enhancing motivation, getting 'psyched up', gaining confidence and staying focused. Nordin and Cumming (2008) tested this model and identified imagery ability to be the key moderator of these relationships. Cumming (2008) identified a small-to-medium correlation between leisure time exercise and appearance imagery, imagery around one's perception of what one's body looks like, and argued that that appearance-health imagery predicted exercise behaviour and coping efficacy. Furthermore, McAuley and Blissmer (2000 reported self-efficacy to be a significant predictor of physical activity and that changes in self-efficacy over-time were related to the changes in physical activity behaviours. This is not consistent with Milne et al. (2005), who found very weak evidence that cognitive imagery predicted task self-efficacy, accounting only for 1.8% of the variance in task self-efficacy. The correlations between imagery and exercise levels and quality were not reported. Therefore, the relationships and influence between imagery, self-efficacy and physical activity behaviours are unclear.

Stanley et al. (2012) explored the relationships between different types of imagery (energy, enjoyment, technique, and appearance imagery) and exercise intention and behaviour. The entire model proposed that energy imagery affects exercise behaviour directly, while appearance imagery has an indirect effect via intentions. Enjoyment and technique influence both intentions and behaviour indirectly via autonomous (self-determined) motivation, which is the motivation to engage in the behaviour consistent with intrinsic goals and values. In this model, intentions correlate with behaviour, but this was not supported by Rodgers and Munroe (2001) who found that imagery only predicted intention but not the behaviour itself.

Stanley et al. (2012) proposed that motivational regulators are predictors of exercise behaviours: amotivation and autonomous motivation predict exercise and intention, but control motivation does not. In Self-Determination Theory (SDT), Deci and Ryan (2008) proposed that one must fulfil the need of autonomy to have self –determined motivation for behaviour change, e.g. one must have autonomy to make a choice to increase their physical activity. Wilson (2003) investigated the SDT factors of introjected (feeling of guilt when not exercising), identified (valuing the benefits of exercise) and intrinsic (enjoying the exercises) regulations in the exercise environment. Those regulations were individually correlated with each type of imagery (appearance, technique and energy). This finding proposes that imagery is closely related to cognitive regulations of exercise behaviours.

The existing literature has produced mixed evidence, often contradictory in some places, therefore this study aimed to conduct a well-powered regression analysis of sensory imagery, motivational cognition, and levels of physical activity. The exploration of the link between cognitive motivation and behaviour is a critical area of research in understanding the psychological processes that drive behaviour change as highlighted in the previous chapter. By investigating factors such as internal motivation, imagery ability, and PA-related goals, I can gain valuable insights into how these cognitive motivators influence individuals' engagement in physical activity. It is important to recognise that cognitive motivation is a complex construct that involves multiple factors and their interactions. An observational study in this case provides a suitable methodology to examine these relationships in a naturalistic setting. Furthermore, it addresses the gaps and issues with previous literature with further validation of physical activity measures.

This study had three aims: (1) to identify the effects of sensory imagery and motivation thoughts upon physical activity; (2) to identify the effects of sensory imagery and motivation thoughts upon achieving minimum exercise levels, according to WHO threshold;

(3) to test the validity of two physical activity measures and their relationships with frequency of imagery and motivational thoughts.

7.2. Method

7.2.1. Ethical Statement

The experimental protocol was approved by the authors' institutional ethics committee. All participants were informed at the start of the study that they could withdraw at any stage. Consent was acquired online.

7.2.2. Participants

Psychology undergraduate students at the local University were approached via the institutional recruitment platform with an award of one participation point as a part of their program requirements.

The measures were completed by 367 participants (285 Female, 77 Male, 5 other / declined to say), aged between 18 and 57 (M = 21.3, SD=5.17). The sample was predominantly White (N=331, 90%), with 14 participants stating mixed ethnicity, 13 Asian or British Asian, six Black, African, Caribbean and Black British, one Chinese and two other ethnicity.

7.2.3. Measures

Four questionnaires were used to assess physical activity, motivational thoughts and imagery ability.

Motivation. Motivation Thought Frequency scale (Robinson et al, 2016) is a 13-item questionnaire designed to test the frequency of motivational thoughts for a specific functional goal; in this case, 'increasing physical activity'. An example question: 'Over the last two weeks, how often did you imagine yourself doing it?' would be answered on Likert scale from 0 (never) to 10 (constantly). MTF scale assesses motivation in three aspects: feeling, imagining, and thinking over the last two weeks. The mean of the scale was computed as a measure of motivation.

Imagery Vividness. The Plymouth Sensory Imagery Questionnaire (Psi-Q; Andrade, May, Deeprose, Baugh, & Ganis, 2014) assesses vividness of mental imagery in the seven modalities of vision, sound, smell, taste, touch, body, and emotion, each modality having five items rated from 0 (no imagery) to 10 (as vivid as real life), and scores can be combined to give an overall imagery score. An example question: ‘Imagine the appearance of a friend you know well’ would be answered on 0 to 10. The Psi-Q is used to assess imagery vividness due to the general nature of the questions which has been used in a variety of samples (Renner, Murphy, Ji, Manly, & Holmes, 2019). I computed the mean over all 35 items as a measure of multisensory imagery vividness.

Physical Activity. The International Physical Activity Questionnaire Short Form (IPAQ-SF; Forde, 2018) is a nine-item questionnaire, which has been validated and commonly tested for reliability. IPAQ is one of the most common questionnaires used to measure physical activity across all aspects of individual’s life, covering work, transportation, housework, leisure-time activities and sitting. The short form includes items focused on vigorous, moderate and walking activities and sitting. An example question: ‘During the last 7 days, on how many days did you walk for at least 10 minutes at a time?’ would be answered on 1-7 days and ‘How much time did you usually spend walking on one of those days?’ would be answered in numbers of hours and day. The metabolic equivalent task was calculated as a measure of overall physical activity, based on each physical activity score, according to the IPAQ-SF recommendations.

Active Time. The World Health Organisation proposed a minimum level of physical activity in terms of moderate, vigorous and strength-building activities (World Health

Organisation, 2020) of at least 150-300 minutes a week of moderate activity, 75-150 minutes of vigorous activity, or an equivalent combination of both and minimum of two strengthening activities a week. An example question: ‘How many minutes of vigorous-intensity aerobic physical activity have you been engaged in in last 7 days? For example: (running twice: 30mins x 2) + (fast walking on the moors: 60 mins) = 120 mins’ was answered in total number of minutes. Based on these thresholds, three measures were answered: a total of moderate and vigorous activities and frequency of strengthening activities. These were then used to calculate the total time spent being physically active and whether the participant met the minimum criteria of exercise above 150 minutes per week and two strengthening activities (WHO, 2020).

7.2.4. Procedure

Participants completed the measures online on the survey platform (Qualtrics), in the order WHO physical activity, MTF, Psi-Q and IPAQ-SF.

7.2.5. Data Analysis

Significance was measured at the .05 level (Lakens, 2013). The complete dataset for item responses and total score are available on Open Science Framework, including the corresponding analysis code, which was completed in R (R Core Team, 2021). The data and the corresponding code are available in Chapter 7 folder here: https://osf.io/tbekp/?view_only=b7497391850a4f31805d4ec558c8abfd

7.3. Results

Through data scanning and cleaning, I identified that four cases have been missing in the questionnaires, therefore after removing them, 363 participants in total were analysed.

7.3.1. Correlation matrix

Measures displayed a variation of correlations strengths, from no correlation observed to a medium-sized correlation.

Table 5

Means, standard deviations and correlation coefficients for motivation, imagery vividness, physical activity and activity time.

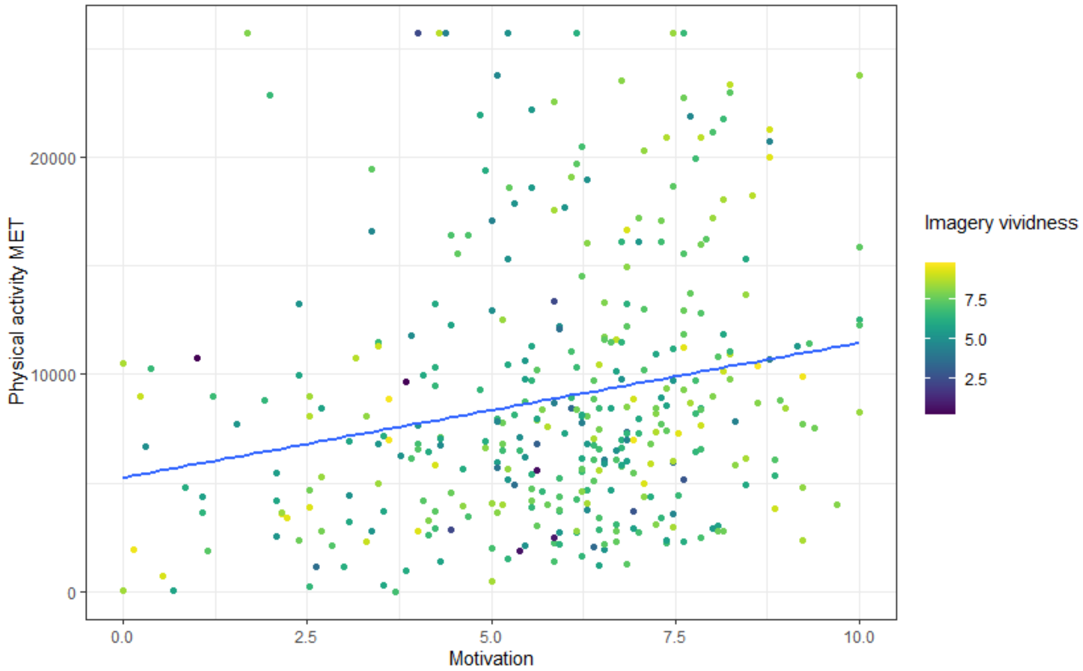
	motivation	imagery vividness	physical activity	activity time (minutes)
Mean	5.87	6.84	8808.00	328.00
SD	2.06	1.63	5904.00	312.00
motivation	-	.13**	.22***	.21***
imagery vividness		-	.03	- .06
physical activity			-	.26***
activity time (minutes)				-

Note: motivation is Motivational Thought Frequency total; imagery vividness is Plymouth Sensory Imagery Questionnaire total; physical activity is Metabolic Equivalent Task, activity time is World Health Organisation exercise measure. *p < .05, **p < .01, ***p < .001

The correlation between physical activity and active time is statistically significant but medium size, despite aiming to measure the same construct. A Scatterplot of physical activity against motivation (see Figure 7) also allows the influence of imagery vividness to be shown. It is worth noticing the lack of correlation of imagery vividness and physical activity in general (Table 5), however those with higher imagery scores do report higher motivation.

Figure 7

Scatterplot of motivation and physical activity with imagery vividness as scale for each point.



I applied mean-centring (scaling) to all four variables: physical activity, activity time, motivation, and imagery vividness. This was done to mitigate multicollinearity concerns (Cohen, 2008) and to facilitate the interpretation of regression results, especially when dealing with interactions, as the variables lacked meaningful zero points in their scales (Hofer, 2017). In other words, mean-centring is a valuable preprocessing technique in regression analysis. It enhances the interpretability of regression coefficients, reduces sensitivity to data scale changes, and simplifies the interpretation of the intercept, collectively improving model stability and comprehensibility in the presence of multicollinearity. I created a multi-level regression model with motivation thoughts and imagery vividness as predictors of total physical activity score and activity time in minutes (both scaled; see Table 6).

Table 6

Prediction of physical activity score was calculated based on effects of motivation and imagery vividness and interaction between them.

		Estimate	Standard error	t value	P (>|t|)
Physical activity	Intercept	-0.01	0.05	-0.29	0.77
	motivation	0.20	0.05	3.76	0.0002
	imagery	0.03	0.05	0.55	0.58
	motivation:imagery	0.11	0.05	2.28	0.023
F(3, 359) = 8.09, p < .001, R squared = 0.055					
Activity time	Intercept	-0.002	0.05	-0.046	0.96
	motivation	0.21	0.05	4.00	<0.001
	imagery	-0.08	0.05	-1.53	0.13
	motivation:imagery	0.02	0.05	0.37	0.71
F(3, 359) = 6.25, p < .001, R squared = 0.042					

The model incorporating motivation and imagery vividness as predictors explained 5.5% of the variance in physical activity measured by metabolic equivalent. This model showed the motivation to be a statistically significant predictor, whereas imagery vividness alone was not significant (p=.58).

The activity time was also predicted from motivation and imagery vividness scores, explaining 4.2% of the variance. Motivation score was a significant predictor, however no other predictors nor the interaction were individually significant (p>.05; see Table 6).

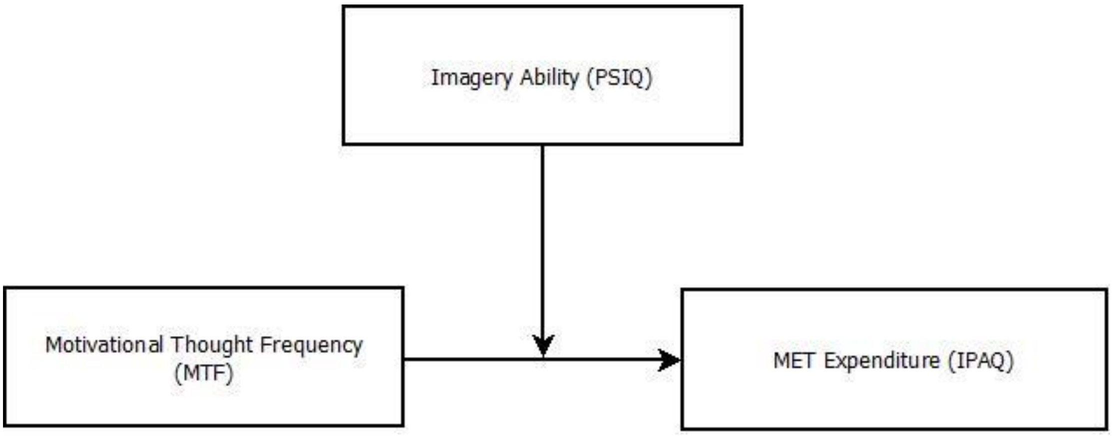
7.3.2. Moderator effect

As the regression coefficient for the interaction between motivation and imagery vividness for physical activity is significant there is a potential moderation effect of imagery vividness on the relationship between motivation and physical activity.

This implies that the impact of motivational thoughts on physical activity behaviours differs depending on the level of vividness of individual's imagery.

Figure 8

The visualisation of moderator effect between Motivational Thoughts Frequency and physical activity score.



7.4. Discussion

I identified the correlations amongst the physical activity (measured by IPAQ) and motivating thoughts frequency for the physical activity goals and behaviours (measured by motivation); I did not find similar patterns between physical activity and sensory imagery.

However I also identified a moderator effect: the proposed relationship between motivational thoughts and physical activity is moderated by the levels of imagery vividness. In other words, people might have high levels motivational thoughts, but without vivid imagery, those thoughts are not leading them to engage in the physical activity behaviours. This is supporting Cummings and Williams (2013), who adopted the earlier imagery model from Martin et al (1999), which uses the imagery ability as a moderator in use of different imagery type for a desired outcome.

Furthermore, this finding is in line with the previous study from Rodgers and Munroe (2001), who argued that imagery affects the intention to exercise, not the behaviour itself. The conclusion is that a natural ability to create vivid imagery might assist individuals, who already have activity-related motivational thoughts, such as to imagine themselves participating and completing the physical activity. Vivid imagery might turn motivation into actions and commitments. However, asking people to create imagery about exercise would only increase activity in those who already was motivated to do so, but were not following through on their intentions. One of the possible mechanisms is the notion that imagery evokes emotions and motivation to drive the behaviour (Ji et al, 2021).

These findings have implications for the theoretical models of physical activity behaviour. First, the identification of a moderator effect between imagery vividness and the relationship between motivational thoughts and physical activity aligns with several theoretical models. It supports the notion that self-efficacy, outcome expectations, and goal setting (factors related to motivational thoughts) may be more influential in driving physical activity behaviour when accompanied by vivid imagery. This finding adds depth to the understanding of the mechanisms underlying behaviour change proposed by models such as social cognitive theory, which emphasize the importance of self-efficacy and outcome expectations (PA-related goals). Secondly, the finding that imagery affects the intention to exercise but not the behaviour itself is consistent with previous research and aligns with the theoretical models of physical activity. This finding underscores the importance of targeting intention formation and motivational processes in interventions aimed at promoting physical activity. By incorporating these findings into theoretical frameworks, I can enhance our understanding of the psychological processes underlying physical activity behaviour and develop more effective interventions to promote and sustain physical activity engagement.

7.4.1. Scales

There was only a medium correlation between activity time and physical activity. The lack of strong correlation between two established measures of physical activity was an unexpected finding of this study and it brought our attention to the validity of the exercise scales or what they originally intend to measure, and more importantly whether they measure different aspects of physical activity. One of the explanations for the size of this relationship is the purpose of the scales: the WHO scale was interested in capturing the minimum threshold of being active, where IPAQ aims at creating a holistic image of one's activity behaviours. Another discrepancy comes from the source of the total physical activity score; IPAQ uses a calculation of all aspects of physical activity, weighted by degree of effort, whereas WHO measures the total time spent, without weighting by degree of effort. Alternatively, objective measures, such as fitness tracking devices, might need to be implemented for the future studies.

7.4.2. Implications

This study highlights the importance of motivational thought frequency and imagery vividness in physical activity and exercise behaviours and proposes that they are incorporated into interventions intended to increase physical activity. Increasing both might be the best way to increase the physical activity behaviours.

Secondly, I stress the importance of calculating the total physical activity as in the annual Health Survey for England (Scholes and Neave, 2017) rather than asking participants whether they meet criteria according to the NHS recommendations (NHS England, 2021). Further work towards one universal measure to capture adequate physical activity levels is required.

7.4.3. Conclusion

This study had an explorative nature to establish the link between the internal motivation and physical activity behaviours. There was a strong correlation between those two variables with natural, untrained imagery vividness acting as a moderator of its strength. The role of natural ability to generate imagery has been linked with the intentions and behaviours for the first time, which highlights the importance of this ability and its training. This finding encourages incorporating methods to evoke motivation and to improve imagery ability into the future physical activity interventions to increase the success rate of PA-orientated outcomes.

7.5. Chapter summary

This observational approach allowed me to conduct an examination of imagery use as a naturally occurring phenomenon and its association with cognitive motivation and exercise behaviour. The key findings focused on the role of imagery ability at baseline. Imagery ability plays a crucial role in the effectiveness of imagery interventions. Individuals with higher imagery ability are more likely to benefit from imagery techniques. Therefore, future research should consider assessing and addressing individual differences in imagery ability when designing interventions. Vivid imagery has the potential to bridge the gap between motivation and action. When individuals can vividly imagine themselves engaging in physical activity and experiencing the desired outcomes, it may increase their commitment and likelihood of translating motivation into actual behaviour. Future interventions may benefit from focusing on enhancing the vividness and realism of imagery experiences to facilitate behaviour change. Furthermore, the challenges of measuring physical activity should be acknowledged and addressed. Accurately capturing and assessing individuals' levels of physical activity is crucial for understanding the impact of imagery interventions on behaviour change. However, measuring physical activity can be complex and prone to measurement error as observed evidently in this study. Future studies should employ reliable and valid multiple measurement methods.

Overall, these findings highlight the importance of considering imagery ability, exploring the underlying mechanisms of imagery effects on behaviour, and harnessing the role of vivid imagery in promoting behaviour change. My future research in this thesis can further advance the understanding of how imagery can be effectively utilized to motivate and facilitate physical activity and exercise behaviour. It can also test the effectiveness of different imagery-based interventions in enhancing behaviour change in PA.

Part 2

Part 2 of this thesis embarks on a focused exploration of Functional Imagery Training (FIT) as a promising intervention strategy for enhancing exercise motivation and adherence. At its core, the research in this section aims to evaluate the effectiveness of FIT in promoting behaviour change and sustaining exercise engagement over time. The overarching intention behind this research is twofold: firstly, to empirically assess the impact of FIT on exercise motivation and adherence, and secondly, to identify potential mechanisms underlying its effectiveness. Through a series of rigorous studies, the research seeks to provide empirical evidence supporting the efficacy of FIT as a behaviour change intervention, particularly in comparison to standard exercise advice or other imagery-based interventions.

Chapter 8 of this section presents a study designed to assess the comparative effectiveness of imagery-based interventions, specifically FIT, in promoting goal-based physical activity (PA) compared to exercise advice alone. The research findings shed light on FIT's superiority in sustaining behaviour change, as evidenced by the maintained increase in PA levels over a longer duration compared to other intervention groups. Moreover, the study highlights FIT's potential to influence non-goal-related behaviours, such as reducing sitting duration, suggesting broader impacts beyond the targeted goals. Chapter 9 delves deeper into FIT's effectiveness, particularly in the context of physical therapy treatment. By evaluating its impact on confidence in successful recovery, motivation for exercise completion, and adherence to prescribed exercises, the research aims to demonstrate FIT's potential as a cost-effective and scalable intervention for both general and chronic injuries. Furthermore, the chapter explores FIT's ability to enhance imagery vividness over time, suggesting its role in progressively strengthening motivation and behaviour change mechanisms.

Overall, the research in Part 2 seeks to advance our understanding of FIT as a behaviour change intervention, providing valuable insights for practitioners and policymakers aiming to promote exercise engagement and improve health outcomes. Through rigorous evaluation and empirical evidence, the research aims to contribute to the development of evidence-based intervention strategies that can effectively support individuals in adopting and maintaining healthy exercise behaviours.

8. Can you imagine yourself exercising? The effects of Functional Imagery Training and imagery-only interventions on physical activity and exercise adherence

The explorative nature of previous studies has revealed a wide variation in use of imagery and the potential role imagery ability plays in transforming intentions into behaviours. Evidence from the meta-analysis supported the effectiveness of Guided Imagery in increasing motivation, intentions, physical activity and exercise. Functional Imagery Training (FIT) adopts the spirit of Motivational Interviewing with guided multi-sensory imagery, mental contrasting and development of imagery ability across vividness and controllability over the time. FIT showed results in physical activity, athletic performance, and weight loss (Solbrig et al, 2018, Rhodes et al, 2019, 2021). Furthermore, through the motivational conversation, individuals have the freedom and autonomy to select their own goals, where imagery produces an emotional and therefore motivational response. Individuals are also tested about their imagery vividness in order to work on improving this aspect throughout the intervention.

Testing of different imagery interventions, such as guided imagery and Functional Imagery Training, which builds on guided imagery, will further investigate what makes a difference and impact in imagery use and why some studies in the systematic review reported no effect of imagery. While the previous chapter has explored the use of imagery in physical activity and exercise through an exploratory, observational manner, there is still a need to delve deeper into the relationship between imagery ability, motivational processes, and behaviour change. The existing evidence has demonstrated the potential effectiveness of guided imagery in increasing motivation, intentions, and physical activity engagement. Additionally, Functional Imagery Training (FIT), which combines elements of guided imagery, mental contrasting, and motivational interviewing, has shown promising results in various domains. However, there is a need to further investigate the specific mechanisms through which imagery influences behaviour change and the role of imagery ability in transforming intentions into behaviours. This trial will compare imagery interventions with exercise advice, evaluate FIT's effectiveness over guided imagery, assess non-imagery components in FIT, and examine the correlation between self-reported physical activity measures.

Conducting this study will allow me to gain a better understanding of the effectiveness and underlying processes of FIT. This research will contribute to the existing knowledge by examining the interplay between imagery, motivation, and physical activity behaviour, and by assessing the effectiveness of interventions that incorporate guided imagery and/or motivational interviewing techniques. Furthermore, it would provide evidence of the effectiveness of Motivational Interviewing used with multi-sensory imagery. Additionally, the study will provide insights into the role of emotional and motivational responses evoked by imagery and the importance of individual autonomy and goal selection in behaviour change processes.

8.1. Overview

The UK Government and NHS (Public Health England, 2020) informed the public that during the period of lockdown in the UK, people may be bored, frustrated or lonely; they may also feel low, worried, anxious, or be concerned. In order, to avoid or reduce this, the official government recommendations suggest to 'exercise inside where possible and outside once a day' (Public Health England, 2020) with more specific examples such as walking or gardening outside and home work-outs provided by Public Health England and NHS Fitness Studio. Furthermore, Holmes et al (2020) called for any research and papers, 'which could provide evidence-based guidance on responding to this pandemic and on how to promote mental health and wellbeing' during the Covid-19 outbreak. The benefits of regular physical activity and moderate exercises on mental health and wellbeing is well evidenced throughout the literature (Fox, 1999; Peluso & de Andrade, 2005; Penedo & Dahn, 2005; Windle, 2014) with highest reductions of acute anxiety and panic symptoms (Paluska & Schwenk, 2000).

Based on the evidence from the systematic review conducted by Buja et al. (2020), which found a positive association between health literacy and physical activity levels, the British government prioritized initiatives to improve the population's Physical Activity Literacy (PAL). Recognizing that individuals with higher levels of health literacy are more likely to have an active lifestyle, the government focused on providing accessible and accurate information about physical activity and its benefits and promoting health literacy as an essential component of overall well-being. Furthermore, the meta-analysis conducted by Bohlen et al. (2022) highlighted the importance of individual perceptions of the consequences of physical activity in predicting long-term behaviour change. By addressing individuals' perceptions and beliefs about the impact of physical activity on their health, the government aimed to support behaviour change and promote a more active population. By examining how PAL interacts with other interventions in promoting motivation, I hope to gain insights into the effectiveness of targeted interventions that address specific components of physical activity literacy compared to imagery-based interventions.

As discussed in the literature review, just the knowledge of what are the PA guidelines is often not enough to increase physical activity levels. Guided imagery is a technique involving one's mind's eye to imagine either visual pictures or multi-sensory scenarios. Guided imagery in particular has shown to increase leisure-time exercise (Biondolillo & Pillemer 2015; Chan & Cameron 2012) and general physical activity (Anderson & Moss, 2011) and against other common methods such as guided relaxation (Kim, 2011) at increasing the metabolic expenditure rate. Giacobbi et al (2016; 2018) concluded guided imagery to be a successful tool in increasing motivation and encouragement for exercise based on the specific goal. Renner et al (2017) has provided further evidence that guided imagery only, acting as a motivational amplifier, can be successful in increasing frequency of enjoyable activities.

Functional Imagery Training is a technique which combines theory and elements of motivational interviewing (MI) with guided multi-sensory imagery of the goals and the technique of mental contrasting. As explained in the earlier chapters, FIT enhances motivation by training the individual to generate positive affective mental imagery of succeeding in behavioural goals, such as maintaining an exercise regime. The client and practitioner form a connection through empathy and work together to achieve the target goal; the opportunity to learn and use imagery is autonomously driven. This fulfils the general criteria for intrinsic motivation to be fostered (Deci & Ryan, 2008) and could maintain any changes through the intervention delivery. Its effectiveness has been tested against MI (Solbrig et al, 2018). Therefore, FIT demonstrates a unique combination of guided imagery (and its development through training and mental contrasting) with non-imagery components, such as use of empathy, person-centred approach and rapport building. However, a recent study with a relatively large sample size (Ismail et al, 2019) identified that motivational interviewing might not be a sufficient tool to increase exercise over the longer term (24 months). Therefore, FIT has potential to impact behaviour change, especially the exercise-related behaviours, by combining the elements of guided imagery, mental contrasting and motivational interviewing.

From the evidence above, it was evidently important to conduct investigation into methods of improving health and wellbeing via exercise during the Covid-19 outbreak. There is a natural baseline of PAL intervention, which every person in the UK has received as part of the government program to increase overall physical activity levels during the pandemic. Both imagery methods (guided imagery and FIT) have evidence from previous intervention studies that they improve motivation and resilience to exercise. However, they display differences in the elements they include, the processes, and attitude towards prescribing the exercise (the element of autonomy to choose your exercises in FIT). In summary, the overall aim of this study is to increase motivation to exercise by applying imagery-based interventions to two independent conditions. A difference between the interventions will highlight the importance in improving motivation and therefore exercise and suggest the critical and most effective elements of these methods. Motivational interviewing's discussion of goals and their personal relevance and importance to the participants might be a vital factor in FIT. A lack of difference between conditions would support the previous study (Ismail et al, 2019), whereas any difference would highlight the importance of motivational interviewing in future imagery-based interventions.

8.2. Research questions

This study addresses the following questions:

1. Are imagery interventions more effective in increasing goal-based PA and exercise than general advice to exercise more?
2. Is FIT more effective than only guided imagery itself?
3. How important are the non-imagery aspects of FIT, in comparison to general guided imagery?
4. How closely related are two self-reported measures of physical activity?

8.3. Method

8.3.1. Ethical statement

The experimental protocol was approved by the authors' institutional ethics committee. All participants were informed at the start of the study that they could withdraw at any stage. Consent was acquired online.

8.3.2. Participants

Forty-seven (M=41.34, SD=12.53) participants ranging from 19 to 75 completed the initial interview. The drop out from baseline to week 4 was 42.5% (N=20) and is consistent with other single-blind intervention studies (Moroshko et al., 2011) or slightly higher (Dixon & Linardon, 2019).

Following the end of the study, I asked participants in the control group whether they were aware of what condition they were in. Half of those who replied reported no awareness of group allocations (N=2) and other half reported that they knew they were in the control group (N=2); one stating ‘I was wondering when do I get to do the imagery’. The response rate was too small to be incorporated as meaningful covariant in any analysis.

8.3.3. Measures

Four questionnaires were used to assess physical activity, exercise adherence and imagery ability. At baseline the imagery ability and physical activity were measured. At weeks 2 and 4, the physical activity and exercise adherence were measured.

1. *Physical Activity*

Physical activity was measured by IPAQ and WHO. As described in the previous chapter, The International Physical Activity Questionnaire Short Form (IPAQ-SF; Forde, 2018) is a nine-item questionnaire, which has been validated and commonly tested for reliability. An example question: ‘During the last 7 days, on how many days did you walk for at least 10 minutes at a time?’ would be answered on 1-7 days scale and ‘How much time did you usually spend walking on one of those days?’ would be answered in numbers of hours and minutes. The metabolic equivalent task was calculated as a measure of overall physical activity, based on each physical activity score, according to the IPAQ-SF recommendations. Unexpectedly, IPAQ created a certain confusion amongst some of the participants, who reported the total amount of time of exercising per week, *not* per day. Therefore, when calculated according to the guidelines, it resulted in more hours than physically possible to complete in a week. These cases were truncated according to the IPAQ guidelines; the same process as previously was followed.

The World Health Organisation proposed the minimum levels of physical activity in terms of moderate, vigorous and strength-building activities (World Health Organisation, 2020). The minimum thresholds of activity included at least 150-300 minutes a week of moderate activity, 75-150 minutes of vigorous activity, an equivalent combination of both and minimum of 2 strengthening activities a week. Based on these thresholds, three questions were asked: (1) How many minutes of moderate-intensity aerobic physical activity have you been engaged in in the last 7 days? For example: (walking to work 10mins x 5) + (cleaning the house 15mins) + easy cycling (45 mins) = 110 minutes. (2) How many minutes of vigorous-intensity aerobic physical activity have you been engaged in in last 7 days? For example: (running twice: 30mins x 2) + (fast walking on the moors: 60 mins) = 120 mins. (3) How many days have you completed any muscle-strengthening activities in last 7 days? As a result, three measures were calculated: total minutes of moderate and vigorous activities and a frequency of strengthening activities; the moderate and vigorous activities were also calculated as MET values according to IPAQ formulas for the comparison purposes.

2. *Exercise adherence*

Exercise Adherence Rating Scale (EARS) is a validated 6-item questionnaire with 5-point Likert response scale. The EARS is scored on a 5-point Likert scale (0 - completely agree to 4 - completely disagree). Items 1, 4 and 6 are reverse scored, the scores will be averaged resulting in a possible score of between 0 and 6. A higher score indicates better adherence. An example question: ‘I fit my exercises into my regular routine’ is answered on a 5-point Likert scale (0 being completely agree and 4 being completely disagree); half of the items are reversed coded.

3. Imagery Ability

The Plymouth Sensory Imagery Questionnaire (Psi-Q; Andrade, May, Deeprose, Baugh, & Ganis, 2014) reliably assesses vividness by examining vision, sound, smell, taste, touch, body, and emotion. Each of the 7 senses have 5 items and scores can be combined to give an overall score. The Psi-Q is used to assess imagery ability due to the general nature of the questions which has been used in a variety of samples (Renner, Murphy, Ji, Manly, & Holmes, 2019). An example question: 'Imagine the sound of an ambulance siren' is answered on 10-point scale of 0 (no image at all) to 10 (image as clear and vivid as real life). The scores are combined for individual imagery of each of the seven senses and the overall score of vividness of imagery.

8.3.4. Procedure

Forty-nine participants were recruited from the participation pool of University of Plymouth and in general public via social and local media (two participants did not complete the baseline measures and did not continue with the study). Those who signed up to the study were randomly allocated (www.randomizer.org) to one of the three conditions: FIT, guided imagery and exercise advice (control).

The first online session via Zoom consisted of (in this order): brief, consent form, baseline imagery use and physical activity questionnaire (PSI-Q; Baseline minutes of PA), delivery of session script (either FIT, guided imagery or exercise advice) and reminder when the next session is going to be. I attempted to deliver similar amount of contact time for all conditions, however the time varied due to the length of the scripts.

They received a booster call one week after the initial meeting consisting of a reminder of the goals and imagery from session 1 and further development of guided imagery for both experimental conditions. The control group (exercise advice only) received a reminder of the minimum exercise levels.

Participants were sent a link to the online survey (in case of no response within 48 hours of this, they were contacted via phone) after 2 and 4 weeks to complete the physical activity questionnaires about the amount of exercise they completed and exercise adherence questionnaire.

8.3.5. Interventions description

The Advice-only group began with myself emphasising the significance of exercise, drawing from authoritative sources such as the World Health Organization (WHO) and the NHS. They highlighted key facts provided by the WHO, including the substantial health benefits of physical activity, the role of exercise in preventing and managing noncommunicable diseases, its positive impact on mental health, cognitive abilities, and overall well-being. I underscored the potential to avert millions of deaths globally through increased physical activity and the heightened risk of death for insufficiently active individuals. I elucidated WHO's exercise recommendations for adults aged 18–64, which advocated for either 150–300 minutes of moderate-intensity aerobic activity or 75–150 minutes of vigorous-intensity aerobic activity per week. WHO also endorsed muscle-strengthening activities at least two days a week. These guidelines permitted the adjustment of aerobic activity levels for added health benefits and advocated against prolonged periods of sedentary behaviour. I delivered the classification of physical activity levels, distinguishing between moderate aerobic activity, vigorous activity, and muscle-strengthening exercises. I provided practical examples of activities that aligned with each category, explaining that moderate activity allowed for maintaining a conversation but not singing. I inquired if the participant could think of exercises or physical activities that matched the recommended guidelines, encouraging discussion about these activities. If the participant had ideas, I invited them to share more details. If not, I inquired if the participant could find ways to meet the minimum exercise requirements outlined.

The guided imagery started from me introducing the concept of mental imagery and its importance in the intervention. The aim was to create an understanding of how imagery could be used to facilitate changes in physical activity levels. The participant was asked if they had observed the use of imagery in their everyday life, with relatable examples provided. This encouraged active participation and reflection. If the participant hadn’t consciously used mental imagery, I assured them that they would engage in exercises to further explain and develop this skill. The participant was assured they could pause or skip any part of the session if the imagery made them uncomfortable in any way. Then I followed the exact same recommendations for exercise and physical activity (WHO and NHS) with explanation of levels and intensity of recommended exercises. As in the other group, I prompted the participant to discuss any exercises they would like to do that aligned with these recommendations. If the participant didn’t have specific exercises in mind, they were encouraged to consider options that met the minimum requirements. The next step was guiding the participant in a mental imagery exercise related to their chosen physical activity. I initiated the transition into this exercise by instructing the participant to vividly imagine themselves engaging in the activity as if it were happening in the present moment. Sensory details, emotions, and positive aspects of the exercise were highlighted. The participant was encouraged to focus on the specific cues or reminders that motivated them to perform the activity. Following this imagery exercise, I engaged the participant in a discussion about their experience, emphasizing the importance of vivid imagery. The participant was then asked to rate the vividness of their imagery on a scale of 1-5, with clear explanations for each level. The participant’s feedback and any particularly vivid aspects of their imagery were discussed. I encouraged the participant to incorporate this imagery practice into their routine and sought their commitment to regular practice.

The participants in the FIT condition received an overview of Functional Imagery Training (FIT) and I asked if the participant had any questions about it. They initiated a conversation about the participant, their situation, and their goals in the spirit of Motivational Interviewing with consideration to the key principles of MI: expressing empathy, developing discrepancy, rolling with resistance and supporting the self-efficacy. The participant was encouraged to reflect on their reasons behind the change, subsequent long-term goals and the little steps of action they could take to achieve these goals; this was conducted in order to engage the participant and help them focus on their goals and desires. I elicited both negative and positive imagery related to achieving or not achieving their long-term goal (mental contrasting) to evoke motivation towards achieving this goal. The participant was asked to rate the vividness of these images on a scale of 1-5, with explanations provided for each level. They were also asked what aspects of these scenarios they found particularly real. The participant was prompted to consider potential obstacles that might impede their progress toward their goals. I inquired about the participant's previous attempts and successes in overcoming barriers and obstacles in order to enhance self-efficacy. They were encouraged to imagine how they would overcome these obstacles and still achieve their goals in 4-6 weeks. Finally, the participant's plan was further explored regarding the amount of physical activity they intended to engage in. They were prompted to consider how they would get started and stay on track. The session concluded with practice using imagery cues and a review of what had been discussed.

8.3.6. Data Analysis

Significance was measured at the .05 level (Lakens, 2013). The complete dataset for item responses and total score are available on Open Science Framework, including the corresponding analysis code which was completed in R. The data and the corresponding code are available in Chapter 8 folder here:

https://osf.io/tbekp/?view_only=b7497391850a4f31805d4ec558c8abfd

8.4. Results

8.4.1. Data cleaning

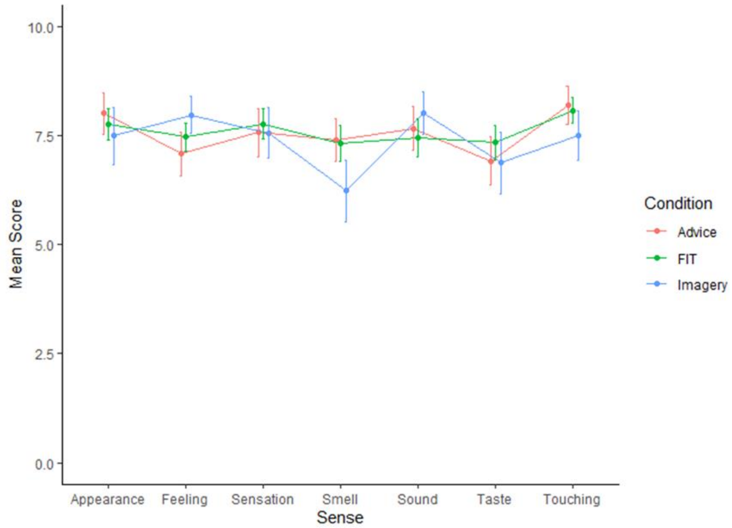
A number of cases were apparently mis-reported in the IPAQ scale regarding the questions ‘how often do you conduct a [particular] activity on a typical day?’ with answers for the total of the whole week. Individual mistakes were corrected (divided by seven) if the total time of the physical activity was greater than the boundaries recommended by the IPAQ.

8.4.2. Imagery vividness at baseline

As seen in Figure 9, visually only the guided imagery group reported lower smell sense on average; however, there were no significant differences between groups’ levels of imagery vividness at baseline ($p>.05$), even in smell which was visually varied, $F(2, 42) = 1.24$, $p = 0.3$.

Figure 9

The changes in average MET from baseline to week 2 and 4 for all three conditions.

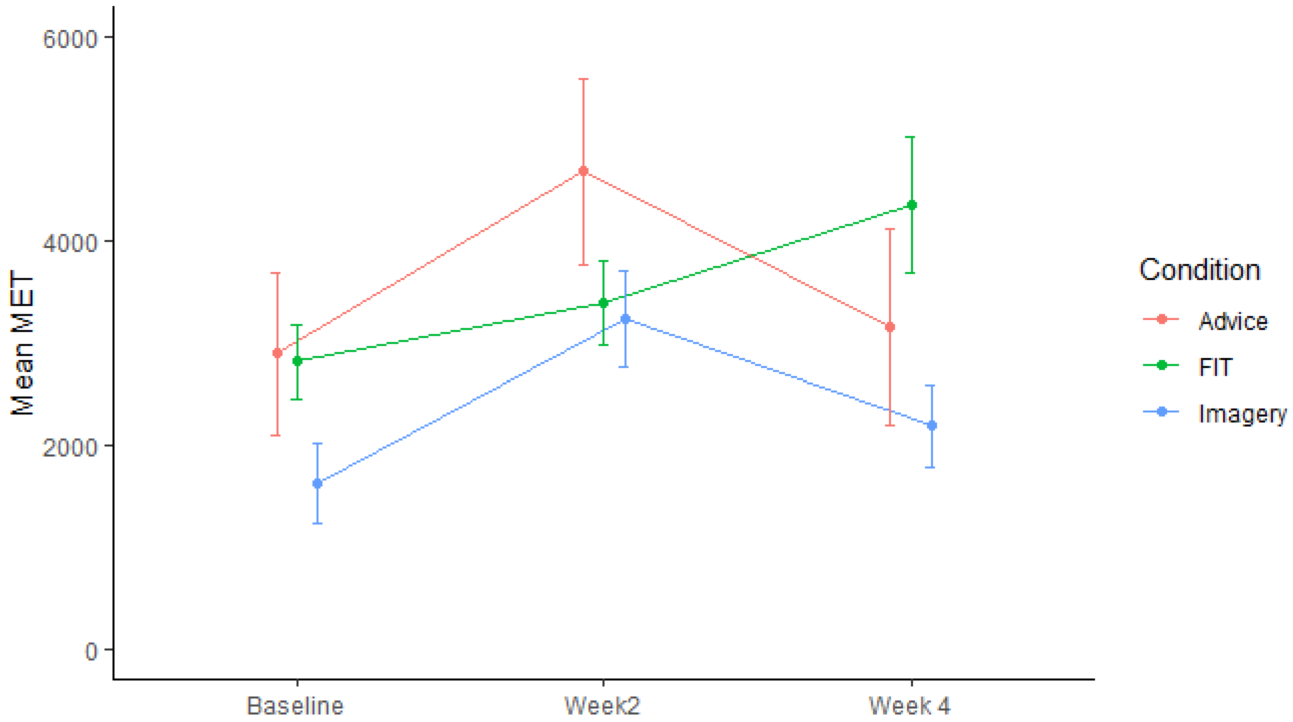


8.4.3. MET score

All groups reported an increase of total metabolic expenditure rate (MET) from baseline to week 2, with only FIT demonstrating the increase at week 4 (Figure 10). Both, advice and imagery conditions, reported lower MET at week 4 on average.

Figure 10

The changes in physical activity (measured in MET units by IPAQ) from baseline to weeks 2 and 4 for all three conditions.



The repeated measures 3x3 ANOVA revealed the condition to be significant $F(2, 91) = 3.81$, ($p=.026$, partial $eta^2 = .07$), however time, $F(2, 91) = 2.77$, $p= .068$, partial $eta^2 = .05$, and interaction between conditions and time being non-significant, $F(4, 91) = 0.87$, $p = .48$, partial $eta^2 = .03$. A post hoc Tukey's HSD test revealed that the FIT group scored significantly higher than the guided imagery conditions differed significantly (Mdif=1272, $p = .034$) with advice condition not varyingly significantly from the two imagery-based conditions.

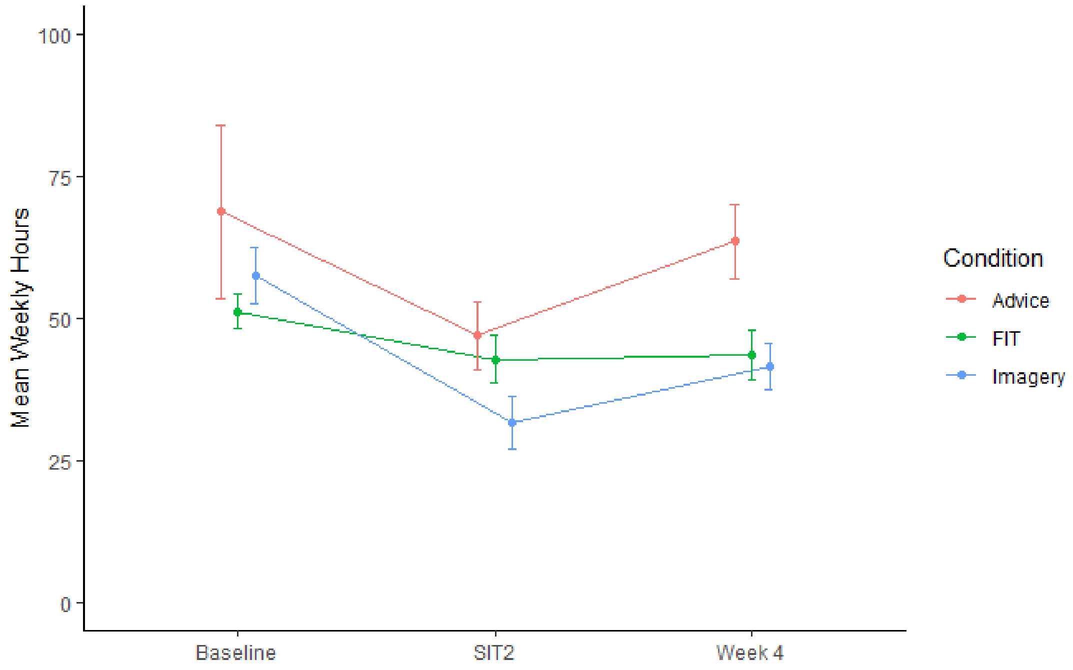
I added imagery vividness at baseline as a covariate in predicting the total MET score at week 4 depending on the condition. Imagery vividness at baseline itself did not have an effect on final MET at week 4, $F(1,22)=0.63$, $p = .43$, partial eta^2 =.02 , however it had a significant interaction with condition, $F(2, 22) = 4.1$, $p=.031$, partial eta^2 = .23. Therefore, the interaction between the group allocation and baseline imagery could predict the physical activity at the end of the intervention (week 4).

8.4.4. Sitting hours

As the activity levels increased as reported above, the sitting hours reduced for all conditions at week 2 and 4 as seen in Figure 11.

Figure 11

The changes in the number of sitting hours a week from baseline to weeks 2 and 4 for all three conditions.



The repeated measures 3x3 ANOVA showed Time to have a significant effect on sitting hours, $F(2, 91) = 4.48$, $p = .014$, partial eta^2 =.08, and Condition to be significant too, $F(2, 91) = 3.36$, $p = .039$, partial eta^2 =.06, with interaction between condition and time not being significant, $F(4,91) = 0.57$, $p = .69$ partial eta^2 =.02. The post hoc Tukey's test revealed that the differences between FIT and advice conditions to be significant (M=15.3, $p = .042$) and between imagery and advice to be approaching significance (M=14.6, $p = .067$). Baseline imagery vividness had no statistically significant effect on the sitting hours across a condition or time of measure.

8.4.5. Adherence scores

I analysed self-reported adherence to the self-selected exercise plans as measured by the EARS scale: visually there were very little differences between the conditions at week 2 and week 4 (no baseline as no previous exercise goals and plans were applicable).

Advice-only group had the lowest adherence score at week 2 (M=1.67), with FIT group being slightly higher (M=1.86) and guided imagery the highest (M=2.33). There were small changes to adherence at week 4 with advice group (M=1.92) and guided imagery (M=2.35) increasing ever so slightly and FIT group decreasing (M=1.79). No differences in adherence scores between any conditions, $F(2, 49) = 1.68$, $p = .2$, nor between the times, $F(1, 49) = 0.01$, $p = .91$, were found to be statistically significant.

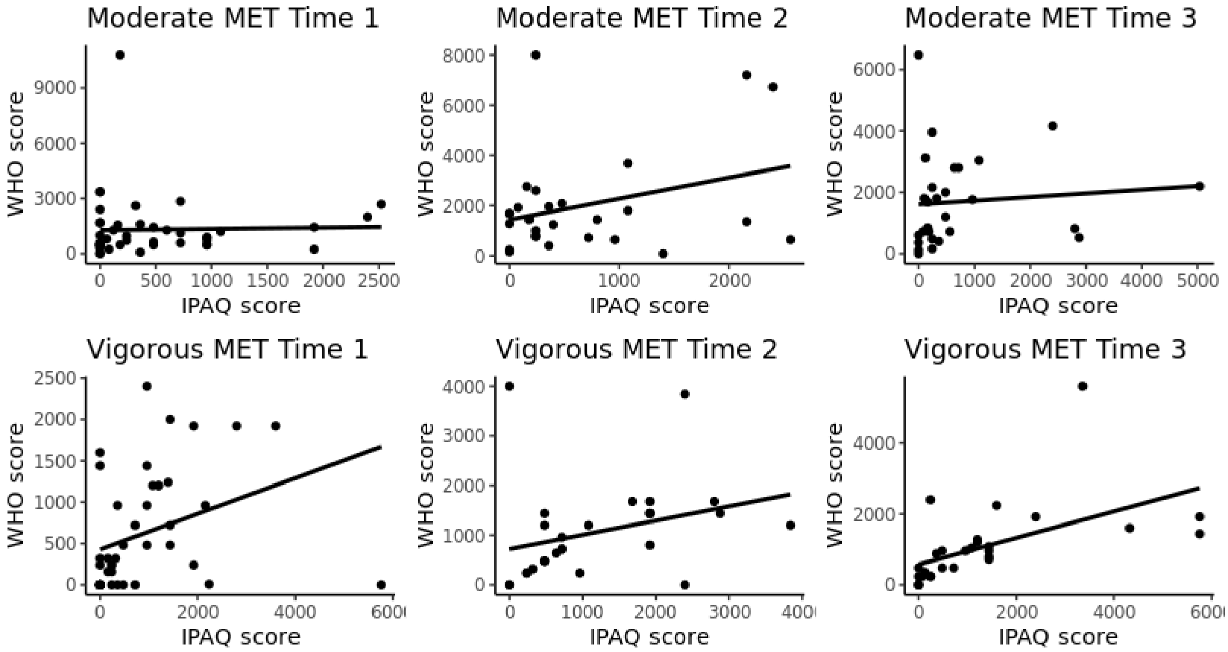
8.4.6. Correlation between IPAQ and WHO

I correlated moderate and vigorous scores on both scales at baseline, week 2 and week 4 to assess the reliability of both measures. Walking and sitting amounts were not correlated as WHO measures did not ask about these variables.

No moderate activities measures were significantly correlated at Time 1 ($r=.027$, $p=.8$), Time 2 ($r=.3$, $p=.13$) and Time 3 ($r=.16$, $p=.41$). The number of vigorous activities are correlated at Time 1 ($r=.54$, $p<.001$) and Time 3 ($r=.69$, $p<.001$), but not at Time 2 ($r=.3$, $p=.13$).

Figure 12

The scatterplots for all moderate and vigorous physical activity measures at times 1, 2 and 3. The logarithm of MET was applied too, with no difference to the patterns presented.



8.5. Discussion

The primary aim of this study was to analyse the effectiveness of imagery-based interventions in increasing goal-based PA in comparison to exercise advice only. The results were mixed; all groups increased in PA over two weeks, however only FIT group retained that difference after 4 weeks from the intervention. Therefore, the effectiveness of exercise advice was higher than previously anticipated, which potentially impacted the anticipated post-intervention difference between the conditions. The NHS advice and recommendations appear to be effective with a potentially already motivated group. This was not consistent in the sitting duration analysis as the FIT and Imagery groups had larger reduction of sitting over 4 weeks, with FIT group being the only significantly different to the advice group. This proposes that the not-goal-related (participants choose to exercise, not to be less sedentary) behaviours might be more affected by the discussion of personal importance, goals and multi-sensory imagery than the advice to be active only.

The FIT group appeared more motivated to increase overall PA in comparison to the group, which received the guided imagery over 4 weeks, proposing the effectiveness of MI over the advice for imagery interventions. This can be explained by the need of self-selected imagery scenarios leading to the autonomy of their imagery choices rather than the suggested one; this can lead to more immersiveness and engagement in the imagery practice. The results suggest that incorporating motivational interviewing techniques, such as discussing goals and personal importance, before engaging in imagery-based interventions, may enhance their effectiveness. By exploring individuals' motivations and values, motivational interviewing sets the stage for more meaningful and personalized imagery experiences, increasing engagement and motivation for goal-based physical activity. The findings also highlight the potential role of mental contrasting in motivating behaviour change as this intervention is only present in FIT with comparison of negative and positive imagery in order to enhance the intrinsic motivation. Mental contrasting involves contrasting the desired outcome with the current reality or negative consequences in the future, which can help individuals recognize barriers and develop strategies to overcome them. By integrating mental contrasting techniques alongside guided imagery, individuals may be more motivated to engage in physical activity and make progress towards their goals.

This study has also highlighted the need of portraying FIT as a model of active components. The study suggests that the effectiveness of Functional Imagery Training (FIT) may be attributed to its combination of active components, such as goal setting, guided imagery, and motivational interviewing. By presenting FIT as a comprehensive model that integrates these elements, practitioners and researchers can better understand its mechanisms of action and optimize its implementation for promoting goal-based physical activity.

Furthermore, they can also understand how each element affect particular psychological outcome.

The findings also highlight that this sample of participants had similar levels of imagery ability at the start of the intervention. This suggests that once individuals were informed about the recommended physical activity guidelines, their imagery ability might serve as a bridge between motivational thoughts and actual behaviour change. The imagery practice provided through FIT may have facilitated the translation of motivational thoughts into actions, ultimately leading to increased physical activity engagement. Furthermore, the imagery ability at baseline had an interaction with the condition of allocation, therefore further suggesting imagery ability being the moderator in these imagery-based interventions.

The correlations between the moderate and vigorous measures in IPAQ and WHO varied from virtual no relationship to very strong, despite asking questions about the quantities of the same activities in the same time period. The most extreme example had a difference of 25 hours of moderate activities in one week. I have also looked at this comparison in previous chapter and the differences between the measures appear consistent across these two studies.

Participants self-reported their adherence to be statistically equivalent for all conditions and times, where from the analysis of the overall MET score and sitting duration, I am aware that this might not be true or at least it varied – this proposes that the adherence should change over time. The combination of consistent self-reported adherence despite a change in physical activity and wide range of correlations between the PA measures, I propose the need of objective trackers of movement rather than the use of self-reported measures.

8.5.1. Limitations

This experimental design had certain flaws, which were not transparent until the study was conducted. Participants in exercise advice received elements of MI as result of asking questions and discussing their goals and barriers aloud with the researcher. The script encouraged participants in the exercise advice group to answer whether they can do the recommended levels of physical activity and what they would do as a part of their self-selected plan. Therefore, the amount of MI was much higher in the FIT group, however it was not possible to completely isolate the MI spirit and elements outside of the FIT condition. Furthermore, the one-session FIT (with only boosters as follow-up) might not encapsulate the training of multi-sensory imagery with participants not having enough time to tailor their imagery to different situations and gain motivation in using imagery. Perhaps the extended, multi-session nature of FIT is required to improve motivation further in the future.

Participants had the freedom to choose their own exercises in all of the conditions to meet the recommended criteria, therefore the differences for each intensity of the exercise are difficult to track down; additionally, if their plans or fitness levels improve the amount of each intensity might vary, e.g., more participants engaging in vigorous activities towards the end of the trials, therefore less moderate activities. Also the dropout rate was higher than anticipated with approximately half of the participants not completing the intervention.

IPAQ created an issue with some answers being not understood by the participants which resulted in manual identification and re-calculating; I have only addressed the data that was physically impossible e.g., not enough hours in a week to complete these many hours of physical activity.

8.5.2. Further research

The effect of being allocated to the advice group has successfully engaged individuals to be more physically active as approximately 80% of organised, research-based interventions reported an increase in the control group, possibly due to behavioural measurement or participant characteristics (Waters, et al, 2012). However, this effect in this study was rather shot-lived as no increase or adherence to the initial increase was observed at week 4. The further investigation of the control condition with inactive intervention, such as waiting list with the group receiving the advice is required. These results also suggested that our effect size and power calculations were not accurate. The impact of only instructing participants what to do and to what degree should be investigated to act as a reliable comparison condition for other interventions. The effect size of this investigation can serve as a reliable factor in calculating the minimum sample size.

8.5.3. Implications

The purpose of MI has been highlighted in this study as potential factor in effectiveness of guided multi-sensory imagery. I proposed that the personalised goals and their importance with the autonomy to choose what activities individual wants to engage in are key in achieving the self-selected physical activity goals. Additionally, it may also impact other health-related behaviours such as less time spent sitting down.

8.5.4. Conclusion

The majority of differences between the conditions were statistically significant suggesting that imagery or just reporting of the exercise behaviours has short term motivational benefits, especially as multi-sensory modalities are engaged. Furthermore, the effectiveness of FIT in increasing PA and reducing sitting behaviours suggests the importance of elements around imagery interventions: autonomy, training of imagery ability over the time of the intervention and mental contrasting; all have an impact on adherence to self-selected PA-goals. Therefore, adding these elements could be crucial in ensuring the effectiveness of imagery-based interventions over long-term.

8.6. Chapter summary

In this chapter, several key findings have emerged that hold significant implications for the investigation of the effectiveness of imagery in promoting physical activity. This study highlights the value of engaging in motivational interviewing techniques to discuss goals and personal importance before applying imagery-based interventions. This finding suggests that taking a person-centred approach that considers individuals' unique motivations and aspirations can enhance the effectiveness of imagery interventions in promoting physical activity. By tailoring the imagery experiences to align with individuals' goals, it is more likely to increase their motivation and adherence to the recommended physical activity behaviours.

Furthermore, the results indicate that incorporating mental contrasting, which involves comparing desired positive outcomes with the current reality or negative consequences, can be beneficial for motivation. By juxtaposing positive and negative outcomes, individuals may gain a clearer understanding of the potential benefits of engaging in physical activity and the potential costs of remaining sedentary. This contrast can further enhance motivation and drive individuals towards behaviour change. The study provides further evidence supporting the notion that imagery ability acts as a bridge between motivational thoughts and actual behaviour change. The findings suggest that once individuals are informed about the recommended physical activity guidelines, their imagery ability plays a significant role in translating their motivational thoughts into actual behaviours. This emphasizes the importance of nurturing and developing imagery ability as a means to increase exercise adherence and promote sustained engagement in physical activity.

The study acknowledges the issues surrounding the measurement of physical activity, and the findings shed light on the importance of analysing and discussing these challenges. By recognizing the limitations and complexities associated with accurately measuring physical activity, researchers can develop more nuanced and comprehensive approaches to capture individuals' activity levels and better understand the impact of imagery interventions. The study emphasizes the importance of comparing the effect sizes of imagery interventions to different control conditions, such as being told what to do only or being placed on a wait-list. This approach enables a more robust evaluation of the specific contributions of imagery interventions in promoting physical activity, providing a clearer understanding of their effectiveness compared to alternative approaches.

Overall, these findings underscore the significance of considering a person-centred approach, incorporating mental contrasting, nurturing imagery ability, addressing measurement challenges, and conducting comprehensive effect size comparisons in investigating the effectiveness of imagery interventions in promoting physical activity. By incorporating these key insights, future research can advance our understanding of the mechanisms through which imagery influences behaviour change and inform the development of more effective interventions in this domain.

9. How can we improve adherence to treatment in physical therapy patients using Functional Imagery Training?

The previous chapter has established that Functional Imagery Training can be more effective in increasing adherence to self-selected exercise goals at four weeks from the initial intervention. The previous chapters also highlighted the crucial elements of Functional Imagery Training, which will form the initial model of FIT for physiotherapy treatment. The shift in research focus from solely examining physical activity to an exploration of exercise adherence stems from the recognition that motivation is a fundamental determinant in both initiating and sustaining exercise routines. Numerous studies (Bauman et al., 2012; Trost et al., 2002) have consistently identified a lack of motivation as a substantial barrier to engaging in physical activity, proposing the need of investigating one's adherence to the physical activity plan.

The further need of this study comes from the number of physical and sports therapists complaining of low patients' adherence to physical therapy and to the rehabilitation at-home-exercises plans. There is small evidence of role of motivational imagery in rehabilitation adherence during the 8-week rehabilitation process (Wesch et al., 2012). Therefore, this study aims to investigate whether Functional Imagery Training can be used as an addition to the physical treatment process and secondly whether it can improve adherence to the treatment, patients' confidence of recovery and completion of the exercise plan, in comparison to treatment-as-usual (control).

9.1. Overview

Physical therapy (including physiotherapy) is a treatment of disease, injury or deformity by assessment and treatment methods such as anthropometry, massage, heat treatment, and exercise, as an alternative to invasive (surgery) or pharmaceutical (drug) treatments. Physical therapy refers to the holistic approach from prevention to treatment and management of pain, disorder or movement (Australian Physiotherapy Council). It is estimated that the annual cost of musculoskeletal injuries for the UK economy is approx. £7.4 billion a year (Health and Safety Executive, 2010), which is a direct cost on NHS and other government funds.

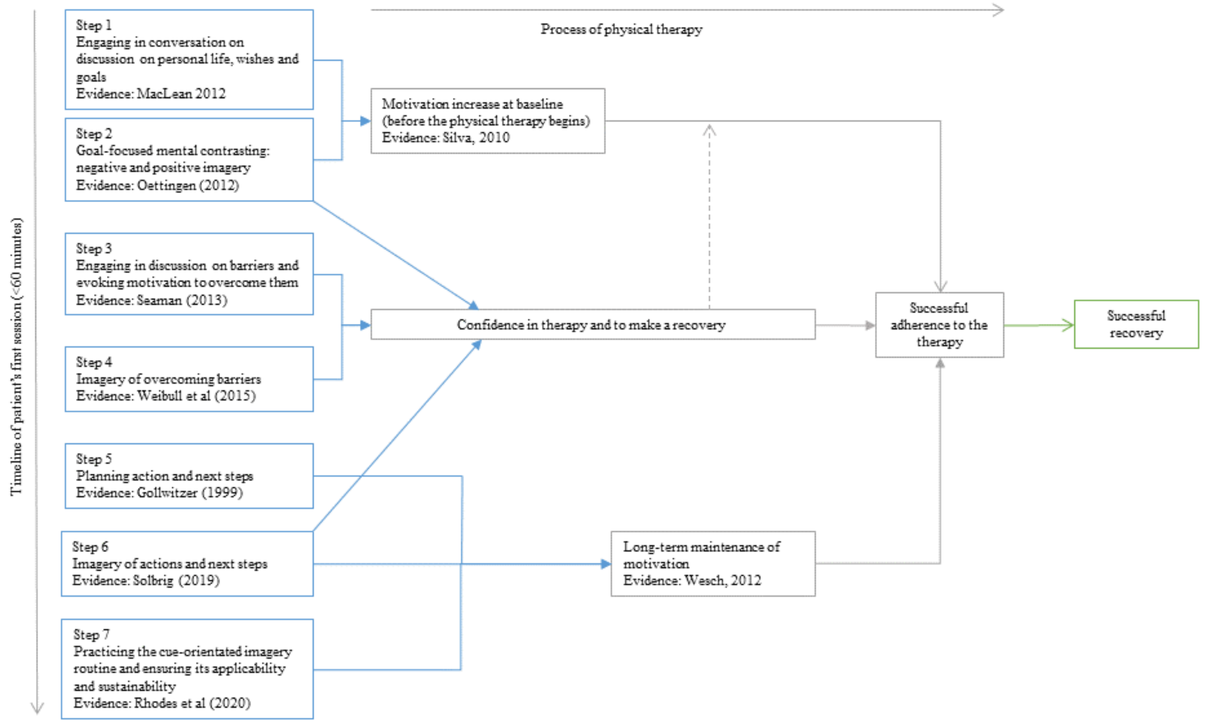
Early intervention with physiotherapy can reduce the amount of time people are off sick and is vital in order to prevent an acute problem becoming chronic (Chartered Society of Physiotherapy, 2012). Poor adherence to physical treatment can have negative effects on outcomes and healthcare cost (Jack et al., 2010). Silva (2010) reported that retention to physical therapy ranged from 45 to 100% in physiotherapy and that some of the patients' reasons for dropping out of treatment include time constraints (Crockett et al., 1986; Long et al., 2004; Schachter et al., 2003 as cited in Silva, 2010) and believing physical therapy was not helpful (Cohen et al., 1983, as cited in Silva, 2010). Maclean and Pound (2000) further explored the patients' rehabilitation motivation in a qualitative study. They identified that high motivation patients prioritised rehabilitation as an important means of recovery and set personal goals for the treatment, such as independence of movement. Desire to leave hospital was also reported as an important motivating factor.

The rationale for incorporating imagery in rehabilitation processes is supported by previous research. Athletes and dancers have reported using imagery for healing, pain management, and injury prevention, as demonstrated in studies by Driediger et al. (2006) and Nordin and Cumming (2005b). Imagery has also been found to have positive effects on knee strength, rehabilitation anxiety, and pain in patients recovering from anterior cruciate ligament (ACL) reconstruction surgery, as shown in the study by Cupal and Brewer (2001). The guided imagery interventions in these studies included visualization of physiological processes, positive emotional coping responses, and engagement of different sensory modalities. Therefore, incorporating imagery into rehabilitation programs can be beneficial for promoting physical healing, managing pain, and enhancing overall well-being (Calmels et al., 2003; Driediger et al., 2006; Nordin & Cumming, 2005; Cupal & Brewer, 2001). Wesch et al. (2012) observed the patterns amongst different variations of imagery, such as cognitive, motivational, and healing, and rehabilitation adherence, its quality, frequency and duration. The levels of these variables remained relatively stable and furthermore they identified motivational imagery to be related to frequency and duration. Unexpectedly, the correlations were negative at the beginning of the rehabilitation process but were positive towards the end of the therapy. This proposes a possible link to explore in improving the adherence and motivation to complete the rehabilitation and treatment.

Functional Imagery Training (FIT) was examined in the previous chapter. As discussed, FIT centres on setting goals, identifying desires, and recognizing the practical obstacles to these goals. This approach is substantiated by research on goal-driven motivation (Maclean et al., 2010) and the use of imagery is further supported by the research on rehabilitation adherence (Wesch et al., 2012). Therefore, I summarised, combined and utilised the existing evidence to create a model of applied imagery for motivation and confidence in physical therapy (AIMC-PT; Figure 13). Firstly, all the active elements of FIT, such as motivational interviewing, mental contrasting and training imagery, have been presented on y-axis as stages that the practitioner goes through.

Figure 13

The model of Applied Imagery for Motivation and Confidence in Physical Therapy.



As Figure 13 shows, the psychological properties addressed by practitioner across the session(s) have been presented on the x-axis, with process and timeline of physical therapy on the y-axis. The psychological properties develop and increase over time and eventually all contribute to the patient's successful recovery. The first steps are a direct result from the previous chapter and are shown to affect psychological properties of successful recovery or behaviour change. This model was created to incorporate the factors of confidence and motivation in the imagery-based behaviour change intervention. This then allowed me to test these factors as a part of the intervention.

The AIMC-PT uses four steps of MI and its philosophy to engage in conversation regarding goals, barriers and planning actions, whilst integrating imagery in three steps to amplify motivation (Renner et al., 2019), and then maintaining the levels of motivation, therefore the adherence to achieving the goal via planned actions. Additionally, the imagery-based elements and conversation regarding overcoming barriers and planning actions increases one's overall confidence in therapy (patients can display competence, but reluctance towards physiotherapy; Anderson & Delany, 2016); positive experience and physiological feedback in therapy could also directly impact self-efficacy to make a full recovery (according to the Self-Efficacy Theory; Bandura 1977).

The MI element of evoking a discussion of the patient's personal situation, goals and wishes is supported by the importance of goals and desires in increasing motivation (MacLean et al., 2012), especially at the start of the rehabilitation (Silva, 2010). Mental contrasting of the goals involving negative and then positive imagery can have a positive effect on the motivation to complete that goal (Oettingen, 2012). Discussing barriers and realistic methods of overcoming them is an important aspect in this model to further evoke the motivation to overcome them in a process to achieve the goal (Seaman, 2013) and further reinforced it with the imagery of overcoming those barriers (Weibull et al., 2015).

The evidence of imagery use and confidence, especially in sports settings, is apparent across the literature (Callow & Hardy, 2001; Munroe-Chandler et al., 2008; Hall et al., 2009), therefore supporting the impact of imagery of actions and next steps in improving the confidence during the treatment process. Developing specific imagery and then equipping the participant with sustainable and easily applicable imagery of actions and next steps can ensure that the motivation to complete the treatment can be sustained over the period of time.

Functional Imagery Training as a combination of Motivational Interviewing approach to elicit discussion and imagery use as a motivational tool is able to support motivation to complete the treatment and increase confidence towards recovery (Solbrig et al., 2018). I theorised that the MI elements improve the motivation at baseline and confidence throughout the treatment, with imagery use improving the motivation to keep attending the treatment every week.

All these combined lead to a successful recovery as a result of adhering to the full treatment, therefore displaying and maintaining a successful behaviour change. I propose that these are the underlying mechanics of successful outcome of the physical therapy supported by applying imagery and MI-style discussion to the physical therapy participants. I set out to compare FIT to treatment-as-usual as a method to improve adherence, retention, and completion of the physical therapy treatment. A secondary aim is to test whether FIT has an impact on patients' confidence of making a full recovery.

9.2. Method

The experimental protocol was approved by the authors' institutional ethics committee. All participants were informed at the start of the study that they could withdraw at any stage. Consent was acquired online.

9.2.1. Design

The intervention study consisted of two independent conditions: Functional Imagery Training for physical therapy and control (treatment as usual), with measures of adherence taken two and four weeks after beginning the study. All the recruited participants came to the clinic with an acute injury and therefore had no baseline physical activity and no plans to adhere to yet. This design allowed a statistical analysis by 2x2 ANOVA and independent t-tests.

9.2.2. Participants and recruitment

Participants were recruited through a single, private physical therapy clinic; the nature of the clinic could attract a specific characteristics population, e.g., very active or sports orientated. The selection criteria identified participants who signed up for a physical therapy, not for a single session (e.g. a relaxing massage) or suffering from chronic injury, which involves long-term management of the injury. This action was essential to select physical therapy patients only. No other requirements were applied.

Twenty participants (M_{age}= 41.3, SD = 13.7) took part in this study, with three participants not completing the 4-week follow up (drop-out of 15%) due to personal reasons (N= 1), no reason stated (N=1) and being advised rest rather than attend treatment sessions (N= 1). Nine were randomly allocated (using randomizer software before the first session) to the FIT condition (M_{age} = 39.8, SD = 14.3) and 11 to a ‘treatment as usual’ control condition (M_{age} = 42.6, SD = 13.8).

A power analysis for a one-tailed two-sample t test (*pwr.t.test* from the ‘*pwr’* package, Champley et al., 2020) with alpha of 0.95, power of 0.8 and the effect size from previous 4-week FIT trial (Andrade et al., 2016) converted to Cohen’s *d* = 0.45 (Lenhard & Lenhard, 2016) gave a minimum sample size N=62, but recruitment had to be stopped abruptly as the outbreak of Covid-19 forced the clinic to close. With 20 participants, the power is predicted to be 0.40.

9.2.3. Measures

Adherence score. Patient Self-Report Scales for the Measurement of Adherence to Home-Based Physiotherapy (Bassett, 2003) adaptation of patient’s assessment for self-report at home purposes was applied. This adaptation allowed the measure of adherence to home-based exercise in comparison to in-clinic treatment, where all scores were averaged resulting in the range of response from zero to five.

Completion of recommended exercises. The percentage of completed exercises based on the physical therapist’s training plan for the patient. It was calculated as a percentage of the minimum number of exercises recommended by the physical therapists, allowing a range of 0% (no completion) through 100% (completing the recommended minimum amount of exercises) to over 100% (completing more exercises than recommended minimum).

Confidence score. A single question 'How confident from 0-100 are you that you can achieve your goals and overcome/manage your injury?' This question was asked as baseline, 2 week and 4 week follow up.

Physical activity. A single question and follow up: 'Have you been physically active in last two weeks? If so what activities have you completed?' was asked to find out if participants had completed any exercises or activities beyond the exercises recommended. The participants had an opportunity to list the activities without any restrictions, so they could include any activities they perceived to be relevant.

Return to physical therapy. A single question 'Have you been back for any more appointments since two weeks ago?' was asked to analyse if participants returned and completed the treatment.

9.2.4. Procedure

Patients who signed up for a treatment were approached to ascertain if they would be interested in taking part in the study about adherence to rehabilitation. Participants were then randomly allocated to a FIT group (experimental) or TAU (control), according to a randomising software (ww.randomizer.org). A four-week duration was agreed with the physical therapy team as the lowest treatment time in the clinic; therefore any participants would be asked to complete at least four weeks of visits and treatment. The participants in the first session had no exercises to complete or plan to adhere to yet, they hadn't returned to therapy, and due to injury they were not exercising, so no baseline measures taken.

Participants in the FIT group received a brief (up to 30 minutes) intervention at their initial appointment. In that session participants were asked about their goals related to physical therapy and recovery, were instructed how mental imagery works and practiced the use of imagery for their injury- and recovery-related goals.

Upon consent from participants, researchers received the copy of their exercise plan to be able to calculate the percentage of completion. Participants in both conditions received phone calls at 2 and 4 weeks after their initial physical therapy appointment. All the measures were asked to each participant.

9.2.5. Functional Imagery Training script

The Functional Imagery Training script (in more details in Chapter 8, section 3.5) involved the elements of the model (in this order). (1) An introduction and general chat about the patient, their life and current situation, additionally the patient's wishes and outcomes from this treatment. This is at core the person-centred approach to build the rapport with the person through active listening skills allowing the patient to express themselves fully. (2) Mental contrasting of those goals is an emotionally charged part of the session and this process requires open-ended questions and reflective listening to ensure a deep understanding of the patient's aspirations and emotions. (3) Discussing any obstacles or barriers, which might be potentially prevent the patients from achieving their goal is a crucial element of MI as it involves reflective listening and summarising skills to encourage the patient to express any challenges the patient may face. (4) After identifying obstacles, guided imagery techniques are used to help the patient imagine the possible methods and strategies to overcome these barriers. This step is where MI skills of empathy and collaboration are crucial to empower the patient in finding their solutions and then immersing themselves in imagery of overcoming them. Furthermore, it is important for the practitioner to roll with any resistance that this change might be bringing. (5) Then, the patient is encouraged to create a plan of action for the treatment based on their knowledge and experience. At this point, the reflective listening plays a role in clarifying the patient's intentions and ensuring they are realistic while maintaining the person-centred approach (patient is the expert as they hold all the knowledge and experience to make a decision or a plan). (6) The patient then engages in guided imagery of themselves taking the planned actions. This is another opportunity for reflective listening to reinforce the patient's commitment to their goals and identify any restrictions or barriers still present. (7) The session concludes by helping the patient create a brief imagery scenario. This scenario is practiced ensuring its practicality and sustainability in the patient's daily life. The patient is encouraged to use this specific imagery scenario daily, reinforcing their motivation and commitment.

9.2.6. Data Analysis

Significance was measured at the .05 level (Lakens, 2013), and Bayesian tests were also conducted. The complete dataset for item responses and total score are available, including the corresponding analysis code which was completed in R (R Core Team 2018). The data and the corresponding code are available in Chapter 9 folder via this link: https://osf.io/tbekp/?view_only=b7497391850a4f31805d4ec558c8abfd

9.3. Results

There was no difference in the number of participants returning for treatment at 2 weeks t(14)=1.15, p=.14 (all returned except 2, who withdrew without any reason stated). All participants in the FIT group returned for treatment at 4 weeks, but only 78% of the control condition did; this difference was statistically significant $t(12) = 1.85$, $p = 0.044$.

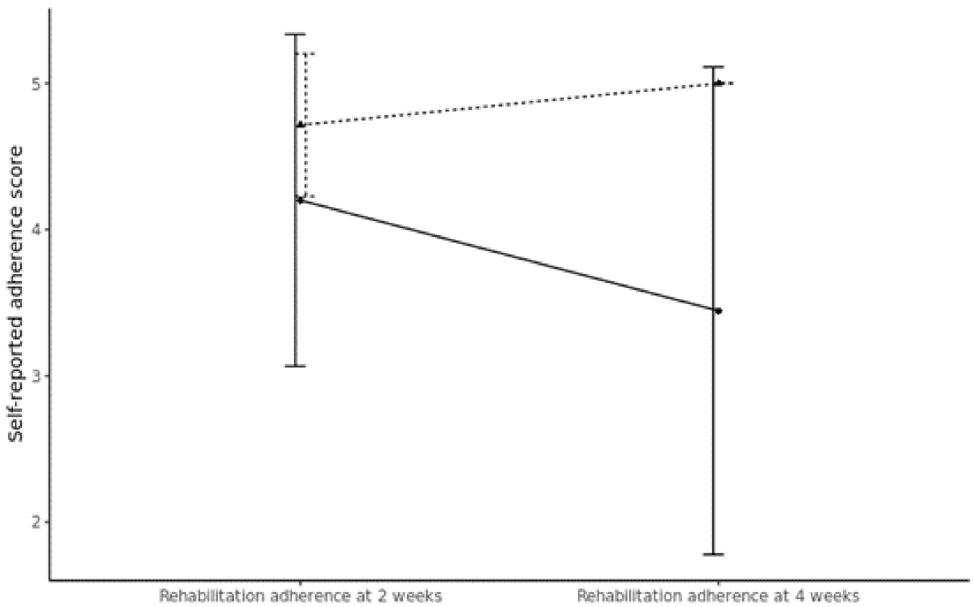
FIT group had a much higher self-reported adherence at week 4 (M=5) in comparison to the control group (M=3.44), furthermore, their adherence increased from week 2 (M=4.71), where control groups has lowered from week 2 (M=3.44). See Figure 14 for the visual representations of these effects.

The self-reported rehabilitation adherence to home-based exercises revealed no group (F(1, 13) = 3.5, $p = 0.08$, BF = 1.43, partial eta^2 = .21) or time effect (F(1, 13) = 0.56, p =

0.47, BF = 0.57, partial eta^2 = .04), but some evidence of an interaction ($F(1, 13) = 5.01$, p = 0.043, BF = 2.08, partial eta^2 = .28).

Figure 14

The means (and SD) scores for self-reported adherence by time and group. The dotted line signifies FIT and solid line the control group.

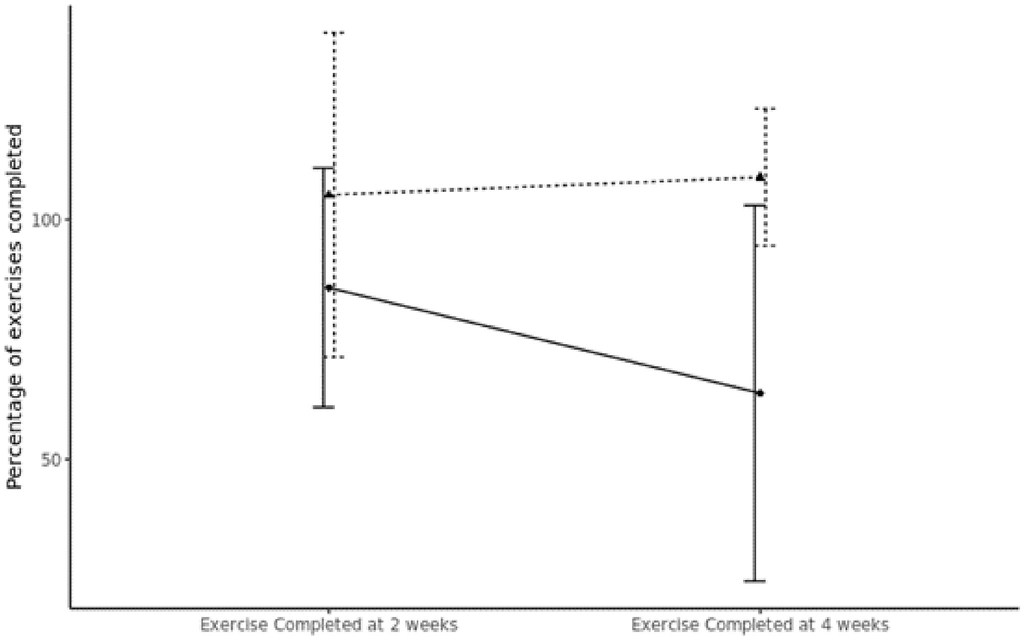


Participants in FIT group maintained the recommended exercise completion (in percentage) from week 2 (M = 105.14) to week 4 (M=108.83), where the control group had a decrease from week 2 (M = 85.8) to week 4 (M=63.78). Again, the visual changes can be seen in Figure 15.

Participants in FIT group completed more exercises than control participants ($F(1, 13)$ = 5.86, p = 0.03, BF=2.29, partial eta^2 = .31), but no effect of time ($F(1, 13) = 0.95$, p = 0.35, BF = 0.64, partial eta^2 = .07) or an interaction ($F(1, 13) = 1.65$, p = 0.22, BF = 0.9, partial eta^2 = .11).

Figure 15

The means (and SD) scores for percentage of the recommended exercises completed by time and group. The dotted line signifies FIT and solid line the control group.

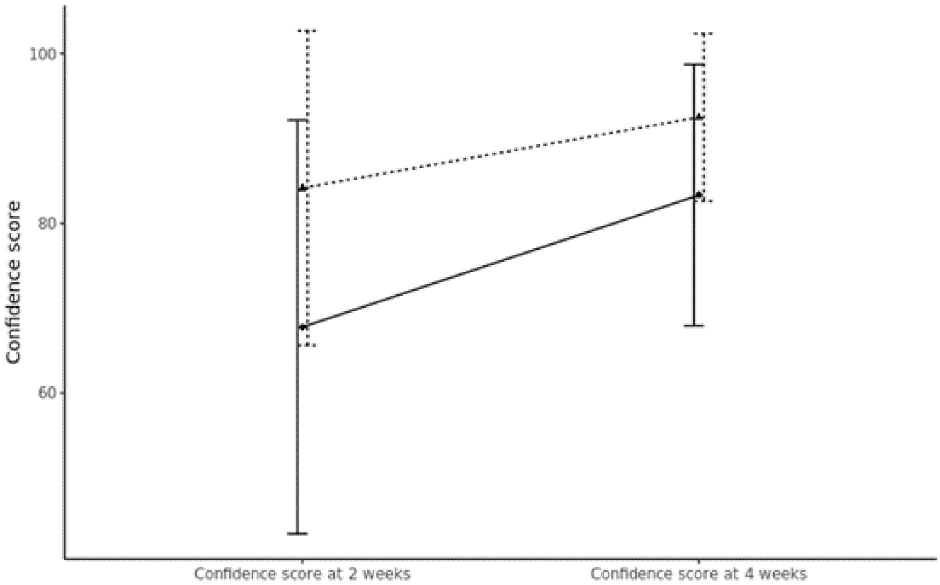


Participants in both groups increased their confidence of making a full recovery across the therapy. FIT group had higher confidence at week 2 (M = 84.17) and week 4 (M = 92.5), in comparison to the control group at week 2 (M = 67.78) and week 4 (M = 83.33). The patterns can be seen in Figure 16.

Participants in the FIT group scored higher on confidence than control participants (effect of group, $F(1, 11) = 6.35$, $p= 0.028$, BF= 0.75, partial eta^2 = .37), but there was no effect of time ($F(1, 11) = 3.42$, $p=0.09$, BF = 2.28, partial eta^2 = .24) or interaction ($F(1, 11) = 0.65$, $p=0.44$, BF = 0.54, partial eta^2 = .06).

Figure 16

The means (and SD) scores for self-reported confidence by time and group. The dotted line signifies FIT and solid line the control group.



Unexpectedly, all participants reported being physical active beyond the therapy-recommended exercises. The most common activities included: Yoga, Gym/Crossfit/Weightlifting, Martial arts, Walking/ Dog walking, Swimming, Freediving, Rugby, Netball, Rowing, Pilates, Additional stretching and Triathlon.

9.4. Discussion

FIT can be utilised for physical therapy to increase confidence and adherence; this can be achieved with relatively low cost and time (one session at the beginning of the 4-week treatment). Confidence, exercise completion and return to treatment are the most impacted variables, which can then lead to adherence. All participants remained active beyond the exercises, but FIT participants displayed higher scores for treatment-related measures. All participants also completed activities outside of the therapy plan and rehabilitation exercises. Therefore, it is important to notify the uniqueness of this sample in being active.

9.4.1. Model reflections

The mechanisms of behaviour change and physical therapy share common elements that make the application of Functional Imagery Training (FIT) relevant in various settings beyond the specific context of this study. Firstly, both behaviour change and physical therapy involve addressing individual motivation and goals. FIT, with its integration of Motivational Interviewing (MI), facilitates a person-centered approach that explores patients' personal situations, goals, and desires. This aligns with the importance of goal-setting and desires in increasing motivation, as supported by existing literature. By eliciting discussions and addressing barriers, FIT promotes motivation to overcome obstacles and achieve goals, which is crucial in both behaviour change and physical therapy.

Secondly, imagery plays a significant role in enhancing confidence and self-efficacy, which are vital factors in both behaviour change and physical therapy. The literature consistently shows that imagery use improves confidence and enhances performance in sports settings. By developing specific imagery and providing individuals with sustainable and applicable imagery of actions and next steps, FIT can increase confidence and motivation to complete treatment, whether it is in the context of behaviour change or physical therapy. This common mechanism of imagery's impact on confidence suggests that FIT can be successfully applied in numerous settings beyond the specific context of this study.

Overall, the shared mechanisms of behaviour change and physical therapy, such as addressing motivation, goals, and confidence, support the applicability of FIT in various settings. By utilising the MI approach and incorporating imagery as a motivational tool, FIT has the potential to enhance motivation, increase confidence, and promote behaviour change across different contexts. Its adaptable nature makes it a valuable intervention that can be tailored to meet the unique needs and goals of individuals in various settings, providing a versatile approach to promoting positive health outcomes and facilitating sustained behaviour change.

9.5. Experiment 2

Based on the findings of Study 1, I concluded that FIT can be successfully applied in acute physical therapy environment. The aims of the second experiment were to explore the feasibility of using FIT as a part of multidisciplinary team in managing and treating chronic injuries. I predicted that a combination of physical therapy and psychological intervention of Functional Imagery Training would increase the confidence in and adherence to physical therapy, resulting in successful management of chronic injuries.

9.6. Methods

9.6.1. Participants

Four participants (M_{age} = 39.25, SD = 13.72) with chronic injuries were recruited through advertisement in a local college and from participants, who were unable to take part in experiment 1, as they had signed up for single consultation sessions rather than a course of treatment.

Participant 1: a 29-year-old teacher, mostly engaged with powerlifting exercises; had a chronic (4 years) lower back injury, affecting the spine, specifically the Lumbar 3-4 region: restricted side flexion range of motion, mild lordosis, weak hip flexor activation & flexibility and imbalance in gluteus maximus. Participant received the exercises to be conducted three times a week with the aim of activating the gluteal muscles and hip flexors/abductors, improve hip flexor flexibility and increase core strength.

Participant 2: a 49-year-old dock yard worker, engaged in cycling and indoor climbing; had cervical radiculopathy, with symptoms of radiating arm pain and numbness (Eubanks, 2010). The participant was given exercises to be conducted daily; they focused on increasing range of movement (RoM) and flexibility in the cervical and thoracic region.

Participant 3: a self-employed 53-year-old, engaged with golf and competitive shooting; had several complaints following a motorbike accident 10 years previous. The most detrimental ailments to his quality of life were frequent headaches, tinnitus, chronic paraesthesia in the 5th phalanx of his right hand, weakness in arms and lack of confidence to lift objects like a cup. Participant were given a 3-session-a-week program; the objective of the exercises was to increase: motor skills, muscle activation, proprioception, and confidence in lifting, eliminate paresthesia in his finger and reduce muscle tension in his upper back.

Participant 4: a 26-year-old prison worker, playing football and previously rugby; had chronic stiffness and pain in his hamstrings. Assessment identified a lordotic posture, anteriorly tilted pelvis (Levine & Whittle, 1996), weak hip flexors, inactive Gluteus Maximus, weak core and poor flexibility in the hamstrings (Hennessy & Watson, 1993) and hip flexors. This participant was given a 3-day program with the objective to increase flexibility in the hip flexors and hamstrings with active stretching, increase glute, hip and core activation (Noffal et al., 2013; Contreras et al., 2015; Lee et al. 2016).

9.6.2. Procedure

Every participant received FIT for 30 to 45 minutes individually before any physical therapy. During those sessions participants were encouraged to discuss their goals, barriers and overcoming them. At each stage participants were guided to practice and master imagery as a skill. The same script as previously was applied and the full version of it is available online (https://osf.io/n3g4a/?view_only=d2491cb3f02044a1b1a5e58c16106282). The follow up sessions were based on refining imagery practice and amplifying motivation for goals.

Each participant was assessed and received treatment from a physical therapy student once a week for 4 weeks. The manual therapy, dependent on the injury type, included Muscle Energy Techniques (METs) (Waseemet al., 2009), Deep Tissue Massage (DTM), Mulligan’s (Exelby, 2002) and Maitland’s mobilisations (van Trijffel et al., 2014), soft tissue massage and Soft Tissue Release (STR), passive stretching, muscle activation and exercises (Hardwick et al., 2006). Each participant also received a list of recommended exercisers with the frequency to conduct them weekly, specific to their injury. Exact exercises recommended to each participant are available in the supplementary materials. Measures were collected at baseline and then at 1, 2, 3 and 4 weeks.

The remaining participants were approached at 8 weeks after the initial session and asked for qualitative feedback regarding the intervention, imagery use and general thoughts about this multi-disciplinary approach. The qualitative form included questions such as 'How is the imagery? And how are you getting on with it? Are there any changes to the visualisation that you have been using?' and 'Prior to commencing physical therapy, how confident were you of achieving your goals?' Out of three participants, only one replied.

9.6.3. Measures

Completion of recommended exercises. The percentage of completed exercises based on the physical therapist's training plan for the patient. As in Experiment 1, it was calculated as the percentage of the minimum number of exercises recommended by the physical therapists, so could exceed 100%. This was recorded at 1, 2, 3 and 4 weeks of the therapy; participants had no exercises to complete at baseline.

Confidence score. A single question 'How confident from 0-100 are you that you can achieve your goals and overcome/manage your injury?' This question was asked at baseline and then at 1, 2, 3 and 4 weeks.

Vividness of imagery. The question of "How vivid was the image, on a scale of 0-5? 0 being nothing at all and 5 being as vivid as real life" was asked three times in the first session to score three different imagery scenarios (exercise, negative imagery and positive imagery).

9.7. Results

9.7.1. Psychological

At baseline, participants rated their confidence of achieving their goal and overcoming the injury. One rated this at 70%, two at 80%, and the fourth at 100%. By session three, all were at or above 90% and remained at this level through to session 5.

Participants demonstrated a range of scores for the vividness of the imagery at the beginning of session 1 ($M = 3$, $SD = 0.82$), however all participants had a higher score of vividness at the end of the session ($M = 4$, $SD = 1.41$).

One participant reported very low scores in the measurements and admitted to not be able to hold an image in their head during the FIT session, despite reporting being able to imagine a whole climbing route after 4 weeks. At 8 weeks this participant reported "still struggling with the long term imagery but using it more in my climbing when working on problems." When asked about confidence in making full recovery at 8 weeks after the initial session, this participant also scored it at 90, stating that, "stress is often a trigger for my back problems. I am more confident now though that these issues can be dealt with." And when asked about likelihood to drop out during the 4 weeks of the physical therapy, participant reported "none, I wished it had gone on longer."

9.7.2. Physical

All participants completed or exceeded the rehabilitation exercises recommended by the physical therapist in the first 2 weeks. In the latter two weeks, two participants dropped below the minimum exercises, but remained at or above 90%. All participants engaged in or returned to additional activities, such as powerlifting training plan, climbing, cycling, farm work and football. Three participants completed a 4-week plan, with one participant dropping out at week 3 without reporting any reason. The same participant mentioned above has also reported their adherence to the therapy and the process to be "relatively easy" and motivation to complete the clinic- and home-based exercises “easy at the time […] but I started to forget to do the exercises once my clinic sessions were over.”

9.8. General Discussion

FIT increased overall confidence in successful recovery, motivation to complete the exercises recommended by the therapists and adherence to return to complete the treatment. For physical therapy of general injuries, this can be achieved at relatively low cost and time (one session in a 4-week treatment). The chronic injuries require more of the multi-disciplinary approach and involvement to assists the patients in treating and managing the chronic injuries; therefore, requiring more time, staff, and resources. Furthermore, all participants remained active beyond the exercises, but FIT participants displayed higher scores for treatment-related measures. Considering the annual cost of musculoskeletal injuries to NHS and the risk of acute injuries becoming chronic, this is a very sustainable and achievable option to reduce these costs and risks. FIT assists adherence and confidence to take part in physical therapy, even with chronic injuries. Furthermore, the psychological aspect of this multidisciplinary approach ensures that participants had necessary tools (imagery use) to manage chronic injuries through motivation of overcoming the injury.

One notable example from the experiment 2 was the progression of a participant’s imagery vividness over the course of 4 weeks. Initially, the participant reported having virtually no imagery ability. However, through the structured FIT intervention, which included guided imagery exercises and discussions, the participant gradually developed the ability to generate and control vivid imagery scenarios. This progression highlights the potential for individuals to enhance their imagery vividness with the support and guidance provided in the FIT program. It suggests that even individuals who initially struggle with imagery vividness can benefit from the intervention and experience improvements in motivation and behaviour change. By providing structured guidance and opportunities for practice, FIT can help individuals develop and enhance their imagery skills over time, leading to more immersive and engaging imagery experiences. The process of developing imagery ability from virtually nothing to self-controlled, self-generated scenario is further explored in Chapter 11.

9.8.1. Model discussion

In the AIMC-PT, I proposed how each of these variables is impacted by the elements of the applied imagery intervention and how these factors can contribute to successful adherence. It is not possible to single out how each step in the model affects patient's motivation and confidence in the therapy. However, the evidence from these studies, combined with the one from the existing literature, support the holistic model of psychological impact of applied imagery for motivation and confidence in physical therapy. In other words, I can conclude that the steps presented in this model are mechanisms underlying the effects of MI, guided imagery and mental contrasting on adherence, motivation, and confidence to therapy. I invite further research into the elements and the overall process of the AIMC-PT. In format, this model can be presented to physical therapists who wish to use FIT as a psychological tool to increase the adherence and confidence in their patients.

9.8.2. Limitations

A private physical therapy clinic potentially attracts more motivated and active population due to the self-referral system. Therefore, this population might display higher awareness of their own health and wellbeing, physical activity level, the professional approach to sport and general affordability of private healthcare. In contrast, future studies should be conducted with the physical therapy departments in NHS with hospital and public clinic patients.

Due to the design of the first experiment (no ability to measure baseline) and group differences, but no interaction, I cannot conclude whether the intervention differed, or groups differed, despite the intervention. A usual limitation of a pilot study is its size and application of the findings; I hope this research will be able to continue after the lockdown restrictions are lifted but appreciate the timely manner of sharing these results within our research window.

9.8.3. Future research

Alongside prevention of developing chronic injuries, the second study provided some degree of evidence that FIT can be used to help participants; further full-scale experiment is required to provide power-supported evidence for this effect. Additionally, the types of chronic injuries can be categorised to be observed whether this effect is universal regardless of the type of chronic injury.

In experiment 1 especially, participants could complete more exercises than recommended minimum and were encouraged too. Rodgers et al. (2001) found that imagery use can lead increased obligatory exercises resulting in negative impact on physical and mental health. Therefore, future studies should work closely with the physical therapists to establish a maximum level of recommended exercises and investigate whether the imagery use can result in excessive exercises. I propose the future evidence to conduct large scale interventions and investigate the risk of over-exercising during the rehabilitation process.

9.8.4. Conclusions

FIT can be utilised as an effective method in supporting the psychological aspects of physical therapy, such as adherence to treatment, confidence of recovery and completion of the exercise plan. One session delivery before the treatment or right at the beginning was sufficient to improve adherence and completion. There is some early evidence for FIT to assist the management and treatment of chronic injuries. The theoretical model proposed before this study is supported by previous evidence and the one generated in this study; furthermore it supports the understanding of how these effects can be produced. Finally, FIT can be incorporated into treatment-as-usual of the physiotherapy patients.

9.9. Chapter summary

The key findings of this chapter highlight the potential of Functional Imagery Training (FIT) as a valuable tool in clinical settings. Firstly, the study demonstrates that FIT can effectively be utilized in the context of physical therapy to enhance adherence confidence, motivation, and adherence to the treatment program. By incorporating guided imagery exercises, discussions, and goal-setting within the therapeutic process, FIT provides a comprehensive approach that addresses both the physical and psychological aspects of rehabilitation. This can lead to improved treatment outcomes and patient satisfaction.

Furthermore, the study suggests that FIT has the potential to be beneficial in managing chronic injuries. By employing imagery techniques to visualize the healing process, manage pain, and maintain motivation during the recovery journey, individuals with chronic injuries may experience enhanced engagement in their treatment and better overall well-being.

The progression of imagery ability observed in one participant, from a very poor starting point to self-generated and controlled imagery, highlights the potential for imagery ability development through the implementation of FIT. This finding suggests that even individuals who initially struggle with imagery can experience significant improvements and ultimately harness the power of imagery for motivation and behaviour change. Further research is encouraged in the field of poor imagery ability at the start of the intervention.

The results of this study also contribute to the development of the FIT model for physical therapy and behaviour change interventions in general. By demonstrating its effectiveness in improving adherence and motivation, the study provides further support for the integration of FIT principles and techniques into existing treatment approaches. This has implications for a wide range of clinical populations and settings, offering a promising avenue for enhancing patient outcomes and promoting positive behaviour change.

Overall, these key findings emphasize the value of FIT as a versatile and effective intervention in clinical settings. Its ability to improve adherence, motivation, and imagery ability development highlights its potential for enhancing the efficacy of physical therapy and facilitating behaviour change. Further research and application of FIT in diverse populations and contexts can help refine the model and expand its impact in the field of healthcare and rehabilitation.

Part 3

Part 3 of this thesis explores optimizing Functional Imagery Training (FIT) to cater to the unique challenges faced by individuals with visual aphantasia, chronic injuries, and broader populations through the integration of exercise professionals. The primary aim of this section is to assess the adaptability and effectiveness of FIT in diverse contexts and populations, thereby contributing to the development of tailored intervention strategies that address individual needs and maximize engagement. Through a series of comprehensive studies, this section aims to elucidate the potential of FIT as a versatile intervention tool that can be effectively integrated into multi-disciplinary approaches and professional practice settings.

Chapter 10 presents a study evaluating the effectiveness of FIT within a short-term interdisciplinary treatment for individuals with Postural Orthostatic Tachycardia Syndrome (POTS). The research findings highlight significant enhancements in various aspects of health and underscore the potential for FIT to serve as a psychological support component in multi-disciplinary interventions for managing complex conditions like POTS. Furthermore, the chapter identifies avenues for future research, emphasizing the need for long-term follow-up measurements and large-scale clinical studies to inform best practices. Chapter 11 delves into the impact of imagery practice on individuals with aphantasia, revealing both challenges and potential benefits. Despite unexpected findings regarding imagery vividness, the study underscores the feasibility of training and utilizing imagery in individuals with aphantasia, emphasizing its potential for eliciting affective responses and motivation even in the absence of visual imagery. Chapter 12 explores exercise professionals’ perspectives on imagery and its utilization in practice. The research sheds light on the perceived value of imagery as a tool for enhancing motivation and exercise adherence among professionals, highlighting the need for structured training programs to enhance their skills effectively. These findings pave the way for future research and educational development in the field of imagery and exercise promotion, ultimately contributing to the advancement of evidence-based practices and intervention strategies. In essence, Part 3 aims to expand our understanding of FIT's adaptability and effectiveness in diverse contexts, providing valuable insights for researchers, practitioners, and policymakers seeking to optimize intervention strategies for improved health outcomes across varied populations and settings.

10. Examining the Effects of Exercise and Functional Imagery Training on Quality of Life in POTS: Feasibility study.

Following the positive results from a case study (Turner et al., 2020) and a previous chapter in this thesis, I conducted a feasibility study to further test how FIT-based intervention could be applied to the specific clinical population.

Postural Orthostatic Tachycardia Syndrome (POTS) is a complex cardiac condition that significantly impacts an individual's circulation and overall well-being. Living with POTS can be life-changing for many patients, affecting their daily activities, mobility, and overall quality of life (QOL). Given the challenges associated with POTS and the need for effective interventions, this feasibility study aims to evaluate the potential of a multi-disciplinary team approach in improving QOL for individuals with POTS. By assembling a team of healthcare professionals from various disciplines, including physicians, physiotherapists, psychologists, and nutritionists, this study seeks to provide comprehensive and holistic care to POTS patients.

The primary objective of this feasibility study is to assess the viability and practicality of implementing a multi-disciplinary approach in managing POTS. By involving professionals from different specialties, the study aims to address the multifaceted nature of POTS and provide tailored interventions, FIT being part of this multi-disciplinary approach, to meet the unique needs of each patient. This approach recognizes that the management of POTS extends beyond the purely medical aspects and encompasses psychological, physiological, and lifestyle factors that influence QOL; this is where FIT showed promising evidence in chronic injury management in the previous chapter.

This study intended to evaluate the impact of the multi-disciplinary team on various outcomes, including symptom management, physical functioning, emotional well-being, and overall QOL. By implementing interventions such as Functional Imagery Training (FIT), which combines guided imagery, goal setting, and motivational interviewing, the study aims to enhance motivation, adherence, and self-efficacy among POTS patients. FIT has demonstrated effectiveness in other populations, and its application in the context of POTS holds promise for improving outcomes and empowering individuals to better manage their condition.

The findings of this feasibility study will inform the design and implementation of larger-scale research endeavours aimed at evaluating the long-term impact of the multi-disciplinary team approach in managing POTS. By establishing the feasibility and potential benefits of this approach, the study aims to contribute to the development of evidence-based guidelines and interventions for individuals living with POTS. Ultimately, the goal is to improve the QOL and overall well-being of POTS patients, providing them with comprehensive care and support to navigate the challenges associated with their condition. I propose that cognitive and motivational imagery combined with exercise is the most effective method to improve QOL in POTS patients.

10.1. Overview

Postural Orthostatic Tachycardia Syndrome (POTS) is a heterogeneous condition of the autonomic nervous system, which causes an anomalously high increase in heart rate (+ 30 beats per minute, within 10 minutes) upon adopting a standing posture or head tilt (Fedorowski, 2019). POTS can have a devastating impact on a patient's ability to lead a fulfilling life, often rendering them seriously incapacitated, with the need to be bed or wheelchair bound (Conner et al., 2012). This reduces self-confidence and cognitive functioning and can lead to depression (Anderson et al., 2014), affecting physical health, and both psychological and sociological wellbeing (Raj et al., 2018).

Exercise is an essential part of managing the symptoms in POTS, as poor circulation arises due to inadequate vasoconstriction of blood vessels, particularly in the extremities, due to muscle deconditioning and/or peripheral denervation (Low et al., 2009). Depressed patients' lack of motivation to exercise, and fear of bringing on an episode of POTS, increases the potential for physical deconditioning, which causes cardiac muscle atrophy (Fu, et al., 2010) and in the long-term may increase mortality.

Exercise as a method to treat POTS has had success managing symptoms (Richardson et al., 2017; Shibata et al., 2012) through enhancing cardiac and skeletal muscle mass, and improving general fitness to perform daily activities. However, improving fitness has not been shown to enhance quality of life (QOL) in POTS studies. In a case study (Tito & Hess, 2017) using aquatic therapy running over 11 sessions, the POTS participant reported general fitness improvements and a decrease in symptoms such as fainting, but QOL as measured on the 26-item WHOQOL-BREF (WHOQOL Group, 1998; Skevington et al., 2004) decreased on the physical, psychological and environmental health domains. This participant, although improving on the social domain and making physical advances such as walking without her wheelchair and achieving functional goals, scheduled more sessions but either cancelled or did not attend the remaining sessions, failing to complete a final re-evaluation. With self-efficacy and motivation being a vital aspect of rehabilitation, especially in this potentially anxious sample, it would be of interest to establish if motivational goal setting when combined with exercise increases QOL.

General motivational goals from interdisciplinary practitioners have been effective for patients rehabilitating from chronic illnesses (Weiss et al., 2013). Bruce et al. (2016) extensively investigated POTS and through a holistic treatment plan with a 19-year old male suffering from POTS, developed a series of goals to ultimately lower factors like depression and anxiety. In addition, Bruce et al. (2016) used cognitive behavioural therapy (CBT) to overcome daily struggles, suggesting that by having a non-judgemental, person-centred focus that utilises individualised goals, will maximise motivation to maintain changes in behaviour.

Bruce et al., along with other researchers (Ralston & Kanzler, 2016) recognise the potential that person centred approaches could have on treating POTS.

A recent case study (Turner et al., 2020) of a 39-year-old female POTS patient described the combined effects of a motivational intervention, Functional Imagery Training (FIT; Andrade et al, 2016; Solbrig et al., 2018), and physical exercise on QOL. Following completion of the program, the subject improved in all four QOL components and this change was maintained over time when compared to baseline measures. The program demonstrated that high levels of exercise adherence beyond the intervention can be achieved when combining FIT and exercise, regardless of the exercise intolerant characteristics presented by a POTS patient. Importantly, QOL is multifaceted and each POTS case differs, from personal goals to individual symptoms. Therefore, FIT could be an effective method to treat POTS alongside appropriate physical exercise.

To assess the feasibility of using FIT in this way, I conducted a small-scale study using three groups (control; exercise only; and FIT plus exercise) that were compared at baseline and after a six-week intervention. As a feasibility study, I aimed to find out whether the study design was practical, and the intervention acceptable to patients. As in the two case studies, I hypothesised that both interventions would increase in general QOL and health satisfaction scores compared to the controls. On the other hand, contrary to Tito and Hess's (2017) findings, but in line with Turner et al, I predicted that there would be an increase in both the physical and psychological domains when assessing QOL, because I were applying interventions that focused on specific person-centred goals and exploring intrinsic motivation. Finally, I intended to conduct an evaluative interview to establish if there are differences between the experimental groups for exercise adherence, as FIT may motivate individuals to train more frequently. It is important to note that as an initial feasibility study, the focus of this study is on ‘can it work’ rather than ‘does it work’ (Bowen et al., 2010), and the number of participants will not support inferential statistical testing.

10.2. Method

10.2.1. Participants

Ethical approval was granted by the lead authors institutional ethics committee. Over two months in 2019, 16 participants were referred to the study by a medical consultant, who is the recognised POTS specialist in the South West of England, or participants expressed interest through a social media post. Of these, 12 met the inclusion criteria of having a medical diagnosis of POTS. These participants (10 females, 2 males; Mage= 32, SD=7.17) were evenly randomized into three groups; FIT plus exercise (FIT), exercise only (Exercise), or a wait-list control group (Control). Informed consent was gained from each participant at the start of the study.

10.2.2. Measures

World Health Organisation Quality of Life Instruments (WHOQOL-BREF). The WHOQOL-BREF (WHOQOL Group, 1998) is a shortened version of the WHOQOL-100, containing 24 items used to assess four specific domains and 2 general QOL questions. The four domains are: physical health, psychological health, social relationships and environment. Each question is rated from 1 (poor QOL) to 5 (good QOL). The raw scores for each domain were transformed to 4-20 range according to WHOQOL-BREF guidelines. Psychometric properties of the WHOQOL-BREF have reported a strong construct validity (see Skevington et al., 2004) and test-retest reliability of .92 in adults (von Steinbüchel et al., 2006).

The Vividness of Imagery Questionnaire (VVIQ, Marks, 1973). The VVIQ, consisting of 16 items is used to assess visual imagery. An alteration was made with the VVIQ scoring to remain consistent with the WHOQOL-BREF. Participants rated their imagery from 0 (No image at all, you only “know” that you are thinking of the object) to 5

(Perfectly clear and as vivid as normal vision). Eyes open and eyes closed mean scores for the tasks are totalled (Woodruff & Klein, 2013) to give a score out of a possible 10.

10.2.3. Procedure

Each participant met me in person or remotely to complete the VVIQ, WHOQOL-BREF, and a short interview was conducted. Participants had an opportunity to discuss their experiences of having POTS and any self-set goals, but only the FIT group received imagery training. The control group was asked to continue exercise as normal and maintain their usual routines whilst they waited for intervention delivery in six weeks. The Exercise group received a physical assessment at the start of the study and weekly training programme that was administered by a registered physiotherapist at a general practice or hospital. These sessions were supervised once a week, with home exercises selected and adapted from Richardson et al.'s (2017) materials.

The participants in the FIT group met me individually and in person at a sports science laboratory. The FIT session was conducted by myself, with meetings lasting approximately one hour. Aligned with Solbrig et al. (2018) and Rhodes et al. (2018), a strict methodology was adhered to by using MI to navigate through four processes: engaging in conversation, focusing on specific goals, evoking change, and planning for action. In each process, multisensory exposure to target cognitive and motivational imagery (Paivio, 1985) was engaged based on the participant's feedback (Lang, 1979). Once a prominent goal was elaborated upon and the desire to adhere to exercise was evoked, participants set their own plan and behavioural cue, triggering positive self-efficacy through imagery related to task success. Task success for all participants was an exercise goal, such as how it would feel to complete a 5-minute jog.

Each week those in the FIT group received a 15-minute imagery booster at the start of their session, often whilst warming up before their allocated 45-minute exercise session to recap targets or reset goals based on Bruce et al. (2016). The exercise sessions for the FIT group were delivered by a physical therapist who initially conducted a brief assessment including range of movement tests, followed by a weekly programme based on generic aims; to burn calories keeping heart rate in an appropriate training zone and improve core stability and strength. Although exercise programmes were specific due to the nature of POTS and individual rates of progress, exercise recommendations (see Richardson et al., 2017; Crnošija et al., 2016) and design (Tito & Hess, 2017) were consistent with other studies. Programme design for the Exercise and FIT groups were set by different practitioners, both agreeing that the programmes were similar, only taking exercises from the session plans available in Richardson et al. (2017), with the rate of perceived exertion (RPE, see Borg, 1998) not exceeding 14.

The intervention lasted for a total of 6-weeks and at its end participants completed the WHOQOL-BREF for a second time administered by the physiotherapist for the Exercise group or physical therapist for FIT-Ex. Exit interviews were given to those in the experimental groups by the lead author and the control group were given a start date if they wished to receive FIT.

10.2.4. Statistical Analysis

Inferential statistics are compared at baseline, but not reported for the difference between groups on the WHOQOL-BREF due to the small sample size. I have, however, conducted a complete analysis using R version 4.0.1 (R Core Team, 2019) using the *tidyverse* (Wickham, 2017) package. The WHOQOL manual (World Health Organisation, 1997) instructs researchers to report raw data and percentage change when comparing differences between groups. The data and the corresponding code are available in Chapter 10 folder via this link: https://osf.io/tbekp/?view_only=b7497391850a4f31805d4ec558c8abfd

10.3. Results

As a part of the pre-intervention measures, VVIQ was scored as eyes closed, eyes open and a total of the two generated. There were no differences between groups for any measures of vividness of imagery at baselines ($F<1$).

QOL was measured at two times (baseline and week 6) and the change between was calculated as a percentage for each condition; values are presented in Table 7. Participants in the two intervention groups had the opportunity to attend six supervised training sessions during the study. The FIT group attended 5.25 on average (87.5%) and the Exercise group attended 3.25 (54.17%).

Table 7

Means and standard deviations for each group for independent items and four domains with change in percentage between baseline and 6 weeks.

Question or Domain	Group	Mean scores (SD)		% Change
		Baseline	6 weeks	
Overall quality of life (Q1)	Control	2.5 (0.58)	2.25 (1.26)	-10%
	Exercise	3 (0.82)	2.5 (0.58)	-17%
	FIT	3 (0)	3 (0.82)	0%
Satisfaction of health (Q2)	Control	2.25 (0.5)	2 (0.82)	-11%
	Exercise	1.75 (0.5)	1.75 (0.5)	0%
	FIT	2 (0.82)	3.25 (0.5)	+63%
Physical health (Domain 1)	Control	8.42 (1.43)	8.43 (1.58)	0%
	Exercise	8.57 (0.47)	10.14 (0.28)	+18%
	FIT	8.29 (1.35)	11.71 (2.16)	+41%
Psychological (Domain 2)	Control	9.16 (0.84)	9 (1.28)	-2%
	Exercise	9.67 (1.28)	9.83 (1.76)	+2%
	FIT	9.5 (1.84)	13.01 (2.75)	+37%
Social (Domain 3)	Control	11 (11.67)	11.33 (3.18)	+3%
	Exercise	10.34 (0.68)	10.00 (0.79)	-3%
	FIT	10.99 (2.74)	12.67 (2.31)	+15%
Environment (Domain 4)	Control	11.25 (0.5)	11.64 (1.02)	+3%
	Exercise	11.13 (0.86)	11.13 (0.62)	0%
	FIT	11 (0.82)	13.01 (2.67)	+18%

Participants were asked to state the frequency of home exercises completed during the previous week with the FIT group reporting a mean of 2.5 training sessions and 1.0 from the Exercise group. When asked if participants achieved their goal, all except one participant (from the FIT group) said that they had achieved their short-term goal. Finally, two participants in the Exercise group reported a change in medication to support exercise (such as heart rate suppression medication), whilst all participants in the FIT modified medications to support their change in activity. Furthermore, three participants in the FIT group decreased or stopped taking antidepressant medication, whilst participants in the control and Exercise reported no change.

10.4. Discussion

Short-term interdisciplinary treatment through a combination of medication, exercise and motivational support results in an increase in physical and psychological QOL and can lead to sustained change post-intervention. Our aim was to merge methodologies from person-centred research, initially hypothesising that there will be an increase in general QOL (Q1) and health satisfaction (Q2) scores comparable to Tito and Hess's (2017) findings, which we can accept for health satisfaction.

Our second hypothesis was based more on our intervention delivery than the case study findings from Tito and Hess, predicting an increase in both physical and psychological health domains. It seemed plausible to predict that exercise would enhance physical health in POTS (Shibata et al., 2012), and that FIT would enable individuals to maintain intrinsic motivation. The groups did differ, with an increase for the exercise group of 19% and for FIT of 41% on the WHOQOL-BREF physical health domain. For only the FIT group, psychological health improved by 37%. Compared to Tito and Hess's case study, which had a 21% decrease from the baseline, this study shows the necessity of using interdisciplinary approaches to improve QOL.

I anticipated that individuals in FIT would attend more supervised sessions due to the motivational approach, however being conscious of the complexities of living with POTS impacting attendance. Compared to the Exercise group, those in the FIT group attended two more supervised sessions (out of six) and completed more than twice as many independent home training sessions. By giving participants the autonomy to select their own (albeit limited) exercises and discussing the processes required to achieve targets, the person-centred nature of motivation and desire to change was evoked. This falls into line with the Self-Determination Theory of intrinsic motivation (Deci & Ryan, 2008), whereby autonomy to make personal choices and maintain control, connection to the practitioner and others, and competence focused on understanding self-health was maximised.

Recruiting participants with specific medical conditions for this intervention was challenging, but I was fortunate to make connections with local health care providers and quickly attracting interest. I assumed there would be a limited local sample and found that the specialist medical consultant was diagnosing on average three patients with POTS each week. Notably, every individual with POTS in our sample presented with similar traits including elevated anxiety levels and a lack of confidence but differed dramatically by symptoms and medications. Although the format of training plans (Richardson et al., 2017) and goal guidance (Bruce et al., 2016) was adapted from other studies, the participant's current mood and feedback dictated weekly training and imagery targets. This method of participant choice worked well to motivate and provide constant specific progression, which could be widely used by physical trainers in all demographics of the population to encourage behaviour adaptation. I appeal to practitioners to give patients a choice and support progress, however small.

There is a great deal of potential for future research based on this feasibility study. I did not track medication, or measure anxiety and confidence levels, and although I assessed home exercise, there could have been other activities such as walking that influenced QOL scores. Furthermore, as in clinical FIT research (Solbrig et al., 2018) follow up measurements should occur to ascertain long-term behaviour modification. I attempted to conduct interviews for all participants six months post intervention, however the physiotherapist had since changed roles, losing all contact details (stored by the physiotherapist to adhere to general data protection regulations) from the Exercise group participants. I conducted brief interviews with the FIT participants, all of whom were exercising at a similar level to that whilst completing the study with some returning to full time employment/education.

The interdisciplinary approach (Shibata et al., 2012; Bruce et al., 2016) is an effective method to improve QOL in POTS and I would like to see motivational imagery administered promptly after diagnosis in a large-scale clinical study. Furthermore, it appears that coupling motivational imagery with exercise is effective at increasing exercise adherence and may decrease the use of antidepressant medication. As a result of this study, our next step is to support the growing number of POTS cases in our local area and develop a larger scale randomized clinical trial to collect additional data to inform best practice in managing this condition and potentially other cardiac illnesses.

10.5. Conclusion

These findings are important not only because it suggest further evidence for imagery and FIT in its effectiveness in improving exercise, adherence and quality of life, but it also demonstrates that FIT can be incorporated as a psychological support part of the larger multi-disciplinary intervention. Furthermore, FIT combined with physical activity can reduce symptoms of POTS over 8 weeks.

10.6. Chapter summary

This chapter presents key findings from the application of Functional Imagery Training (FIT) in a multi-disciplinary setting for individuals with Postural Orthostatic Tachycardia Syndrome (POTS). The results provide further evidence of the successful implementation of FIT in a clinical context, highlighting its potential as a behaviour change intervention within multi-disciplinary teams.

The study demonstrates the clear impact of FIT in reducing symptoms and improving the quality of life of individuals with POTS. By incorporating FIT into the multi-disciplinary approach, significant improvements were observed in symptom management, physical functioning, and emotional well-being. FIT's focus on goal setting, guided imagery, and motivational interviewing proved effective in enhancing motivation, adherence, and self-efficacy among POTS patients, leading to positive outcomes in symptom reduction and overall well-being.

The findings support the integration of behaviour change interventions, such as FIT, into clinical multi-disciplinary teams. By including professionals from various disciplines, such as physicians, physiotherapists, psychologists, and nutritionists, the multi-disciplinary approach ensures comprehensive and holistic care for individuals with complex conditions like POTS. FIT provides an additional tool to address the behavioural aspects of POTS management, complementing the medical interventions and enhancing the overall effectiveness of the treatment approach.

These findings align with the model proposed earlier, which emphasizes the importance of addressing multiple dimensions of health and well-being. The improvement in quality of life observed in this study through the implementation of FIT reflects the holistic approach of the model. FIT's integration into the multi-disciplinary team facilitates a comprehensive understanding of the individual's needs, promotes personalized goal setting, and empowers patients to actively participate in their own care. The model recognizes the interconnectedness of physical, psychological, and behavioural factors, highlighting the importance of addressing them collectively to achieve optimal outcomes and improve quality of life.

Overall, this chapter highlights the significant impact of FIT within a multi-disciplinary approach for individuals with POTS. The findings emphasize the importance of incorporating behaviour change interventions into clinical settings and support the integration of FIT as a valuable tool for improving symptom management, adherence, and overall well-being. By adopting a holistic approach and integrating behaviour change interventions, multi-disciplinary teams can enhance the care provided to individuals with complex conditions, leading to improved quality of life outcomes.

11. What can you imagine? Guided imagery intervention with Aphantasia: Case study.

Aphantasia is partial or complete lack of imagery ability; most often involving lack of visual imagery (visualisation). This can be a particular challenge in applying imagery-based interventions and training one’s imagery ability, which previous findings show to be a crucial element of successful behaviour change. The progression of imagery ability observed in a different participant in Chapter 9, from a very poor starting point to self-generated and controlled imagery, highlights the potential for imagery ability development through the implementation of FIT. This finding provides strong justification for conducting a full-scale case study to further explore the impact of FIT on imagery ability development and its subsequent effects on motivation and behaviour change.

Using both qualitative and quantitative data in this case aligns with my philosophical stance, which embraces a mixed methods approach and values a comprehensive understanding of complex phenomena. By conducting a comprehensive case study, I can delve deeper into the process of imagery ability development and examine the specific techniques and strategies employed within FIT that contribute to this progression. Understanding how individuals with limited imagery ability can develop and enhance their visualization skills through FIT will not only provide valuable insights into the mechanisms of imagery-based interventions but also offer practical implications for practitioners working with individuals who may struggle with imagery. Furthermore, a full-scale case study will allow for a more detailed exploration of the relationship between imagery ability, motivation, and behaviour change. By closely tracking the progression of imagery ability and its impact on motivation and adherence to physical activity goals, I can gain a more nuanced understanding of the underlying mechanisms and potential pathways through which imagery influences behaviour change.

To my knowledge no published interventions focused entirely on practice of guided imagery has been conducted with measures of imagery vividness before and after. I recruited a participant with aphantasia (female, 68 years old) through a larger trial (experiment 1 in Chapter 8), who received a guided imagery intervention as randomly allocated. This chapter proposes further work in research and practice and discusses how to apply imagery-based interventions for those with extremely low imagery vividness across one or more senses.

11.1. Overview

Aphantasia is a phenomenon, often referred to as disorder, characterised by a complete incapacity to consciously produce any forms of visual, mental imagery (Whiteley, 2021). It has been described as a novel discovery, however almost 150 years ago Galton (1880; as cited in Zmena et al., 2015) was the very first to report 'no power of visualising' in few participants. Participants with aphantasia reported a complete or, at least, substantial lack of voluntary visual imagery in 'one's mind's eye' (Zeman et al, 2015); interestingly participants reported having involuntary imagery in form of 'flashes' or dreams.

Faw (2009) analysed a large sample of 2500 participants and identified that approximately 2.1-2.7% of them claimed to have no visual imagery. The prevalence of aphantasia (Dance et al., 2022) has been further calculated at 3.9% (absent or vague imagery, often no visual imagery) with the most extreme cases of complete absent of imagery (no senses in imagery) at 0.8%. This proposes a further spectrum of aphantasia and a need to adapt methods of measuring and applying imagery.

As the evidence above proposed aphantasic participants report below average visual imagery and that being the key character of this phenomenon; however the varied spectrum of no sensory imagery does not suggest a lack of metacognition (Keogh & Pearson, 2018). Furthermore, Keogh et al. (2021) reported that those affected can have imagery, just not the visualisation; with participants completing many imaginative tasks. Therefore, the research supports the above percentage of visual and complete aphantasia, and the sensory imagery might vary between the individuals.

Wicken et al. (2021) reported that aphantasic individuals' lack of physiological response while trying to imagine is not caused by poor emotional and physiological response, but instead by the lack of capacity to imagine. This evidence is particularly important for the use of imagery in applied context, where the affective response might be the key to cause behaviour in line with emotional amplification theory of visual imagery.

Evidence from interventions with athletes showed that training of imagery over time can lead to more vivid imagery (Rhodes et al, 2020), more frequent and easier use of imagery (Rodgers et al., 1991) and metacognition of imagery (Rademaker & Pearson, 2012). Therefore, practicing and/or training multi-sensory imagery can be an answer to producing more affective response to the voluntary and vivid imagery. The findings from the previous studies suggest that imagery ability plays a crucial role in connecting motivational thoughts to actual behaviour. The evidence indicates that training and practicing imagery over time can lead to improvements in imagery ability, including increased vividness, frequency, and ease of use. This suggests that individuals who engage in regular imagery practice may experience a more affective response to their voluntary and vivid imagery. Furthermore, the development of metacognition of imagery, or the awareness and understanding of one's own imagery processes, can also contribute to the effective use of imagery in bridging the gap between motivation and behaviour. Metacognition allows individuals to reflect on and regulate their imagery experiences, enhancing their ability to align their thoughts, intentions, and behaviours.

Overall, the findings suggest that imagery ability acts as a connector between motivational thoughts and actual behaviour. Through training and practice, individuals can enhance their imagery ability, resulting in more vivid and affective imagery experiences.

This, in turn, can strengthen the link between motivation and behaviour, increasing the likelihood of engaging in the desired behaviours.

11.2. Context

One participant (R.V.) reported having aphantasia and asked whether she was eligible to take part. I decided to include R.V. as a case study to analyse the spectrum of aphantasia in this individual and the change it might present due to the training of imagery over time.

The aim of this project was to explore R.V.'s self-reported and perceived vividness of imagery in all senses with quantitative measure. After receiving training of motivational, goal-orientated imagery as a part of 4-week training plan, the retest was conducted to capture the change in the imagery vividness. Due to trying to understand an individual and specific perception of aphantasia, I interviewed the participant to get a better and richer understanding from the qualitative answers.

I aimed to address the following questions: will imagery intervention have any effect on aphantasic self-reported imagery? Will the imagery vividness change after 4 weeks of imagery training and practice? Is the imagery training possible to be applied for aphantasic participants and can it then produce an affective response?

11.2.1. Philosophical Application

I adopted a humanistic cognitive approach, which gave R.V. the opportunity to learn imagery through cognitive methods after the initial session. This approach is in line with previous research (Turner et al, 2019), which gives the participant the autonomy to learn imagery to foster intrinsic motivation.

11.2.2. Case overview

R.V. is a 68-year-old, Caucasian cis-female (born female), who is a former nurse. She received higher education with biology degree and has keen interest in health, environmental changes, and general scientific matters.

R.V. discovered that she has aphantasia very recently, “certainly within the last 12 months and it possibly was earlier this year”. It was due to online post regarding how each person imagines an apple in potentially different way of context and colours: “I saw something online, and it was I can’t remember it may have been on Twitter […] and there was a it was a diagram actually and it was it was two people, and it was saying, if you close your eyes and you’re asked to visualize an apple, what can you say. And the little diagram was somebody with an apple in front of them, basically, so I closed my eyes, I couldn’t see anything and as they say I’d never really given it much thought before.” Furthermore, she reported never questioning and even discovering that she doesn’t have this visual ability to form pictures in her mind “I had no idea that I couldn’t visualize things until I literally saw this.”

Before the discovery, she reported that it was never anything missing, due to lack of awareness of visual imagery being there in the first place “if you asked [me] to imagine walking along a forest path or being on a beach or something, I’ve just accepted I don’t see anything never occurred to me that other people could.” All these experiences led to learned acceptance of how her imagery was “I can see I’m a bit dark in the picture and what you’ve never had you never miss I had no idea” and sympathising with those who acquired aphantasia through loss of visual imagery “I can imagine if somebody had had it lost it and it must be horrific for them, but I can’t imagine what it must be like having it be truthful.” Upon reflection of the life time, R.V. reported she was not sure what would be the effect of visual imagery if she hasn't had aphantasia "It's never I don't think it's ever held me back, but I don't know whatever what my life would have been like with it."

On the other hand, the recent discovery has not been entirely positive; it also brought negative emotions in form of frustration "the frustration is new, because of this" due to possibility of missing out "because I could die ever since and I felt really frustrated and felt that I'm missing it." However, there was the overarching theme of acceptance of aphantasia "I will not lose any sleep on it, but it would be nice to spend 24 hours in somebody else's head just to see what it's like."

A close relative does not share the aphantasia; R.V. even reported her daughter having vivid imagery, especially for emotional scenarios "if it's sad sense and she said mom it's not always what it's cracked up to be, because if she hears things I mean she would imagine." Again, sympathising with others, but not being able to relate or understand what it is like. This was particularly shown through self-reported lack of emotional response due to inability to visualise those images "I mean the horrors of war, I know what it must have been like, but she obviously sees visual images and, in some ways I'm quiet, but I don't see that." This aspect is in line with previous evidence (Wicken et al, 2021) reporting lack of physiological response to fear stories.

The multi-sensory imagery was different to visualisation (or visual imagery) with auditory "if I actually think noises, I can imagine what I hear", olfactory "I can sort of I can imagine the smell of nice paint" and somatosensory stimulus "some of them are easier than others a sort of tactile ones." However, all of them were reported to be tasking and effortful to produce "I certainly have to make an effort." The difficulty of generating sensory imagery was repeated throughout the interview with the imagery being "too nebulous" and some particular scenarios being more difficult such as "to imagine hearing an ambulance I really have to think about it, make a concerted effort to try and do it, it doesn't come easily at all."

Additionally, the autonomy in generating imagery with personal preferences contribute to the strength of imagery, in this case gustatory - “if somebody had stirred my cup of tea, with a spoon they stirred coffee with I knew I could taste, I could smell it because I dislike it.”

As proposed earlier, the metacognition does not seem to be affected or involved in the aphantasia (Keogh & Pearson, 2018) and verbal skills acting as potential coping mechanisms “because I’ve always been able to describe things verbally.” Furthermore, to support this, R.V. reported, including retrospectively, to always have the memory above average “when I was younger, I was all over everything my mind was extremely sharp nothing got past me. I didn’t forget things and once I’ve been if I was it something from the start. I would remember, and I could recall it instantly. Not quite so good at that these days, I’m still better than a lot of people.”

11.3. Case formation

I gathered information regarding aphantasia and as the lack of imagery varied in sensory scores between each person, R.V.’s imagery vividness was assessed at week 0, also referred to as pre-intervention or baseline.

11.3.1. Ethics Statement

The experimental protocol was approved by the authors’ institutional ethics committee. The participant was informed at the start of the study that they could withdraw at any stage. Consent was acquired firstly online and then verbally before the interview was conducted.

11.3.2. Measures

The Plymouth Sensory Imagery Questionnaire (Psi-Q; Andrade et al., 2014) assesses vividness of mental imagery in the seven modalities of vision, sound, smell, taste, touch, body, and emotion, each modality having five items rated from 0 (no imagery) to 10 (as vivid as real life), and scores can be combined to give an overall imagery score. An example question from the vision scale is ‘Imagine the appearance of a friend you know well’. The Psi-Q is used to assess imagery vividness due to the general nature of the questions and has been used in a variety of samples (Renner et al., 2019). I computed the mean over all 35 items as a measure of multisensory imagery vividness, as well as mean scores for every sensory modality.

The follow-up interview had a semi-structured style with questions focused on demographics, background, discovery of one’s aphantasia, the process of planning and imagining, and the training of imagery itself. An example question was asked: How do you plan for a task? With the follow-up: Has that changed now since before the intervention? The interview was recorded and transcribed for the analysis and practice purposes.

11.3.3. Guided imagery intervention

Guided imagery has been adapted numerous times in sports (Cumming & Ramsey, 2008; Simonsmeier et al, 2021), exercise (Cummings & Williams, 2013; Giacobbi et al, 2018) and health environments (Hagger & Conroy, 2018). Recent investigation (Renner et al, 2019) utilised imagery as a motivational amplifier for behaviour change; as this case study was part of a larger scale imagery-based trials, I adapted Renner’s method to apply exercise-based imagery to have a clear motivational goal. Creating an imagery practice around an exercise goal has shown to not only increase the physical activity levels, but also encourage more imagery practice via increased motivation, intentions and action planning (Chan & Cameron, 2012). Therefore, I used a multi-sensory guided imagery for exercise goal with R.V in order to enhance motivation, but focused predominantly on the training and use of imagery.

The intervention involved measuring the imagery vividness by PSIQ and retesting after 4 weeks of imagery practice. The initial session was based on explanation of what imagery is, sharing and discussing examples of imagery; the very first exercise was based on trying a multi-sensory imagery example, in this case an object of lemon. The education of multi-sensory aspect of imagery ensured that R.V. understands the nature and modalities of imagery. After this, I discussed the need of physical activity, the recommended PA-levels (according to NHS and WHO) and allowed R.V to discuss her current levels and desired exercise behaviours. This provided us with information to lead a guided imagery of the exercises; this involved preparation for activity, doing the activity, including all senses such as kinaesthetic movement, breathing rate, skin reaction and vision, and finally the post-exercise feeling and movement, such as how rewarding was it. At the end of this session, R.V. was asked to create a personal cue, which will remind her to do her imagery practice at least once a day. There was no cue for the exercise, only for the imagery practice.

A review session was conducted one week after the initial meeting and remained unscripted to ensure that any points, including problems, came from R.V. This session consisted of a reminder of the goals and discussing the practice of guided imagery with any new developments, changes or problems. R.V. reported no problems with the imagery itself and was positively surprised by the effects of it. The data is available in Chapter 11 folder via this link: https://osf.io/tbekp/?view_only=b7497391850a4f31805d4ec558c8abfd

11.4. Delivery of the intervention

I started the intervention from establishing a definition of imagery as a multi-sensory scenario or event or object that you consciously create in your own mind, with the difference of imagery and dreams, conscious effort vs unconscious automatic generation. I discussed some examples with R.V. such as book reading and thinking about the future; she has reported hearing a story while reading a book ("I think I do") or planning "I rehearse things I can't imagine how it's going to look, probably, but I do rehearse things potential outcomes and that sort of thing, yes I most definitely do that."

Once imagery was clear, we moved to an actual effortful imagery example, in this case lemon exercise, where R.V. was asked to imagine all sensory aspects of a lemon in her hand (full exercise description is available in the script). This was then tested verbally for the vividness of all senses and accessibility to imagery mode. Response to this activity was relatively strong in kinaesthetic “it’s not particularly heavy and it’s quite firm I can squeeze it”, feeling “it’s got quite a waxy feel” and gustatory “it’s funny when you said taste it, my mouth immediately puckered up because I don’t like sour things”. There were some visual descriptions, which come from recall, rather than fantasy: “there’s often green around the bit where it sits on the tree and I, like the little pattern there’s always a nice little pattern”. This final aspect proposed that visual imagery relies heavily on recall and what an object ‘always’ looked like, where the other sensory imagery can rely on fantasy to create these scenarios.

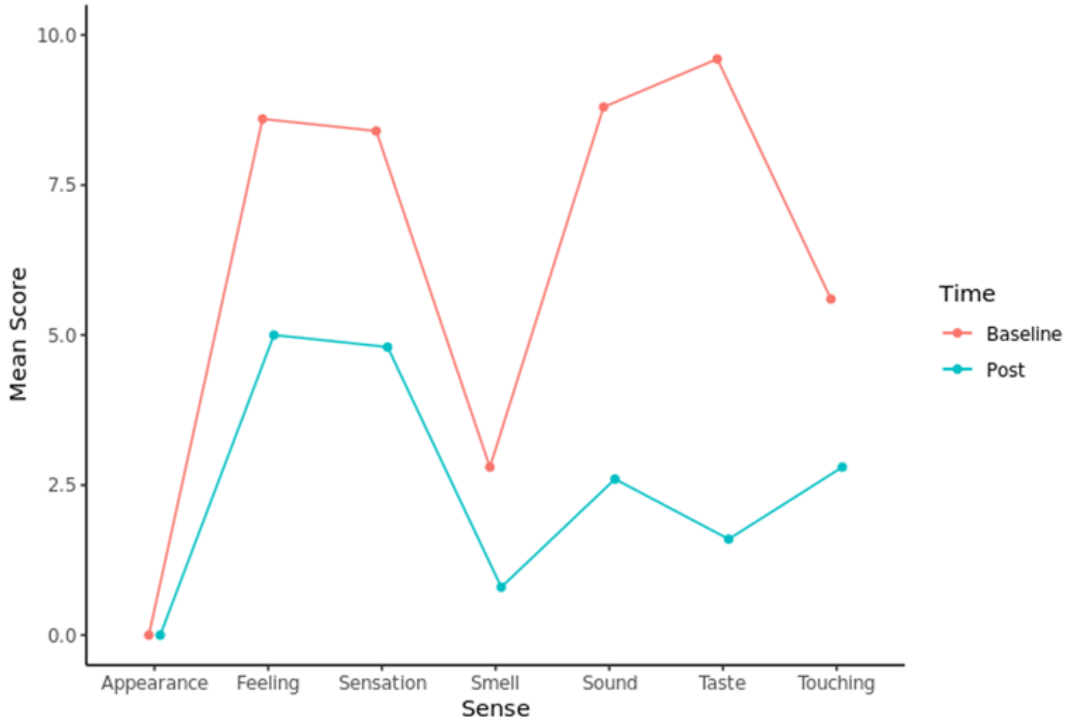
At this point, we discussed the World Health Organization (2020) and National Health Service (2020) recommendations for the physical activity levels for adults and goals in references to those guidelines. R.V. picked “walking” as the activity with the particular focus on “quality” and “speed of my walking”. She justified this choice “I do enjoy walking and there are some quite nice areas to walk around here, where I feel safe.” We moved on to the imagery mode (eyes closed or focused on one point) of this physical activity with all the senses engaged. As this activity was relatively familiar, it was therefore a combination of recall and adding novel sensory details such as breathing rate. We encouraged highlighting the sensory input, rather than focusing on the visual incapacity. Verbal feedback was rather positive regarding the imagery: “it was quite vivid” and “it is motivational now I’m describing it.” As it was a positive experience, we moved to regular training of the imagery ‘mode’ with picking a cue to serve as daily reminder to complete the imagery exercises. At the end of this initial session, R.V reported a positive overall response: “I’m very pleased that you sort of dropped me into this [imagery] mode really because it’s just never occurred to me to approach things in that manner, I mean I could apply to all sorts of things to be honest with you." One week later, I contacted R.V. to discuss any issues with imagery mode, things that might work or not and the use of cues.

11.4.1. Evaluation of the intervention

The scores of the PSIQ have been scored for each modality and plotted as baseline and post-intervention scores (see Figure 17). Against our expectations, the overall scores of all modalities have decreased (apart from visual, which remained at zero), while the pattern of the scores was repeated.

Figure 17

The graph showing the change of imagery scores across all modalities (senses) at baseline and post-intervention. The appearance (visual) score has not changed, but all the other ones decreased throughout the intervention.



The follow-up interview provided further and detail-rich information on what effect has this intervention had on R.V. She reported using imagery: "it is certainly something that I actively do” and “when I go out purposely, I do think about what I’m going to see, as I say, and things like that and the end results.” The potential, increased use was based around future: “I won’t say it’s increased a lot to be honest with you, but I think it has increased, because I do try to imagine where I’m going to go and what I’m going to see.” Imagining the outcome was repeated in reference to the motivation “it’s the end result that spurs me to do it that’s what motivates me.” It was the sense of achievement that had the best perceived effect on motivation: “when you said imagine what you’re going to feel like […] emerging your sense of achievement after you finished it, you know, and I think that that sort of triggered something.” This imagery practice also stretched to other points of life: “I feel I can apply it to other things” and encouraged some further reflections “it certainly gives me food for thought”.

The imagery itself was reported as involving psychological and physical modalities: “it’s a bit of both actually and I think probably more psychological, but there is an element of physical feeling.” Interestingly the sense of achievement would encourage a more psychological response, potentially suggesting that affective response “that would be flipped if I’d done something that I would particularly be proud of.” this was reported to be missing in aphantasic participants (Wicken et al, 2021). When encouraged to imagine a place she has never visited (therefore relying more on fantasy rather than recall), R.V. brought up a detailed description of the artistic monument “I can, there’s silver they look as though they’re made up of sort of rectangles of metal that are riveted together.”

Regarding the planning, verbal processing was still present in describing the process of getting ready: “I’ll get all I’ll get that ready I’ll get my coat ready I’ll get my purse ready my they should have got my phone at my boots on.” There were some aspects of imagery in the process of planning the selected activity, walking - “when I go out to exercise, I do actively think about well what my feet, whether they’re going to be on leaves or on the pavement or you know walking across grass or ever." Therefore, the planning has not changed, but the activity of focus has changed "no, what has changed, as I say, is when I go out specifically just to walk." I propose that the imagery focused on a specific task, such as walking, will increase the use of imagery for that task, however a 4-week practice is not long enough to impact other aspects of everyday life.

11.5. Reflections and recommendations

I was interested in three main research questions. Firstly, imagery practice over four weeks has an impact and effect on aphantasic self-reported imagery to some degree. R.V. reported using imagery more often and finding bringing things up in her imagery easier and more accessible. Imagery got better for specific objects and tasks when practiced; whether it would naturally stretch to other aspects or modalities of life is unclear after 4 weeks; recent paper suggest long term effects of imagery on metacognition and creativity (May et al, 2020). In line of other research on general population (Rademaker, & Pearson, 2012), imagery might have long term improvements on metacognition in aphantasic cases too.

Furthermore, the imagery practice has had negative impact on the imagery vividness as measured by the PSIQ scores. This is against the assumption I had that training would improve the sensory modalities of imagery. One explanation is that practicing imagery makes person realise how much more they can imagine than they thought, therefore their own abilities at the time seem much less (where original scores remain inflated). Therefore, some of the baseline scores might have been self-adjusted at second time after practicing it; the similar patterns across both times support this explanation. Further evidence comes from Dunning-Kruger effect (as cited in Mazor & Fleming, 2021) suggesting that those who perform poorly tend to overestimate their own abilities in the self-report measures in the first place.

The alternative explanation could be that the baseline scores were reported from recall; where the post-training scores involved a combination of recall and fantasy therefore would be decreased by attempts to generate novel fantasy imagery. Visual imagery has not changed at all, suggesting that this modality does not have capacity to change over such short period.

Finally, the training of multi-sensory is possible to be applied with aphantasic participants and I have observed some affective response to it, despite no visual imagery. R.V. reported a strong sense of achievement as a result of effort and intentioned actions. This goes against the previous research suggesting no physiological response to emotional scenarios (Wicken et al, 2021); I propose that affective, physiological responses are possible with multi-sensory imagery, and I encourage a larger trial to test this phenomenon over longer period of time.

In practical application, one's current state of imagery needs to be explored verbally and tested where possible. This recommendation comes from the observation that the voluntary imagery of novel objects can help to understand the level of capacity one has to generate novel objects, events, and scenarios. This is critical for the practitioners or professionals working with aphantasic population. Furthermore, imagery relies on recall and fantasy and this ratio potentially varies between individuals; therefore, in this case when visual imagery is missing, but memory is reported as above average, the recall might take over in producing these verbal descriptions instead of visualisation.

11.6. Conclusions

The key purpose of this research was to observe whether imagery can be trained and utilised with aphantasic person and to what effect. I delivered the script of guided multi-sensory imagery with relative ease and despite the self-reported vividness decreasing from baseline to post-intervention, qualitative informative suggests that imagery is used more often and to a greater affective, and therefore motivational, degree. I highlighted the importance of inclusion of imagery practice even when visualisation might not be present and how this intervention can be delivered to a larger sample. Furthermore, other recent research proposes that some impacts of imagery use cannot be observed till four months of practice (May et al, 2020). I encourage researchers and practitioners to apply and train a multisensory imagery with aphantasic individuals for motivational purpose and affective response. Further research can apply this intervention to larger sample over longer period of time and propose new method of measuring imagery of low vividness.

11.7. Chapter summary

In summary, the findings of this chapter suggest that imagery can be effectively trained and utilized even in individuals with aphantasia, a condition characterized by the absence of visual imagery. Despite a decrease in self-reported vividness, qualitative data indicates that the use of imagery is more frequent and has a greater affective impact, leading to increased motivation. These findings emphasize the importance of including imagery practice in interventions, even for individuals who do not have the ability to visualize. The aspect of emotional response is so important in larger scale of successful behaviour change and imagery effectiveness.

This study also highlights the need to deliver this intervention to a larger sample and explore its long-term effects. Additionally, other research suggests that the full impact of imagery use may take several months to manifest. Therefore, researchers and practitioners are encouraged to incorporate multisensory imagery training in motivational interventions for individuals with low vividness and explore new methods for measuring imagery in this population. Further research should investigate the effectiveness of this intervention on a larger scale and over an extended period of time, while also considering the development of alternative measures for assessing imagery in individuals with low vividness.

12. Qualitative study of the perception and use of imagery in exercise environments by fitness professionals

"The only limit to your impact is your imagination and commitment." Tony Robbins

Alongside with how individual's imagery vividness might moderate the link between cognition of exercise and its behaviour, I set out to investigate the understanding of and attitudes towards imagery by exercise professionals. While previous literature has primarily focused on the use of imagery in individuals who engage in exercise (Giacobbi, 2003) and sports (Driediger, 2006), there is a gap in knowledge regarding the role of imagery in the practice of exercise professionals. By exploring their understanding and attitudes towards imagery, this study seeks to contribute to a more comprehensive understanding of how imagery is perceived and utilized in the context of exercise promotion and behaviour change.

This qualitative study is aligned with the broader aims of the research to explore and test the effectiveness of psychological tools, including imagery, in promoting physical activity. By examining the perspectives of exercise professionals, valuable insights can be gained into the practical application of imagery in their work with clients. This information can inform future interventions and training programs for exercise professionals, enhancing their ability to effectively incorporate imagery techniques into their practice.

This study also addresses the aim of investigating the moderation effect of imagery vividness on the link between cognitive factors related to exercise and actual behaviour. By understanding exercise professionals' perceptions of imagery and how it influences their practice, insights can be gained into the potential role of imagery vividness as a moderator. This can help inform interventions and strategies that consider individual differences in imagery ability and tailor approaches accordingly. This is the first study focusing on exercise professionals and the role of imagery in their applied practice.

12.1. Overview

Physical and psychological benefits of physical activity have been well investigated and demonstrated in a number of studies (Warburton et al., 2006; Jannsen & LeBlanc, 2010). One of the potential ways that people can access physical activity is through a growing number of sport centres and gyms located nationwide. There were almost 10 million gym memberships in 2017 and this number is suggested to be gradually increasing every year (State of the UK Fitness Industry Report, 2017). Additionally, another widely available and commercial method of supporting physical activity is personal training (PT). The Register of Exercise Professionals, a national, independent, public organisation, reports between 19,000-25,000 registered members in UK. PT consists of one-to-one or small groups of 4-6 people being instructed on individualised exercise techniques and being motivated by a qualified instructor.

However, despite these impressively large numbers, 20 million people in UK do not engage in even minimal physical activity (Physical Inactivity Report, 2017). One reason for such low physical activity despite the number of gym memberships is a lack of motivation (Bauman et al, 2012; Trost et al., 2002); with further evidence suggesting that increasing motivation is a key strategy to ensure participant's adherence to the long-term plan and continuing exercising after completing the program (Huberty et al, 2008).

In those who exercise and attend exercise facilities regularly, the literature suggests they use imagery more frequently (Gammage, 2004; Giacobbi, 2010; Hausenblaus, 1999). The only qualitative study investigating exercise imagery (Giacobbi et al., 2003) explored the topics of mental images in sports and exercise. Further simple frequency studies (Hauseblaus et al., 1999; Short et al., 2004) supported those findings by simply confirming that regular exercisers do indeed use imagery. Further studies investigated the effectiveness of applying and guiding imagery – the evidence supported the effectiveness of applied imagery in increasing physical activity and exercise (Andersson & Moss, 2010; Chan & Cameron, 2012) and reducing weight (Solbrig, 2018). Therefore, in summary, there is a body of evidence to explain that imagery is indeed used by regular gym users (not only by professional athletes as assumed before within the sports field) and it can improve the physical activity in general population. Finally, the previous literature (Giacobbi et al, 2003, p. 173) recommended conducting further investigation into ‘the motivational aspects of exercise related imagery utilizing qualitative methods with other groups of individuals’.

The need for this qualitative study relies on the need to explore the mechanisms, behaviours and habits of using imagery by the exercise professionals and whether they incorporate the imagery in their own practice. In order to complete this goal, semi-structured interviews were chosen as the most suitable method to allow participants to express their own practices and understanding without potential judgement from others with same career path and work environment. This would not be possible to be grasped in quantitative measures or even in focus groups. Reflexive thematic analysis was selected as the most suitable analysis method to interpret and understand the individual approaches and intra-participants differences in order to grasp the depth and variation of understanding and uses of imagery.

12.2. Method

Fifteen participants (M_{age} = 33.57, SD_{age} = 7.85, 14 males, 1 female) were recruited through local and social media and interviewed individually. The majority (80%) of the participants were from UK, with two (10%) from Australia, one (5%) from New Zealand and one from the US (5%).

Interviews were semi-structured with all questions based around motivation and imagery and were transcribed by a trained team of three. The purpose of this research was to explore and understand the role of imagery in each personal trainer’s perception, practice, and their own training; therefore, questions reflect those three main topics.

12.2.1. Exclusion of participants

The key purpose of this study was to explore and investigate understanding and use of imagery in personal trainers. Two participants were recruited who later revealed that they didn't work with individuals in fitness, but with teams and athletes in sports environment. The number of reasons for exclusion included: (1) sports coaches receive formal training in psychological skills, therefore it will not be representative for the PT population with no formal training, (2) the general population do not have access to work with professional sports coaches, only individuals or team athletes employed by them or the sports club and (3) PTs focus on working towards a fitness goal or simply conducting regular exercises with an individual, the sports coaches focus on conditioning, performance and sports-specific technique.

12.2.2. Data saturation

The number of participations in qualitative research has been a point of interest/debate (Guest et al., 2006) as not reaching data saturation in qualitative research can have an impact on the quality (Kerr et al., 2010). According to Fusch and Ness (2015), data saturation can be attained by collecting data that is simultaneously rich ('many-layered, intricate, detailed, nuanced' and so) and thick (lots of data). Researchers attempted to reach the data saturation by:

(1) Choosing the specific area of interest (role of imagery in personal training) (O'Riley & Parker, 2013) due to understanding that number of themes can theoretically be limitless in nature (Green & Thorogood, 2004; Wray et al., 2007)

(2) Recognising researchers' personal lens of biases, values, and ideologies (Chenail, 2011; Bernard & Bernard, 2012)

(3) Recruited participants from multiple sources and backgrounds to improve data triangulation (Denzin, 2009 as cited in Fusch et al., 2018)

(4) Asking all participants the same questions (Guest et al, 2006)

(5) Satisfaction that these results can be replicated (O'Riley & Parker, 2013)

12.2.3. Analytic story / process

Reflexive thematic analysis was selected as the most suitable method for the analysis of this particular data to inductively develop themes. Thematic analysis also offers primary researchers theoretical flexibility and freedom in coding and developing meaningful patterns. Furthermore, it allows each participant to voice their own understanding and their own unique practice to be accommodated as the patterns of meaning.

Braun and Clarke (2006) have defined six stages of thematic analysis to explore the patterns across data, with their nature being chronological and recursive.

Step 1: Become familiar with the data. This data collection was a result of lockdown of sports centres and gyms worldwide with recruitment on social media and fitness forums. This process was relatively brief over few weeks with enough participants expressing interests across the globe.

Step 2: Generate initial codes. The key point of this stage was finding best or more representative ways to show what the datasets were showing e.g. emotions, attitudes. The self-reflection pre- and during familiarisation were input as notes from many perspectives and environments so PT, gym, applied exercise psychologist and then sports psychologist. I had an awareness that changing roles and environments would influence analytic sensibility and interpretative responses.

Step 3: Search for themes. Refining the codes to really send a message. Awareness of clusters or summary names not being codes themselves.

Step 4: Review themes. This stage was predominantly focused on refining the thematic maps of the themes that started to appear in the previous step with review of the original coding patterns.

Step 5: Define themes. Part of this was explaining the themes to my colleagues or other researchers to find ways to present these themes in a digestible way. Another part was presenting the preliminary findings and thematic maps at a conference to clarify the explanation of the patterns and encourage discussion with experts in the field of sports, exercise and psychology.

Step 6: Write-up. As this report was written and each theme described in detail, that further refined the explanation of each theme and the relationships between them. Empathic sensibility and non-judgement approach in this stage helped me to conclude the themes and suggest future avenues of research and suggestions for the practice.

The thematic analysis, raw materials and early maps are available in Chapter 12 folder here: https://osf.io/tbekp/?view_only=b7497391850a4f31805d4ec558c8abfd

12.2.4. About the researcher

In line with the reflexivity guidelines and the role of the researcher in constructing and shaping themes, rather than 'discovering' or 'emerging', I conducted reflexivity activities (Braun & Clarke, 2022).

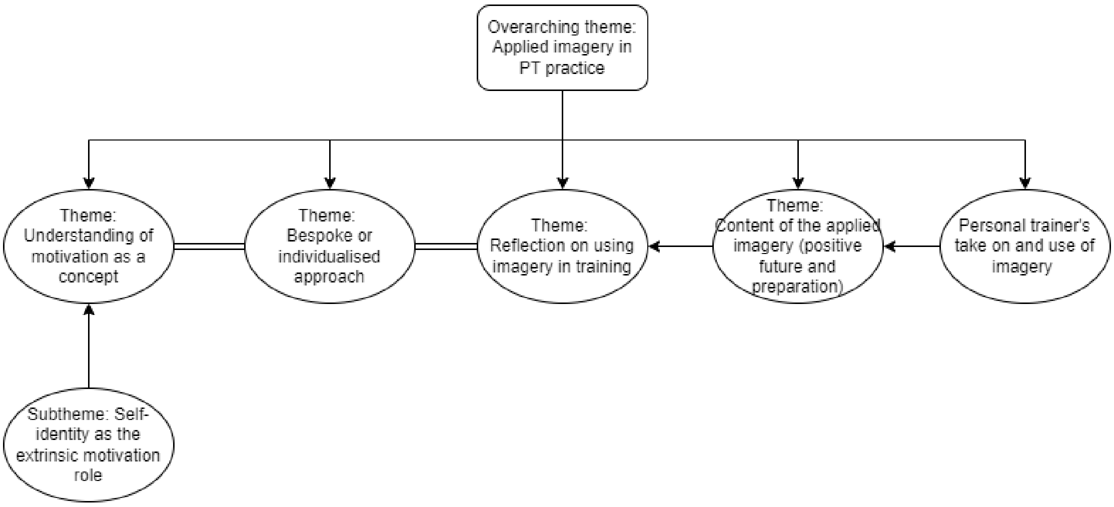
I am a Caucasian male with constructivist, pragmatic philosophical stance. Before and during the data collection process, I have examined my own judgements, practices, and belief systems as a result of my experience of personal training is substantial (7 years). These reflections on the personal choices and attitudes towards personal training have been kept in a separate document and I have been aware of my own judgement and stance in this research. I have received training in qualitative methods, and further supervision from researchers more experienced in the methodology.

12.3. Results

I have worked through the process of reflexive thematic analysis to produce the themes based on the coding (Braun & Clarke, 2022). Supplementary materials include early themes around cluster and summary topics with thematic maps used to refine the themes below.

Figure 18

Thematic map of three key themes with relevant sub-themes.



As a result of the process of refining the themes and joining the similarities, three key themes have been: understanding of motivation as a concept, bespoke and individualised approach and imagery in PT practice.

12.3.1. Theme A: Understanding of motivation as a concept

At the beginning of the semi-structured interviews, participants provided their perception of motivation. It was very common to try to describe motivation to be ‘the reason why you do something’, and ‘getting the best out me/from yourself’. Oxford’s English Dictionary has a strikingly similar definition of ‘the reason why somebody does something’ with addition of behavioural action: ‘or behaves in a particular way’. Furthermore, in order to explain motivation to the researchers more descriptively, most participants used analogies and metaphors, for example it is ‘the fire in the belly’, instead of trying to create a standard definition of what motivation is.

One explanation was particularly detailed and explained double nature of motivation: “the internal or external driving force to try and achieve something” (Participant 14). This is in line with the psychological intrinsic-extrinsic dualism theories (as cited in Reiss, 2012). The split for intrinsic-extrinsic comes from the original research on motivation, such as self-determination theory (Deci & Ryan, 1985), with most research now moving towards multi-faceted theories of motivation (Ryan, 2012). This particular multi-factor and multi-layer nature of motivation was also described in two interviews: “There’s so many layers to motivation and why people do stuff” (Participants 1 and 3).

Motivation as a feeling, not a constant state

Many also referred to the motivation as a feeling (Participant 2 - “motivation is kind of a feeling”), which depends on time and between clients (Participant 10 – “it waxes and wanes, even within individuals”) and one even suggested that it is only present when you are in the positive mood. This quote below was the most descriptive in describing the fluidity and changing nature of motivation:

“motivation is a bit like a muscle it’s sort of, it needs exercising, you need to test it out, sometimes it’s strong, sometimes it’s weak, sometimes it can be overworked. Uh so it’s quite fluid” (Participant 13)

Most participants linked the feeling and fluid nature of motivation to its real-life effectiveness. Participant 12 proposed that it is present at the beginning: “motivation is what gets people going, but it is not long term nor sustainable” and “is very rarely actually something that I think gets something done with a client” (Participant 12). This was further echoed by the role of motivation along other factors: commitment, enjoyment, purpose and consistency. “I don’t feel motivation is as good as sort of um commitment, enjoyment and purpose” (Participant 2) and “in some ways, the motivation is the start, because motivation is, and I don’t know if motivation is the right word, but it’s the consistency that you can plug away” (Participant 13). Additionally, one participant suggested that the feeling that comes from insecurities could be the source of motivation too: “we’re insecure, we’re not happy with what we see, we want to change things.”

This theme has portrayed how exercise professionals view motivation via their common views and attitudes towards it, such as what motivation is, the dual and fluid nature of motivation and its role in comparison to other factors, such as commitment, consistency and enjoyment or purpose. Some participants’ knowledge and understanding of motivation has overlapped with formal definitions and scientific research in its nature, however it is important to notice that not all definitions and explanations were shared across the whole sample.

12.3.2. Subtheme: PT as an extrinsic motivator

When discussing motivation, some participants also referred to the dual nature of motivation, especially the extrinsic side, which made us consider this as a sub-theme of the general motivation concept. “Motivation in one word is just encouragement” (Participant 9) was one of the more specific statements and the reasoning behind the extrinsic encouragement was to “achieve a personal best in say a squat some external motivation um in terms of encouragement can be good” (Participant 2). This motivational tool is consistent with hundreds of articles on ‘how to motivate your clients’ aimed at and available to fitness professionals online, which Google search yields.

Deeper layers of offering the extrinsic motivation have been orientated around maintaining the training and the momentum towards that goal: “trying to keep your clients going no matter what” (Participant 13) and helping or enabling yourself or other people to "stay on the right track". Furthermore, they reported motivating specific clients through learning and understanding that person: "I'm finding out about them, to learn about them so I can motivate them on their interests" (Participant 3). One participant, however, observed the issues with external stimuli in the dual nature of motivation: "there's probably going to be scenarios where literally nothing you can do can make someone do something even if you get into admit that its beneficial and worth it" (Participant 1).

The furthest reflection was based around self-reflection of their own role in their clients' lives and fitness journey, therefore leading to the self-identity of being the extrinsic motivator in comparison to more internal ones, such as willpower.

> "They [clients] won't be motivated without me training them, um, so they kind of need an external stimuli to, I guess get them motivated a lot of the time and it's not something that they can just pull from wherever. Whereas I'd kinda um, call that willpower more if you could kind of bring it from wherever, whenever you wanted." (Participant 12)

This identity of being the client's only extrinsic motivation was further supported by "so many people have a PT once a week and that becomes their only motivation" (Participant 1) and furthermore, reinforced their self-identity "I'm rent a friend, I'm rent a motivation for an hour" (Participant 1). The last quote very specifically portrays the fitness professional as friend-based motivation, which can be purchased as needed. Additionally, that action of befriending the personal trainer can further enhance the social motivation itself over the time "obviously you become friends, or you get to know your PT well, and then you almost feel obliged to keep going" (Participant 1).

Participants displayed strong self-identity of being the source of extrinsic motivation in their work and furthermore identified issues with that one side of dual-naturistic motivation.

12.3.3. Theme B: Imagery and personal trainers/ Personal trainer's take on and use of imagery

A number of participants describe imagery in the format of visual imagery: "painting a picture of what it is we're trying to achieve" (Participant 6), "your picture in your view within, of what you're what you're wanting" (Participant 7) and "what you see your end goal to look like" (Participant 1), to the degree that imagery was reported synonymous with visualisation: "when you mentioning imagery, you're mentioning visualization" (Participant 5). This effect was probably an oversight during the design of this study as researchers focused on imagery, where the term 'visualisation' might be much more coined and established within the sports and exercise environment.

Participant 5 proposed an imagery 'mode' like meditation – planned scenario where you can sit down and imagine it. From an interesting point raised, the imagery was reported to be affected by external comments and feedback, especially in form of body image: "you're looking really good, you can see the efforts or maybe you know, your arms are looking skinny or you put a bit of weight on over lockdown and these are the things that play in our you know mental image of ourself." (Participant 8). Therefore, external comments play the potential role in mental body image.

A further unexpected aspect that came up during the part of the interview discussing what imagery is, was mixing of imagery with social media posts and pictures: "full spectrum visual prompts or visual um motivation is important" and "like an influencer so they will put up imagery" (Participant 3). The source of this overlap was not explored during the interview; however, we propose to possible sources: unawareness of what imagery is or the common use of the term 'imagery' to describe any visual stimuli, prompt or aid.

Practice/use

When asked about imagery in practice, participants reported different ways they apply imagery with their clients in form of journey and technique: "the aspect of that is, visualizing so, uh, in lots of different ways, so if you're doing, say a competition for instance, you generally, I would, uh, I go through a technique that I suppose I've learnt um, from years ago where you're visualizing the journey." (Participant 13).

Participants also reported using imagery themselves as a tool: "I'm the same human being, so there's no difference between us, you know, I'm not superhuman, super athlete, you know, when, we're exactly the same, so. We share all the same problems, so you know, I use the same tools to help me perform better, you know, and look better, depends on the goal" (Participant 9). And in form of vocalising a pre-written vision board with imagery "a vision board, but it's kind of like a, a piece of paper, where I read through where I want to be, who I want to be like, um and then yeah, everything that I kinda, want to get out of life" (Participant 12). This is line with previous literature indicating that those who exercise regularly use imagery more frequently (Giacobbi et al., 2003, Gammage et al., 2004; Giacobbi et al., 2010; Hausenblaus et al., 1999) and as stated above, exercise professionals who exercise are no exception from this relationship. Interestingly one person reported imagining their clients happy and satisfied at home and that feeling having a motivation response on themselves: "me imagining Brian sat at home after a session, you know, feet up, feeling really good about themselves. That probably is the most rewarding thing for me as well, in terms of having an effect on someone else" (Participant 6). Therefore, not just using imagery in their own exercise, but in their career and work-related context.

However, not everyone reported applying imagery in their practice:

> "I mean if you set yourself a goal you kind of, have an image in your head a bit about what that looks like, um, whether you're, sort of actively attempting to visualize it or not. I'd imagine they'd do that a little bit, but um, no I don't really do it that much" (Participant 5)

This was met with self-reflection on using the imagery but not with others: “I suppose getting them to do the things that I would do myself”. This was further explored through recent reflections on client’s success with imagery:

> “having seen the success that she’s had, it’ll be something that I will, I’m sort of trying to go into more, but in the past, it hasn’t been something I’ve used a lot” (Participant5)

Furthermore, this conversation pushed one participant to reflect on imagery as a motivation for the first time, previously just associated with the goal: “I’ve never heard of imagery in that in that context in motivation before but off the top of my head it kind of seems like imagery is what something someone like someone’s goal” (Participant 1).

Participants viewed imagery predominantly as a visualisation or visual stimuli and reported as one of the ‘tools of their trade’. Furthermore, some reported using it with clients and other reported using imagery themselves and not reflecting on using that imagery with their clients too.

12.3.4. Theme C: Content of imagery in practice

Content and type of visual imagery reported by participants had two key purposes: motivational imagery around the goals or the future (during and outside of the sessions) and preparation-based (to improve technique, prepare for the movement, prepare for obstacles during the long-term exercising or to activate neural or muscular connections).

Goal-based and positive future imagery

The appearance-based imagery of the future: “you’re going to look, a certain way in six months time” (Participant 12) and “then I’ll quite often say, ultimately this session comes down to how much you wanna look good naked” (Participant 1) were most reported by the participants. Some even called relevant words to induce a specific mental image e.g. ‘wedding dress’ during the sessions. Majority of the participants were referring to clients’ specific goal or plan in the future ("the only imagery which I've ever done but it was, it was always made for them on a very personal level"; Participant 8), with importance of each person having a personalised goal:

> "imagine yourself, you know, achieving, getting gold medal or medal in marathon. Uh, some clients said it's a wedding, 6 months' time wedding, so imagining yourself fitting well in the wedding dress, so that would vary from client to client, you know. It's difficult, um, to really mention every single one" (Participant 9)

One participant gave a detailed description of the future imagery process with highlighting the nature of imagery and fantasy, so the client might have never seen this specific image or scenario, but they are able to imagine it as they are there in the future.

> "One of my clients who first started with me probably a year or two ago now, had a holiday coming up in about 6 months' time and he was going to a water park and he did in fact spend quite a lot of time in our sessions, probably using imagery, imagining himself being, you know, at this waterpark, in better shape. Neither of those two things are something he had actually seen in real life before, it's not like he's seen how he's gunna look in 6 months' time or he's actually been to the waterpark before. So, yeah, I guess he's using quite a lot of imagery there to picture himself, you know, lean, whatever his desired physique is, at the waterpark. Yeah, that's gunna take some sort of imagination." (Participant6)

Others reported to "getting people to imagine their, sort of, pushing themselves up a hill, or imagine they're sort of moving closer towards their goals" (Participant 4) and "I've asked a client look how will you feel when you when you achieve this or how you feel in the gym" (Participant 2). As a part of the process of goal setting (with or without the PT), some professionals reported the action of managing clients' expectations about said goals. This specific task and action came down to "being well informed, and you understand that process, you understand what is, umm, what is achievable" (Participant 1) before encouraging or applying imagery: "manage that expectations to make the client envisage them, and not something that they've seen on telly or on an advert that isn't them you know" (Participant 3). The process of goal setting involves teaching clients about "setting realistic expectations, um, and teaching them what they have and how good they can hold that particular thing". Interestingly, professionals also reported using imagery to manage expectations during the long-term process of working with a client:

> "around week 8, it's always a dark time and I use imagery to go uh you know what do you feel, how do you think you will feel, imagine how you'll feel when you achieve this and then in some instances depending on its very sort of like client related how would you feel if you didn't achieve this" (Participant 2)

Participant 13 reported helping clients to focus their imagery towards the future feeling rather than a numerical value: "how much weight do you want to lose and she'll say a stone, I'll say well, why a stone? And she's like, I don't know. It's like well, what would you look like and feel like if you lost a stone, and it's, um, and, you know, how, how can you imagine that being, you know, we could do it in this way". Where other referred to using imagery to imagine how the client might look like as their body composition changes: "you kind of have to, picture yourself especially when you're talking in terms of like, body composition, body fat percentage. Um, it's been referred to as like the iceberg theory, like you have, um a water level essentially representing the fat, and only when you decrease the water level decrease the fat level, do you really see what's underneath and what you got going for you so" (Participant 11).

Positive nature of imagery

Apart from one mention of possible negative imagery, the positive nature of applied imagery was predominantly reported by participants:

"I've tried a more powerful and positive light; I don't say look you're going to die fat you know you're gonna have a heart attack um I try and I try and um have it as positive but as close to their life as possible have a big impact" (Participant 2)

Sometimes, using emotion-based imagery, such as "be healthy enough walk down the aisle at your daughter's wedding and that's sort of a very powerful imagery" and as close to the clients' personal life: "have it as positive but as close to their life as possible have a big impact" (Participant 2).

The link of applied imagery and motivation was further re-enforced by other interviewees: "you can see like this it's very vivid they like they have in their mind like a perfect body so you could say honestly it is imagery, very vivid imagery that they used to motivate themselves and it does work" (Participant 10). Furthermore, one participant referred to the analogy of motivation: "it builds a fire in them" (Participant 1)

Professionals also reported helping their clients with imagery to reinvent client's identity: "if someone fully believes that they're not, that they're a lazy person or doesn't do exercise, or they're not an, an exercise kind of person you've almost got to, get them to imagine reinventing themselves into something else" (Participant 13). This is a very important finding, which is in line with research in psychoeducational field - Wigfield and Wagner (2005) reported that students' identity development has important implications on their competence and motivation. The other explanation for the motivational effect was avoiding regret in the future: "there's gunna be a 20 minute workout where you're gunna wish you had more in the tank, here's your opportunity to get more in the tank. Then it's almost like helping them imagine that painful part, that pain that's going to come in six months' time" (Participant 1).

Attention (distraction from hardship or focus on muscle)

Professionals also referred to the use of imagery in context of shifting focus; that was done as two main purposes: to distract clients from the difficulty of the physical exercise or bring their focus on their own muscular nerve connect.

Refocusing the attention can have an effect of distraction: “you have to swallow that misery and that bitterness of the day-to-day training, so what is a distraction? We can call it distraction, I would call the slightly different point of focus, slightly focusing the future, what’s going to happen in the future, you know, using that imaginary.” (Participant 1) They reported reminding them of their bigger future-based goals, their achievement so far or their purpose:

> “um reminding them what their goals are and reminding them why they’re there ‘cause sometimes you just thinking about how awful it is at the time or you know kind of almost why am I doing this, when if you can remind them either why they started, or how much they’ve already progressed, or what their future goal is, if you can remind them of those things, then it refocuses them to be able to think actually no there is a purpose for me being here um and it is worth it because you know imagine how great I’ll feel when I get to, you know the final goal. Or imagine ahead of where I was.” (Participant 7)

One participant reported their observation of connection between future-based imagery and movement-focused imagery: “50/50 split” of gym population between the appearance in the future and the efficient movement in this session (Participant 1). Furthermore, Participant 1 expanded: “some days I’ll use, you know, the weight loss, the aesthetic side, some days use the performance side” when discussing the content of imagery applied. This split was repeated by other professionals in terms of movement or process of lifting during the session: How they use technical imagery and imagery of the process and/or timeline “I use imagery with people who might not necessarily have lifted this heavy before.”

Furthermore, some participants reported very specific techniques for activating imagery during the physical training: “I’ll get them to, press together as if there is a beach ball in between their arms and trying to squeeze that together with the insides of their elbows to get better activation. So I guess, there’s a bit of imagery there as well” (Participant 12) and “I’ll sort of always say things like, you’ve probably heard the apple on the arm, so in vision that there’s an apple here on the inside of your elbow and that you’re gunna squeeze that apple as hard as you can to try and put as much focus or attention to that part of the body as possible” (Participant 6). The reasons behind these specific imagery examples were reported to be bringing awareness to the muscle movement as “creating a mind muscle connection” (Participant 11) and to support building new neural pathways in the brain via physical exercises: “you’re connecting some neural pathways there so, imagery is really huge uh in what we do” (Participant 11).

The amount of information on the content of imagery from the participant resulted in the size of this theme, which has focused on the motivational purpose of the goal- and future-based imagery and preparation of the clients for the lifting and process of long-term training. Professionals reported using future-based imagery to distract their clients from the hardship of the situation and help them focus on the future scenarios or events, normally around their goals.

12.3.5. Theme D: Reflections on using imagery in real-life practice

The conversation-style interactions with the participants have prompted them to reflect on the imagery in their practice in terms of clients’ natural imagery abilities, effectiveness of imagery, problems and troubleshooting and how imagery changes over time. Participants also reported on how they observed a number of concepts around and/or related to imagery.

Clients using imagery untrained and independently to their PT

Participants reported that “all clients use imagery to different extent” (Participant 7) and “I think everyone uses it, it just depends on how big an image they’ve got for the future or whether it is literally just week on week you know smaller goals” (Participant 7). This view is present in a number of recent studies where vast majority (98-99%) of sample demonstrates some imagery ability, with a small percentage of aphantasia (lack of imagery; Rhodes et al, in press). Furthermore, the vivid imagery was linked with the motivation to exercise: “you can see like this it’s very vivid they like they have in their mind like a perfect body so you could say honestly it is imagery, very vivid imagery that they used to motivate themselves and it does work” (Participant 10). I can summarise these observations by the fact of not needed to be prompted by the professional with client’s intelligence serving as explanation: “she’s a very intelligent person, so she doesn’t use it because I’ve told her too, as such, but she uses it because it’s something she does” (Participant 5).

That imagery was reported as occurring during and post session in this detailed description around the process of long-term physical training:

> “evidence of that in the sessions because you know, he would make it very apparent, sort of, after a bicep curl, maybe he’d, sort of touch his bicep and you could sort of see him looking into to the sky as if it was 6 months’ time and it was bigger than it actually is. Um, and then out of the sessions as well, I know just from the sort of person he is that, the texts I get randomly every now and then, that he is the kind of person that would, hence why it probably brings me a bit of satisfaction to imagine it, is because I can picture it actually happening, him sat at home, you know chilling out looking into the future, picturing himself in 6 months’ time.” (Participant 6)

Imagery changing over the time

The quote above proposes that imagery varies or changes to some degree and in fact, other participants reported how imagery develops over the longer period of time. In other words, imagery is not the same forever: “think clients goals may change during this time something might happen which completely changes it and I think in that instance, imagery does change” (Participant 2). With others suggesting that element of development “this picture starts to become a bit more of a reality, rather than something that’s just been your imagination. It becomes, well the goal posts getting closer and closer” (Participant 6) and progresses alongside the goals “when they start achieving the imagery becomes clearer” (Participant 2).

This process was further explained in terms of goals achievement and new goal setting:

> “Now it’s changed because she isn’t, she is not focused on her body weight right now, now it’s a, now she pictures herself in her head lifting, or dead-lifting a 60 kilogram barbell, yeah, but at the time she would look at the scales image or she would visualize that, the number” (Participant 5).

Response to and effectiveness of imagery

Trained, guided or natural imagery has been reported to produce physical response such as facial response or muscular activation: “get people to close their eyes imagine it you’re often greeted with a smile like people start to smile” (Participant 2) and “you know, if you pay attention to the detail you can watch people’s hamstring start to fire up, whereas maybe they didn’t before, just from little representations like that, that may help them relate to it a bit more” (Participant 6).

The psychological aspects of ‘visual motivation’ (“[imagery] raise their sort of, I wouldn’t say motivation to the lift but a willingness to lift”; Participant 2) and the higher psychological factors, such as purpose, commitment and sense of expectation have been reported as the results of imagery too: “enjoyment and commitment and purpose seems to elevate once you use imagery” (Participant 2) and “[imagery] would bring a sort of heightened sense of maybe expectation" (Participant 6). One participant summarised the whole process of repeated visual imagery of weightlifting to enhance the motivation:

> "she's playing this image through in her head of when we're back in the gym and the gym is open again, she wants to deadlift 65 kilograms because that's the weight that she used to carry round on her body. So, this is just something she's been playing through and visualizing in her head, which makes her feel really, really motivated" (Participant5)

The reason behind this effect can be tracked down to the content (as described in the previous theme) "that visualisation of them improving or an optimum version of themselves, I always think they are going to get the best results" (Participant 3). These effects are achieved possibly through the distraction from the physical training or diet: "I think it helps them to go through the training, it helps them to go with that, kind of, misery of strict regimen and diet, so you know" (Participant 9), and preparation for the regime: "We found when we go through that, clients are more likely to stick with it and achieve that lift then simply just letting them letting them go for it without that sort of expectancy and imagery of how it's going to feel" (Participant 2).

Problems and troubleshooting with imagery

However, some participants reported the issues in using imagery around not having a specific goal, stress, needing to switch off and non-imagers. The first aspect which was getting in a way of applying imagery was factors outside of the training, such as the amount of stress from work: "work outside is stressful and they bring that stress in sometimes the imagery it doesn't work, potentially on that day so we find it good to sort of come away from the imagery just use just sort of you know uh don't try and employ imagery and just talk to them a lot of the time." (Participant 2). The solution here was proposed to be just talking to their client without a psychological tool applied. This problem also tides up with client's need to switch off "they like being told what to do by someone to have someone completely take it you know take a take control of the sessions for the for the hour and what they're gonna be doing so they don't want to do sort of any mental work including imagery, they just wanna move the body and switch off up here, so we have found that as well." (Participant 2). In this instance, the proposed solution was for the professional to indeed just lead the session. Finally, the daily attitude (which is possibly affected by the external factors) dictates the use of imagery: "it changes from week to week as to what um attitude they walk in with you know what their week's been like, how tired they are, how this, that and the other, it's whether we're imagining getting to the end of the session or we're imagining in six months time the progress" (Participant 7).

The other problems with imagery were focused on more internal matters, such as not having very clear goals in the future and client's natural ability to imagine. The lack of clear enough goals stops them from using imagery around that specific image in the future: "a lot of the other clients weren't as specific with their goals I don't think so, um, it would more be like, health gains I guess you'd call it so that it would be, specifically just to move a little bit better, or it wasn't like a specific image, so that was kind of, hard to have an imagery around that I guess" (Participant 12).

The most commonly reported problem was the issue with clients' natural ability to imagine: "we work with a really diverse range of clients and some of them it doesn't work whatever reason there are real non-responders" (Participant 2). This lack of imagery ability possibly caused confusion if the client can't access the imagery quickly "use this imagery you speak of a little bit better are the ones who are unable to understand it a little bit quicker, it sort of, makes sense to them. The others are the ones that give you a bit of a blank look as if to say, 'why are you talking about cranes and pully systems when I'm supposed to be doing a deadlift" (Participant 6). However, the observations suggested that imagery ability might be poor, but never non-existent: “They do struggle to imagine, it will never come back to me, I can’t really imagine myself crossing the channel, it might be difficult but the whole point of the exercise is try as hard as you can, see yourself crossing the channel, or you know, in that dress. It might be difficult to them, but I can’t really recall a response sorry I can’t imagine myself” (Participant 9).

Almost all the participants’ clients were reported to have imagery ability and using it to some degree, with those who have potentially lower imagery having more troubles to access that or the external factors, such as stress, blocking the ability to use it effectively. Imagery also changes with time, place and/or progress of the goals and can enhance motivation, commitment, purpose and sense of achievement.

12.3.6. Theme E: Bespoke and individualised approach

The final theme was result of the insights and observations from the PTs practice and was based around individual approach and utilising other psychological tools. Working with others, especially motivating them has been reported as an ‘individualised concept’ due to “some people have more than others and obviously it waxes and wanes, even within individuals” (Participant 10). This is in line with the theme of motivation as a concept and how it changes or is different to commitment and dedication. This difference was further explained as resulting from different backgrounds and learning - motivation “would vary from client to client because we would, with people with different growths” (Participant 9). A majority of the participants have demonstrated the need of finding out how to motivate each person in bespoke and individualised manner: “everyone’s motivated in different ways so you gotta just gotta find what works for them” (Participant 1). Furthermore, the learning aspect resonated with the participants as an essential awareness during their journey with each client: “different types of learners, people need to uh, actually have, like a physical approach, some need the mental stimulation, things like that. I think some people are very imaginative people, some people maybe not so much" (Participant 6) and learning with individual differences: "everyone kind of picks up on, you know different things at their own, at their own pace, and then, you know, different exercises just uh vibe differently with different people" (Participant 11). One participant brought up a specific example of motivating one client in a way that worked for them:

> "there are some people that, unless you get to know people as well, you know, hopefully you know how to motivate people. So, you know who's on a weight loss journey or you know whose got, I don't know, loves a bit of swearing, and like, that training kit at obviously my last place, their slogan was 'be better'. There was one day I was literally, like stood in front of someone at a bike screaming at them be better, and their motivation was me telling them that they were [***] and they were getting angry." (Participant 1)

The individualised concept results from the personal attitude towards each client and their goals: "it all depends what their goals want to be and what we're trying to break down. So it's all very very quite individual. You see patterns, but I think, uh, usually a lot of people come with me thinking they want one thing when actually they want something else" (Participant 13). Furthermore, it is understanding each person's goal and selecting and offering relevant tools for each specific goal: "it's very personal, we've got all different goals. and my job as a PT is just to, so the very first question I ask people 'why are you here?', come into my studio, what is your goal? And this is your goal, so these are the tools I'm giving you, and I'll teach you how to use the tools to achieve your goal. So, and once again, the using the imagination as one of the tools, and it's gunna be specific towards that goal." (Participant 3). As seen above, the part of this bespoke and individualised approach is focused using imagery and other psychological methods as tools in order to get to the goal.

Interestingly, Participant 9 reported having ‘no emotional attachment’ to either of the tools, they were just means to get to the goals.

Imagery was not the only tool that participants reported using in their bespoke and individualised approach towards their work with clients. List of tools reported alongside imagery include:

- teaching self-appreciation first before discussing any changes with their clients “teaching the client to love their self first, it’s from a psychological aspect having clients that come to you um, I hate this about myself and I hate that about myself and I wanna change this and I wanna change that and it is kind of making that person like you’ve got to appreciate who you are” (Participant 13)
- adding meaning to the visual prompts “full spectrum visual prompts or visual motivation is important” (Participant 3)
- using social media for social support and encouragement. But one participant forbidding it: “you don’t share them on social media, you don’t show your friend or even your boyfriend girlfriend whatever, this is for you. You take 3 pictures at the very start” (Participant 8)
- developing a mindset diary for clients to keep “ we developed a mindset diary and that, that’s enough for some people, to bring their diary in and to fill in their achievements in that book an- and in the book there are some uh some tasks um there’s like a picture of a mirror to ask you to what do you see in your reflection, what would you tell yourself if she was having a negative day and that would put you back on the forefront?” (Participant 3)
- encouraging clients to use meditation apps “I’d suggest apps to them if they don’t like, um, the meditation. A lot of people, or my clients will say that they’re more just

sitting there with their legs crossed and thinking rather than actually meditating so, um, yeah I guess yeah, that's kind of how we go with that." (Participant 5)

- explaining and encouraging mindfulness and being in the moment rather than imagining down the line "visualize something at way down the line that's great, eyes on the prize, but enjoy the training, enjoy being in the moment enjoy the personal bests, enjoy the improved fitness and the mental wellbeing then when we stand back and have a look in the mirror eventually, you'll notice that change, you'll notice that hopefully the visualization is somewhat close to where you envisioned yourself being later down the line" (Participant 3)

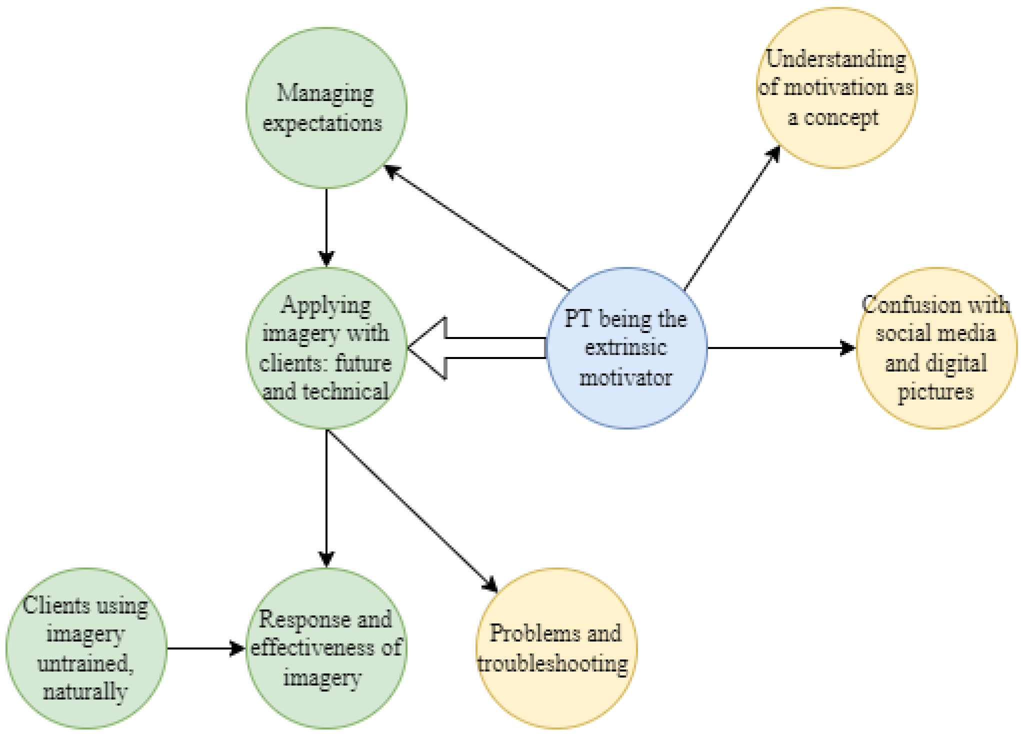
This theme showed the holistic attitude that professionals have in work with their clients and methods to understand their client on individual basis and bespoke technique to motivate them. Additionally, professionals reported using or encouraging use of different psychological tools alongside the physical training.

12.4. Impact-based thematic map

Throughout the process of refining the themes themselves and the thematic map, I have identified earlier, smaller themes (which were then collapsed into larger ones above), where impact in practice can be applied. The results can be seen in Figure 19.

Figure 19

A limited thematic map of where impact can be applied, with colour coding to indicate how the professionals see themselves (blue), what they reported as impactful or effective in their practice, including imagery (green) and what problems or confusion they reported (yellow).



The map above suggests that participant do perceive themselves as an extrinsic motivating factor in their client's journey, which became the leading factor. However there was a vast variation in understanding what motivation is and overlap between mental imagery and images on social media. Participants also reported having to manage expectations at the beginning before applying any imagery, which many reported to be the effective as they observed their clients' response to imagery (guided or natural). However, they also reported issues where imagery is not applicable for various reasons, such as tiredness, not wanting to shift focus, clients' being low imagers so imagery itself becoming confusing.

One participant proposed that they do indeed train their participants autonomy and skills in using all these methods, such as self-motivation and self-visualisation: "important I think that people that can self-motivate and self-visualise or with a little bit of guidance can visualise their selves, at an obvious improvement, that's gonna get the better results and less disappointment" (Participant 3). This quote encourages the training and education to apply and utilize these skills in practice, in order to achieve better results.

My main task through refining this map was to prepare future studies or interventions or courses for what personal trainers currently know and do in practice and where education can be applied to clarify and maximise the effectiveness of applied imagery. I propose that future interventions or courses define motivation and imagery through discussion and available literature and teach professionals different methods and underlying mechanisms of applied imagery, such as multi-sensory experience, training of imagery, PETTLEP approach, just to name few, to maximise the effects of imagery on motivation and physical activity.

12.5. Discussion

This is the first study to approach this aspect of professionals' views on and use of imagery with the aims of exploring the mechanisms, behaviours and habits of using imagery by exercise professionals and whether they incorporate the imagery in their own practice. The five key themes and one subtheme around the overarching theme of imagery have presented such views and practices of imagery use and also revealed the professionals' take on motivation and their individualised and specific approach to this field of work.

In summary, participants have seen motivation as the reason why their clients exercise, understood the dual nature of motivation and its fluidity in contrast with other aspects, such as commitment or purpose. Most have seen imagery as predominantly visualisation and therefore a tool they can use in their bespoke and individualised approach in work with their clients; the range of non-physical tools have also extended to meditation, mindfulness and visual prompts. The applied imagery has been mostly based on the client's future goals to enhance motivation, distract from hardship and avoid regret and some imagery on the preparation on movement and process of long-term process of exercising. Participants also reflected on their own experience of using imagery; they highlighted that almost all clients use imagery (naturally or guided by the PT) and the effect of it being visible and observational. The problems with imagery (stress, tiredness and non-imagery) have been reported from their own experience with the further observation of how imagery changes ('evolves') over time.

12.5.1. Reflection to previous literature

This explorative, naturalistic study investigated the applied side of imagery use, rather than the internal mental imagery during exercise for the first time. These findings bring light to how professionals perceive it and use it, in comparison to all the evidence based on participants exercising. Additionally, when analysing use of imagery for personal use, almost all participants reported using imagery themselves during their own exercise and physical activity and when we assume that exercise professionals are active, it is consistent with the evidence that those who exercise regularly also have a higher frequency of imagery (Giacobbi, 2003; Gammage, 2004; Giacobbi, 2010; Hausenblaus, 1999). Therefor this study brings the light to professionals' attitudes, behaviours, and habits.

12.5.2. Limitations

It is important to highlight the nature of this sample, the recruitment was conducted via voluntary advert in social media. Therefore, this sample has expressed pro-active and open-minded nature of the professionals, who came forward to contribute to this research. I have to assume that I am able to tell only a half of the story, with possible less open minded and pro-active professionals existing in the thousands of registered exercise professionals in the UK, due to a different attitude, having different thoughts and skills or lack of them.

12.5.3. Implications in education and training

Through the impact map, I have identified areas, where I know PTs apply psychological methods, which can be further defined by discussion and with addition of areas of improvement they can be constructed into a standardised, evidence-based and action-based training and education. I suggest training and education especially in the areas of defining motivation, defining imagery (and what imagery is not) and problems with imagery use reported by professionals, such as low-imagers having the potential to improve their imagery ability over time (as seen in the previous chapter). Furthermore, as these professionals reported using imagery, while managing expectations and noticing clients' natural ability to imagine, I encourage structured training to improve the effectiveness of these methods; this outcome can be achieved by working forwards and backwards with the professionals as they would have a large amount of real-life experience of what works with their clients. Therefore, I propose that the standardised training in imagery use for health and fitness professionals could be a next step in this field; the organisation of knowledge and evidence could be extremely beneficial for professionals' future practice.

12.5.4. Conclusion

This study was a first attempt to obtain insight into the exercise professionals' knowledge and use of imagery; this specific population was particularly important due to its size and the number of trained clients worldwide, in comparison to sports psychologists for example, who receive formal and structured training in imagery. The themes showed a variation of understanding of motivation and imagery, with majority reporting using future- and goal-based imagery for motivational purposes. This investigation shed light onto professional practice and its current state, which allows future research to focus on development of interventions and education.

12.6. Chapter summary

This chapter provides a summary of the qualitative data from the study investigating exercise professionals' views on and use of imagery. The key themes identified include motivation, understanding of imagery, application of imagery in practice, personal use of imagery, and the evolution of imagery over time. Participants recognized motivation as a crucial factor in their clients' exercise behaviour and perceived imagery predominantly as visualization, which they utilized in their individualized approach to work with clients. The findings also highlighted that exercise professionals themselves commonly use imagery during their own exercise and physical activity. The study contributes to the existing literature by exploring the applied side of imagery use among exercise professionals, offering insights into their attitudes, behaviours, and habits regarding imagery. It expands the understanding beyond previous research focused on participants engaging in exercise. However, it is important to note that the sample of participants in this study may not represent the entire population of exercise professionals, as recruitment was conducted through voluntary advertising on social media platforms. Implications for education and training are identified based on the findings. Areas such as defining motivation, defining imagery, and addressing problems reported by professionals can be incorporated into standardized, evidence-based training and education programs. The study suggests the potential for structured training to enhance the effectiveness of imagery methods used by exercise professionals, taking into account their real-life experiences with clients.

In conclusion, this study provides valuable insights into the knowledge and use of imagery among exercise professionals. It sheds light on the current state of professional practice in this regard and paves the way for future research to develop interventions and educational resources that can enhance the application of imagery in the field of exercise and fitness.

13. Review of the findings

Physical inactivity is a significant public health concern with detrimental social and economic consequences. Despite efforts to promote physical activity, the statistics remain alarming, suggesting the need for innovative approaches to behaviour change. This thesis aimed to systematically synthesize existing evidence on the role of imagery in physical activity and exercise, investigate the link between imagery, cognition, and behaviour, and test the effectiveness of a novel intervention called Functional Imagery Training (FIT) in promoting behaviour change and adherence to physical activity. Additionally, the thesis assessed the feasibility and effectiveness of applying imagery interventions in populations in need of motivation and adherence, explore the knowledge and practices of exercise professionals regarding imagery use, and contribute to the understanding and application of psychological tools, such as physical activity literacy, goal setting, motivational interviewing, and mental imagery, in promoting physical activity and improving overall health and well-being. Through these aims, this research seeks to advance the understanding of imagery and its potential as a psychological tool for promoting physical activity behaviour change, while also addressing the needs of specific populations and contributing to the professional knowledge and practice in this field.

The findings of this research have shed light on the effectiveness of imagery interventions in promoting physical activity behaviour change. The systematic review and meta-analysis conducted in this thesis revealed varying effect sizes and highlighted the importance of considering factors such as imagery quality, duration, and materials. The observational study provided insights into the natural use of imagery and its associations with intention and behaviour. The interventions, including Functional Imagery Training (FIT), demonstrated effects on adherence to physical activity goals. Furthermore, the application of imagery in specific populations, such as physiotherapy patients and individuals with Postural

Orthostatic Tachycardia Syndrome (POTS), showed promising results in improving adherence to more active lifestyle and overall quality of life. The qualitative analysis of exercise professionals' understanding, and use of imagery provided valuable insights into the practical application of imagery techniques in the field.

The mixed-method approach used in this study provided a comprehensive understanding of the topic by integrating quantitative and qualitative data. The systematic review and meta-analysis allowed for an objective synthesis of existing evidence, while the observational study provided insights into the natural use of imagery in real-world settings. The interventions and case studies added practical relevance and explored the effectiveness of imagery techniques in specific populations. Furthermore, qualitative follow-ups and analysis helped me to understand how individuals responded to imagery and the process of how it might have impacted them. The qualitative analysis of exercise professionals' knowledge and use of imagery provided valuable insights into the practical implications of imagery in the natural settings, with further recommendations for future interventions of this population.

13.1. Summary of the issues identified in the literature and systematic reviews

In the literature review I came across a number of issues and aspects, which I intended to investigate. The first discovery was based on the traditional approaches focusing on knowledge rather than behaviour change, which may contribute to the limited success in promoting physical activity. Although knowledge and Physical Activity Literacy might be impacted, many individuals struggle with adhering to physical activity plans, highlighting the need for psychological skills and support from professional trainers to help overcome barriers and maintain motivation. As multi-factorial interventions, informed by theoretical models and frameworks, are suggested to be more effective in promoting behaviour change and addressing barriers to physical activity, I summarised the current models and frameworks with the existing evidence.

Some actions and plans were directly related to the recent manifesto (Smith et al., 2022), which proposes twelve action points to improve the quality and rigor of research and to engage the public over the next five years. These actions include addressing replication crisis, focusing on effect size, considering risks and limitations of being too active, assessing the global impact of physical inactivity, and bridging the gap between research and practice. Engaging the public: The research aims to engage the public by focusing on autonomy and motivation, reducing sedentary behaviour, and adopting a life-course approach to physical activity.

A number of further reasons and intentions for this thesis came from more formal analysis of the evidence as the specific review and meta-analysis (Chapter 6) of the imagery interventions and observations. Firstly, I aimed to delve deeper into the cognitive processes underlying motivation and their influence on behaviour change and imagery's role in this process. By investigating factors such as self-selected goals, motivational thoughts, and imagery ability, I intended to gain a comprehensive understanding of how imagery impacts behaviour. Building on the findings of this research and the effectiveness of imagery interventions as presented in the systematic review, I have intended to compare interventions to identify which factors contribute to long-term effects of imagery.

The poor-quality reporting across the literature was very evident, which fits with the larger issue of reproducibility crisis in psychology field. I have been committed to ensuring the transparency and replicability of my research in this field. To achieve this, I have provided comprehensive and in-full reporting of the interventions and results. Clear descriptions of the imagery techniques used, the duration and intensity of interventions, and the measurement tools employed have all been made available online or upon request where not possible to be hosted online, and I hope that these actions have enhanced the scientific rigor and comparability of my studies. I have also incorporated control groups and randomization in experimental designs to strengthen the evidence base.

Throughout my research journey, I have come to appreciate the profound implications of extending the application of imagery interventions to specific populations, particularly individuals undergoing physiotherapy and rehabilitation. My work has been driven by a keen awareness of the potential benefits of incorporating imagery techniques into physical therapy interventions. By focusing on the practical application of imagery in rehabilitation settings, I aspired to make a tangible impact on patients' quality of life during and after the rehabilitation process, ultimately contributing to the advancement of research in the field of physical therapy. In my final research study, I investigated the perspectives and experiences of exercise professionals in implementing imagery interventions. Through semi-structured qualitative interviews, I gained insights into the challenges, facilitators, and best practices in incorporating imagery techniques into exercise programming. This qualitative exploration provided valuable insights into the real-world dynamics of using imagery in industry of encouraging exercise and physical activity. This knowledge will hopefully inform the development of training programs and guidelines for exercise professionals, enabling them to effectively integrate imagery into their practice.

By addressing these research avenues, I aimed to stand on the shoulders of the giants where I build upon the findings of the previous research and contribute to the advancement of imagery-based interventions for physical activity and exercise behaviour change. My intention was set on the research endeavours to contribute to the development of evidence-based strategies and interventions that can effectively motivate individuals to engage in regular physical activity, ultimately leading to improved health and well-being.

13.2. My findings

The findings from the studies collectively provide valuable insights into the role of imagery and other psychological tools in promoting physical activity and behaviour change. The summary can be found in Table 8 below.

Table 8

Summary of all studies and key findings from the doctoral thesis.

	Study	Key findings
1	Systematic review and meta-analysis	Intention does not always mean behaviours. Varied effect sizes, e.g. quality, duration or materials of imagery.
2	Explorative research in physical activity and imagery (regression)	The effect of moderation. Natural imagery unprompted (untrained) and its links to intention and behaviour. Possible need to train imagery ability.
3	Functional Imagery Training and imagery only (single-blind trials)	Imagery has short term effects when multi-sensory modalities are engaged. Training imagery ability (Rhodes). Improving the quality of the intervention (by adding MI discussion and mental contrasting) can have a long-term effect on adherence to self-selected PA-related goals.
4	Physiotherapy trials with Functional Imagery Training	FIT can be incorporated into treatment-as-usual of the physiotherapy patients.

		One session delivery before the treatment or right at the beginning was sufficient to improve adherence and completion. Model for applying FIT into physiotherapy with the critical stages.
5	FIT use with a specific clinical condition (POTS)	FIT can improve the quality of life in the chronically ill patients. FIT combined with physical activity can reduce symptoms of POTS over 8 weeks. Feasibility of FIT being incorporated as a psychological support part of the larger multi-disciplinary intervention.
6	A case study of aphantasia (no visual imagery)	Importance of inclusion of imagery practice even when visualisation might not be present. Demonstration of applying guided imagery in individuals with no visual imagery.
7	Qualitative analysis of professionals' understanding and use of imagery	PTs have a varied understanding of motivation. Most apply imagery of goal-orientated positive future or at least notice that their clients use it naturally. Training or CPD in better understanding and application of imagery for fitness professionals can impact the effectiveness. The need of feasibility study of teaching and training imagery.

The first important finding is that intention alone does not always translate into actual behaviour change. This highlights the need to explore additional factors that influence behaviour and consider alternative motivational strategies beyond intention. This is where techniques like imagery can play a significant role in bridging the intention-behaviour gap and enhancing motivation for physical activity.

Another crucial aspect highlighted in the studies is the natural use of imagery and its connection to intention and behaviour. The evidence suggests that imagery is an important cognitive process related to physical activity engagement. However, it also indicates the need to address individual differences in imagery ability. Training individuals to enhance their imagery ability may be beneficial, particularly for those who do not naturally engage in imagery. By improving imagery ability, individuals may be better equipped to visualize and mentally rehearse physical activity, thereby strengthening their motivation and adherence to behaviour change.

Imagery ability is an important factor in connecting motivational thoughts with behaviour, and it can be developed and trained over time. The inclusion of imagery practice, even when visual imagery is not present, can still be effective in promoting motivation and behaviour change. The case study of individuals with aphantasia reveals the importance of including imagery practice, even in those who do not have visual imagery. This highlights the multi-sensory nature of imagery experiences, emphasizing that imagery techniques can still be effective in individuals with different forms of imagery ability. The findings suggest that individuals with aphantasia can benefit from guided imagery exercises, even without vivid visual imagery, thereby enhancing their motivation and engagement in physical activity.

Imagery interventions have shown promise in increasing goal-based physical activity, particularly when combined with motivational interviewing and goal-setting techniques. The effectiveness of these interventions may be influenced by factors such as imagery vividness, goal specificity, and autonomy in decision-making. Additionally, the use of mental contrasting, which involves envisioning both positive and negative outcomes, has been found to enhance motivation for goal pursuit. By incorporating multi-sensory elements and mental contrasting into imagery practices, individuals can experience a more robust affective response and increased motivation. These findings collectively demonstrate the potential of imagery interventions in promoting behaviour change and highlight the importance of incorporating imagery techniques into various contexts, including physical activity promotion, rehabilitation, and professional practice. The integration of imagery into these settings has the potential to enhance motivation, improve adherence, and support individuals in achieving their physical activity goals.

The effectiveness of Functional Imagery Training (FIT) emerges as a significant finding across multiple studies. FIT combines various evidence-based techniques, including goal setting, multi-sensory guided imagery, mental contrasting, and motivational interviewing. The results demonstrate that FIT has the potential to enhance motivation and promote behaviour change in the context of physical activity. FIT sessions have a structured format that includes discussing goals, potential obstacles, and past successes related to behaviour change. The practitioner guides participants in using imagery to see the positive outcomes of reaching their goals, as well as overcoming barriers. The imagery here is directly linked to achieving specific goals, and it's designed to enhance motivation for behaviour change. The integration of multiple techniques allows for a comprehensive approach to goal pursuit, improving self-selected physical activity goals and long-term adherence. In comparison, guided imagery can be used for other reasons and purposes, such as relaxation, stress reduction, and mental calmness, where FIT is a structured approach to create increased motivation for behaviour change. Additionally, the guided imagery approach might lack the training of imagery practice and its ability (which acts as a moderator for the behaviour), therefore it might be more suitable for repeated practice for desired mental state e.g. calmness, rather than to increase the dynamic goals. However, overall these findings suggest that incorporating imagery and other psychological tools in interventions can have a substantial impact on behaviour change.

The successful integration of FIT into physiotherapy treatment represents a practical application of imagery-based interventions. It highlights the potential to incorporate imagery techniques into existing healthcare practices. The studies demonstrate that a single session of FIT delivered before or at the beginning of physiotherapy treatment can improve adherence and completion rates. This finding has important implications for integrating imagery techniques into physiotherapy at critical stages to enhance treatment outcomes and overall patient experience.

Additionally, the application of FIT in a clinical condition such as POTS illustrates its potential as a psychological support component. The findings indicate that FIT can improve the quality of life and reduce symptoms in chronically ill patients. By combining FIT with physical activity, a comprehensive approach is provided to address both the psychological and physiological aspects of health. This suggests that FIT as a structured and unchanged approach can be a valuable addition to multi-disciplinary interventions for various clinical populations, providing psychological support alongside medical and physical treatments. In the larger scale of evidence in this thesis and in the literature, use of imagery in physical therapy and rehabilitation can enhance adherence, confidence, and overall treatment outcomes. Furthermore, the application of imagery techniques in a multi-disciplinary setting has shown positive effects in improving quality of life and managing chronic conditions.

Professionals in the exercise and fitness industry recognise the importance of motivation and frequently use imagery as a tool in their practice. On the other hand, the qualitative analysis of professionals’ understanding and use of imagery in promoting physical activity underscores the need for better training and understanding among fitness professionals. The findings indicate that many fitness professionals have a varied understanding of motivation and how to effectively utilize imagery. Providing training or continuing professional development opportunities for fitness professionals in the effective use of imagery can enhance their effectiveness in promoting physical activity and behaviour change among their clients.

Lastly, in unexpected results, physical activity and health literacy and understanding the consequences of physical inactivity play a significant role in influencing individuals' levels of physical activity. Ongoing research and exploration are necessary to further understand the mechanisms of knowledge sharing and being instructed to exercise and its effectiveness in promoting physical activity behaviour change; this can be conducted in the exercise professionals' field.

In conclusion, the findings from these studies collectively demonstrate the potential of imagery-based interventions, such as FIT, in promoting physical activity and behaviour change. By addressing individual differences in imagery ability, integrating imagery techniques into existing healthcare practices, and tailoring interventions to specific clinical populations, researchers and practitioners can enhance motivation, improve adherence, and ultimately promote behaviour change. Further research is needed to delve deeper into the mechanisms underlying imagery effects, explore individual differences in imagery ability, and optimize the integration of imagery techniques in various settings and populations. By considering these findings, researchers and practitioners can continue to refine and tailor interventions to effectively utilize imagery and other psychological tools to promote physical activity and improve overall health and well-being.

13.3. Contribution to existing models of physical activity

Several theories and frameworks have been used to understand and promote physical activity. These include self-efficacy, reasoned action, planned behaviour, operant conditioning, social cognitive theory, decision theory, transtheoretical model, relapse prevention, and motivational interviewing.

The findings of this research contribute to the theoretical understanding of behaviour change and motivation. The Economic Decision-Making Model has been applied to explain the impact of infographics on low physical activity levels by considering the costs and benefits associated with different choices. Theoretical frameworks underlying physical activity behaviours, such as self-efficacy, social cognitive theory, and dual process theory, provide valuable insights into the psychological processes involved in imagery-based interventions. The Socioecological Framework highlights the importance of considering multiple levels of influence, including individual, social, and environmental factors, in designing interventions; these levels are also relevant to the WHO quality of life assessment. The COM-B Model for behaviour change offers a comprehensive framework for understanding the components necessary for behaviour change and can inform the development of imagery interventions. Classification framework for theories of exercise and physical activity behaviour: Theories can be organized into belief-attitude theories, competence-based theories, control-based theories, stage models, and hybrid models; each focuses on different aspects, such as cognitive beliefs, self-efficacy, autonomy, and the process of change. As discussed earlier, many of these models emphasize the importance of imagined end states (behaviours or goals) and the motivation for action resulting from them.

In reflection, my studies have attempted to shed light and contribute to the number of these models. The review and meta-analysis contribute to the understanding of different factors across all levels of physical activity interventions and can contribute to all the models discussed above. Furthermore, explorative research in physical activity and imagery explores the role of imagery in the context of physical activity behaviour and its links to intention and behaviour. It provides insights into the relationship between imagery ability, intention, and behaviour, which aligns with the theoretical frameworks underlying physical activity behaviours. In COM-B model, intrinsic Motivation is evoked by the person-centred approach and by imagery of successfully (in contrast to not) completing the goal or the outcome. Additionally, regular multi-sensory imagery improves one's Capability through the immersive of successfully completing the task or a goal. Furthermore, these two enhanced concepts will increase the desired or goal-orientated Behaviour, which in return can impact the Opportunity available to the person. Whereas in the Theory of Planned Behaviour, regular imagery can impact the Intentions (more motivated to complete it), the Norms (more exposed to this behaviour being a norm) and the Perceived Control (more familiarity and exposure to the desired behaviour increasing the perception of one's control over it), and these directly and indirectly can lead to Behaviour. Interestingly, in the original TPB, behaviour itself would lead to increased perceived control over such behaviour, and imagery frequency can provide a substitute for the behaviour with a mental action, resulting in more control. In both models, imagery ability can be the underlying mechanism of those concepts being increased by regular imagery.

The comparative research between Functional Imagery Training and well-established and tested guided imagery investigated the effectiveness of Functional Imagery Training (FIT) in promoting physical activity behaviour change. FIT combines multiple techniques, such as imagery, goal setting, and motivational interviewing. Its use of imagery aligns with the social cognitive theory and the socioecological framework. Furthermore, the factor of autonomy in making your own choice in regards to exercising and being active is in line with the humanistic theory of self-actualisation and growth. Physiotherapy and POTS trials with

Functional Imagery Training trials examined the integration of FIT into physiotherapy treatment for various patient populations. By incorporating FIT into treatment-as-usual, these studies address the socioecological factors influencing physical activity behaviour change and support the concept of multi-level interventions in the clinical settings. By incorporating FIT as part of a larger multi-disciplinary intervention, these studies demonstrated the feasibility of integrating FIT into clinical settings and highlights its potential impact on improving the quality of life and reducing symptoms.

The aphantasia case study investigated the use of guided imagery in individuals with aphantasia, a condition characterized by the inability to visualize mental images. It emphasizes the importance of including imagery practice, even in individuals who may not have visual imagery, aligning with the humanistic approach and demonstrating that capability can still be enhanced in the COM-B model for behaviour change, even if not all senses are available. Qualitative analysis of professionals' understanding, and use of imagery examined professionals' understanding and application of imagery in the context of physical activity promotion. It highlights the need for training and professional development to enhance the effectiveness of imagery interventions, aligning with the social cognitive theory and the need to improve professionals' self-efficacy and understanding of imagery.

13.4. Reflection on the mixed-method approach

Throughout this research and doctoral enquiry, a pragmatic and critical approach has been adopted, with a focus on deductive reasoning and effectiveness from general application to specific populations. The ontological standpoint has been predominantly informed by critical realism, aiming to capture the complexity and reality of the human world through a broad and critical examination of knowledge. The epistemic stance has been oriented around constructionism, recognizing the social construction of knowledge and seeking meaning through the interplay between the researcher (myself) and the object of this doctoral work.

This approach acknowledges the subjective nature of knowledge production and the importance of understanding different perspectives and contexts. By adopting these philosophical and methodological frameworks, this research has aimed to provide a comprehensive and meaningful understanding of imagery's role in motivating physical activity and exercise.

Firstly, the research demonstrates a commitment to understanding the complexity of human experiences and behaviour change. It recognizes the multidimensional nature of physical activity and the need to explore various psychological factors that influence behaviour. The use of mixed methods in the research, incorporating both qualitative and quantitative approaches, reflects a holistic understanding of the research question and the recognition that multiple sources of data can provide a more comprehensive understanding of the phenomenon under investigation. This approach aligns with the ontological assumption that reality is complex and subjective, and that it can be understood through multiple perspectives and social contexts. Moreover, the research embraces a pragmatic and critical approach by addressing real-world problems and issues. It aims to improve the lives of individuals and communities through the application of evidence-based interventions and the exploration of practical strategies for behaviour change. The philosophical stance also resonates with the focus on participant autonomy and individual goal selection in the FIT intervention. These aspects align with the axiological assumption that value-laden research should be respectful, inclusive, and ethical. Through the qualitative part of this research, I have demonstrated reflexivity, acknowledging the role and impact of the researcher in the process. It recognises the importance of self-reflection and self-awareness in shaping the research process and findings. This aligns with the epistemological assumption that knowledge is socially constructed and subjective, and that it is produced through interaction and dialogue between researchers and participants.

The interventions incorporated the elements of critical realism by seeking to uncover the complex interactions between imagery ability, motivation, and behaviour change. It recognizes the importance of understanding the underlying processes and mechanisms involved in order to develop more effective interventions. By adopting a mixed methods approach, combining quantitative measures of physical activity and motivational processes with qualitative insights from participants, the study embraces the idea that reality is multifaceted and can be best understood through a combination of objective measurements and subjective experiences. Throughout this thesis, I have acknowledged the diverse range of experiences and acknowledges the role of the researcher in co-constructing knowledge through interactions with participants.

Implementing the mixed method approach through the thesis (the use of mixed methods, systematic review and meta-analysis, observational studies, interventions, and qualitative approaches) has resulted in a number of challenges for me as a researcher, but it also strengthens the quality of the evidence I presented. The process of integrating multiple methods was complex and resource-intensive, requiring hours of studying research methods, careful planning and particular and detailed analysis. This also opens the potential for inconsistencies or limited generalisability due to variations in findings or specific contexts. On the other hand, this approach offered me to have complementary perspectives, allowing for a more comprehensive understanding of the research questions. Triangulating data from diverse methods enhances validity and reliability, while generating rich and multifaceted data. The use of multiple methods increases the robustness of the research and provides a nuanced understanding of the phenomenon under investigation.

Overall, the research I conducted, presented, and discussed reflects a philosophical stance that values comprehensive understanding, real-world application, and ethical considerations. It embraces the complexity of human experiences and behaviour change, using mixed methods and a pragmatic approach to generate evidence that can inform practice and improve the well-being of individuals and communities.

13.5. Implications

Following the findings, I discussed earlier and how they implement certain theoretical contributions, I would also like to propose a number of practical implications from these findings. The first key implication includes incorporating multi-sensory guided imagery; utilizing imagery techniques that engage multiple sensory modalities, including all seven senses, to enhance the vividness and effectiveness of the imagery experience. This also leads to integrating imagery interventions, such as Functional Imagery Training (FIT), into behaviour change interventions for physical activity and exercise. FIT combines imagery with other evidence-based techniques, including goal setting and motivational interviewing, to enhance motivation and goal pursuit. As FIT has been now applied in different settings, the use of imagery in various contexts, including rehabilitation, other clinical populations, and general exercise promotion can be utilised. This process also involves the feasibility and effectiveness of incorporating imagery into different settings to enhance motivation and adherence to physical activity and exercise goals. To effectively utilise Functional Imagery Training (FIT) for behaviour change, practitioners should prioritize the creation of a supportive and non-judgmental environment where participants feel comfortable sharing their goals and concerns. Identifying potential barriers to change and using imagery to imagine their resolution can be a transformative step. Additionally, practitioners should encourage participants to draw upon their past successes and build their confidence in making the desired changes. Planning next steps and using imagery cues for continued practice is crucial. Furthermore, conducting further research to better understand the mechanisms and effectiveness of imagery interventions for physical activity behaviour change is critical as continuous process of evaluating and refining imagery techniques to optimise their outcomes and adapt them to the specific needs of diverse populations.

Imagery experience also appears to rely heavily on the imagery ability as proposed previously and highlighted throughout this thesis. I encourage providing training and practice opportunities for individuals to improve their imagery ability, particularly in cases where individuals may have limited or impaired visual imagery. This can include techniques such as mental contrasting and guided imagery exercises. The findings from my research on imagery ability and the current findings on the moderating role of appearance-health images in exercise behaviour (as cited in Cummings, 2008) show a clear connection. The ability to create vivid appearance-health images enhances the relationship between imagery frequency and exercise engagement, coping efficacy, and scheduling efficacy. Individuals who possess stronger imagery ability, particularly in visualizing and experiencing their appearance and health, tend to exercise more frequently. Furthermore, these individuals exhibit greater confidence in their ability to cope with exercise-related challenges and effectively manage their exercise schedule. This suggests that imagery ability acts as a facilitator in transforming imagery frequency into actual exercise behaviour and supports individuals in overcoming barriers to exercise participation. Together, these findings highlight the importance of developing imagery skills, particularly in relation to appearance-health images, as a means to promote exercise engagement and enhance self-efficacy in dealing with exercise-related difficulties. When discussing the appearance-based imagery, it is important to highlight that negative body image can have a detrimental effect on obligatory exercises frequency, therefore a close monitoring is required and further research in this field.

Discussing imagery ability also highlights the need to consider individual differences in generating multisensory imagery, both across individuals and between sensory modalities; this is very evident in aphantasia cases. Recognising that imagery effectiveness may vary among individuals, can lead to effective interventions tailored to individual preferences and needs. Some individuals may respond better to personalised imagery interventions, with a highlight of personal meaning and individually adjusted imagery practice. Flexibility in approach and adaptability of the method are key. To assist individuals and specially to enhance professionals' understanding and application of imagery, training and professional development opportunities for fitness professionals, therapists, and healthcare providers to improve their understanding and utilization of imagery techniques can and should be provided. This includes enhancing their knowledge of imagery theories, strategies, and practical implementation. At this point, it is also worth noting that the behaviour change process and injury rehabilitation process share similarities in terms of the underlying mechanisms and strategies employed. Both processes involve a series of steps aimed at modifying behaviour or recovering from an injury, with the ultimate goal of achieving desired outcomes. This is the possible reason why imagery plays such a large role in both processes.

Finally, imagery itself can be effectively applied in behaviour change work, however when combined with other behaviour change strategies, such as person-centred approach relying on autonomy, personal meaning, goal setting and self-monitoring, can maximise the effectiveness of imagery. Other evidence-based techniques can be further tested and their role to maximize imagery's impact on motivating physical activity and exercise. These recommendations provide a framework for utilising imagery as a motivational tool for physical activity and exercise, taking into account individual differences, theoretical foundations, and the practical application of imagery techniques.

13.6. Limitations and future research

The limitations of any research should be acknowledged and considered when interpreting and applying the findings, and it is also true for this thesis. The points discussing limitations also allowed me to highlight areas for further investigation and refinement of research methods in future studies.

The philosophical approach adopted in this thesis acknowledged the subjective nature of knowledge production and the influence of multiple perspectives and social contexts. However, this subjectivity may introduce biases or limitations in interpreting and analysing the data, as the researcher’s own experiences and beliefs can shape the research process and outcomes. The use of mixed methods, observational studies, interventions, and qualitative approaches offers valuable insights but also presents limitations in form of methodological constraints. Each methodology has its own unique strengths and weaknesses, and the choice to use multiple methods may introduce complexities in data analysis and interpretation. I do hope that the action of including mixed methods approach has largely reduced individual weakness of each method.

Reflexivity is an essential component of qualitative research, involving the researcher’s self-awareness and critical reflection on their role and influence in the research process. I recognised that my experiences, decision making and thinking patterns are an integral part of the research, and my own experiences, values, and biases can shape the research design, data collection, analysis, and interpretation. However, I am also aware that these aspects may influence the wider research process, data collection, and analysis. Efforts have been made to minimize these effects, but nevertheless they should be acknowledged and critically reflected upon.

The research throughout this thesis has been conducted within specific contexts and timeframes, which may limit the transferability of the findings to different temporal, cultural, or social contexts. Factors such as societal changes, technological advancements, or cultural differences that happened during the process of this doctoral work, including a global pandemic, may impact the applicability and relevance of the research outcomes. Finally, this research has been done predominantly with human participants on one-to-one basis, therefore ethical considerations and challenges can and should be considered as possible limitations. Informed consent appeared to give away the randomised condition allocation in at least one study, which can impact the comparative results between the independent conditions. Furthermore, only the intervention scripts submitted and approved by relevant research ethics boards or institutional review boards, were applied; this ensured the adherence to equal treatment, following ethical guidelines and scientific rigour and consistency. However, this also limited the flexibility and ecological validity of certain methods, such as motivational interviewing, which relies heavily on the input from the participant in that conversation-style interview.

Based on these findings and limitations of this research and unexplored avenues of research, a number of areas for future research can be identified. Further investigation is needed to assess the long-term effects of imagery interventions on physical activity behaviour, in comparison to 4-8 weeks interventions. Longitudinal studies could explore the sustainability of behaviour change and the factors that contribute to long-term adherence to physical activity goals (similar to Solbrig et al, 2018). Furthermore the affective response to imagery and its role in improving physical activity can be analysed throughout these interventions. The affective aspect of imagery implementation has been raised in a few places across this thesis, however there was no formal measurement of affective state besides the qualitative data, which pointed towards elevated emotions due to use of imagery. Future research can investigate the role of affective response in evoking motivation and whether successful behaviour change relies on emotional response or whether it can occur without.

Further comparative studies can be conducted to compare the effectiveness of different imagery techniques or approaches, such as functional imagery training (FIT) versus other imagery-based interventions. Comparing the outcomes and mechanisms of different approaches, especially the active components and elements, can inform the development of evidence-based guidelines for using imagery in promoting physical activity and further refinement of imagery.

Research can focus on strategies for effectively implementing imagery interventions in real-world settings, such as NHS services, positive psychology and coaching practice, and feasibility of such implementations. This includes exploring the training and support needs of practitioners who deliver these interventions and identifying strategies to integrate imagery interventions into existing healthcare or physical activity programs.

The terms *imagery*, *imagination* and *visualisation* bring a certain level of challenges when translated and implemented into different cultures. Investigating the influence of cultural and contextual factors on the effectiveness of imagery interventions is important. Cultural differences in beliefs, values, and preferences may impact individuals’ response to imagery techniques, such as belief in higher power and the role of imagery in this process and therefore in motivation and actions taken. Understanding the cultural and contextual factors that can shed new light on what imagery is and how it is used across different cultures; it can also guide imagery adaptation and implementation in diverse populations.

Given the rapid advancements in technology, even just during the period of this doctoral work (virtual reality, AI based scripts and technology in general), future research can explore the potential of technology-based approaches, such as virtual reality or AI-based application, in delivering imagery interventions. Examining the efficacy and user experience of technology-based imagery interventions can expand the reach and accessibility of these interventions and tell us more about the role of external stimuli in more traditional approach to imagery.

Overall, future research should continue to explore the mechanisms underlying imagery interventions, address the limitations identified in this research, and further expand the evidence base for using imagery as a motivational tool in promoting physical activity and exercise.

13.7. Conclusion

Throughout this thesis, I have discussed the role of imagery in motivating physical activity and exercise. Studies have shown that imagery can be a valuable tool in promoting behaviour change, enhancing motivation, and improving adherence to physical activity goals. The findings from these studies highlighted the importance of incorporating multi-sensory guided imagery, training imagery ability, and integrating imagery into behaviour change interventions. Functional Imagery Training (FIT) is as a promising approach that combines imagery with other evidence-based techniques, such as goal setting, mental contrasting and motivational interviewing. FIT can impact goal-based behaviours more due to its entire purpose and furthermore, as a structured method it can be incorporated into a larger multi-disciplinary approach. Additionally, my recommendations emphasised the need to consider individual differences, enhance professionals' understanding and application of imagery, and continually evaluate and refine imagery interventions. In conclusion, imagery has the potential to be a powerful tool in motivating physical activity and exercise. By harnessing the cognitive processes and mechanisms underlying behaviour change, imagery can enhance motivation, improve adherence, and contribute to positive health outcomes.

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15. Appendices

15.1. Appendix A: Intervention-based studies reviewed.

	Study	Country	Study design. Blinding, Allocation method	Mean age (SD)	Sex	Ethnicity	N at baseline and drop-out	Conditions	Materials	Measures	Effect size ( )	p-value
1	Andersson and Moss (2011)	UK	RCTs with single-blinding allocation (intervention study)	34.5	16 M 34 F	Forty-six (92%) participants were white European, two (4%) were Black-Caribbean, two (4%) were Asian.	59 Drop out: 9	Guided imagery – implementation condition – relaxation condition - control	Guided imagery scripts	Physical activity (imagery ability controlled)	0.13 0.17	.043 .045
2	Biondolillo and Pillemer (2015)	USA	Random allocation (intervention study)	19.24 (1.25)	43 M 167 F	94.3% of participants were Caucasian. No other information.	217 Excluded: 31 Dropout: 9	Positive memory – negative memory – control	Short description of the memory	Exercise intention LTEQ (when controlled for baseline differences)	 0.05	>.05 .008
3	Chan and Cameron (2012)	New Zealand	RCTs with no blinding (intervention study)	N/S	33 M 149 F	92 participants were New Zealand/European (51%), 51 were Asian (28%) and 39 classified themselves as other (21.5%).	178 Excluded 47 Drop-out 46	4 imagery conditions, no control	A brochure with the mental imagery explaining the 5-min imagery exercise audiotape with the imagery instructions	Intentions to engage in PA (Time x Approach imagery) Action planning Energy expenditure (MET) (Time x Approach imagery) Leisure time exercises (Time x Approach imagery)	0.67 0.21 0.37 0.2 0.16 0.2 0.17	.001 .01 .001 .001 <.05 .001 <.05
4	Duncan (2012)	Canada	Intervention study (random allocation, not blind)	29.54 (8.34)	102 F	White (58%), Hispanic (6%), Asian (6%) and others, mixed or not reported (30%).	102 Drop-out 44	imagery - control	Eight exercise imagery scripts	Intrinsic motivation	0.12 0.06	.001
5	Giacobbi 2014	US	RCTs (intervention	19.91 (1.70)	43 F	40%Caucasian, 17% Hispanic, 17% Asian, 9% African-	43	imagery - control	An imagery script read at three different times	Exercise Motivation Scale time-by-group interaction	0.3 0.21	.001

			study, not blind)			American, 4% American Indian or Alaskan Native, 4% Hispanic plus Caucasian, and 4% other.	Drop-out 11					
6	Giacobbi 2016	US	Peer-delivered intervention (not blind)	20.73 (2.07)	33 F	10 Caucasians, 5 Hispanic, 2 African-Americans, 1 Asian, and 1 refusal. Some participants indicated multiple race/ethnic categories.	33 Drop-out 11	Face-to-face - telephone delivery	A guided imagery script (1191 words)	Exercise Motivation Scale	0.39	.001
7	Giacobbi 2018	US	RCT with wait-list (intervention study, not blind)	45.5	48 F	N/S	48 Drop-out 13	Imagery - wait list	Three guided imagery scripts	GLTEQ Exercise motivation	NA NA	NS
8	Kim 2011	US	RCT with repeated measures, not blind	70.38 (8.15)	27 M 66 F	37 African Americans, 36 as Asian, 14 as White, 4 as Latino, and 2 as other.	184 Drop-out 93	Guided relaxation (only) vs guided relaxation and guided imagery	CD consisted of 14 tracks for imagery	Energy expenditure (MET) by group group-by-time interaction	0.15 0.05	.001
9	Marquadt 2017	Germany	RCT with hierarchical design, not blind	56.82 (9.74)	74.77% males (total number N/S)	N/S	183 Drop-out 107	3 conditions: Mental constructing imagery - 2 controls (structured vs unstructured information	Mental contrasting of implementation intentions (experts' recommendations vs MCII: goal setting, imagery of desired and imagery of reality)	Baecke Sports (ITTA) Baecke other leisure PA (ITTA) PA diary (ITTA) Weight diary (ITTA) Baecke Sports (EA) Baecke other leisure PA (EA) PA diary(EA) Weight diary (EA)	0.022 0.008 0.036 0.028 0.133 0.097 0.029 0.055	.047 NS .026 .024 .006 .022 .029 .007
10	Martin 1995	Canada	Intervention study with random allocation	27.23 (5.6)	15 M 24 F	N/S	39	Performance plus outcome imagery – performance imagery – control	Brief instructions to image performing a behaviour	Minutes of exercise	0.24	.01

11	Murru 2010	Canada	Intervention study with random allocation	21.43 (3.28)	30 M 80 F	White-Caucasian (48%), Asian, (20%), and South Asian (19%)	110 Drop-out 30	3 conditions: control – imagining positive selves – imagining negative selves	Imagining one in the future either as a healthy or unhealthy person (duration few minutes)	Minutes of exercise (4 weeks) Minutes of exercise (8 weeks)	0.05 0.11	.057 .027
12	Solbrig 2018	UK	RCT with single blind	44.04 (N/S)	31 M 83 males	N/S	141 Excluded 20 Drop out 7	Motivational interviewing – Functional Imagery Training	Guided imagery intervention sessions	Weight (kg) Waist (cm)		<.001 <.001

NS= non-significant, RCTs = Randomized Clinical Trials, LTEQ = Leisure-Time Exercise Questionnaire, GLTEQ = Godin Leisure-Time Exercise Questionnaire, ITTA = Intention to Treat Analysis, EA = Explorative Analysis

15.2. Appendix B : Observational studies reviewed.

Study	Country	Study design/ Allocation method	Mean age (SD)	Sex	Ethnicity	N at baseline and drop-out
Cumming (2008)	UK	Correlational	23.8 (7.09)	65 M, 97 F	N/S	162
Gammage (2000)	Canada	Cross-sectional (observational)	22.22 (4.54)	264 M, 312 F	N/S	577
Gammage (2004)	Canada	Cross-sectional (observational)	20.6 (5.6)	235 F	N/S	235
Giacobbi 2010	Canada and US	Correlational	20.55 (3.88)	211 M, 147 F	287 Caucasians, 24 African Americans, 21 Asian Americans, 12 Hispanics, 9 Native Americans, and 5 not reported.	358
Hall 2010	Canada	Independent sample comparison (observational)	44.88 (14.00)	218 M, 252 F	N/S	470
Hausenblas 1999 (Study 1)		Descriptive	23.08 (7.46)	11 M, 133 F	N/S	144
Hausenblas 1999 (Study 2)	Canada	Cross-sectional (observational)	22.74 (N/S)	12 M, 466 F	N/S	478
Kostelli 2018	UK	Correlational	59.73 (7.73)	168 M, 144 F	296 White, 6 Asian,	299

					2 Mixed ethnicity, 7 chosen not to report	(312 Missing=9 Outliers=4)
Lutz 2003	US	Correlational	20.14 (2.94)	71 M, 70 F	N/S	141
Milne 2005	Canada	Correlational	46.63 (N/S)	147 M, 183 F	N/S	330
Nordin 2008	UK	Correlation	20.69 (2.95)	69 M, 86 F	N/S	155
Rodgers and Hall, 2001	Canada	Observation (prediction) (repeated measures within-subjects, no manipulation)	30 (11.5)	144 M, 97 F	N/S	243
Rodgers and Munroe 2001	Canada	Correlational and regression	N/S	36 M, 575 F	N/S	611 Analysed as two samples (388, 223)
Short 2004	N/S	Mixed-method–questionnaire and content analysis	20.78 (3.45)	214 M, 281 F	N/S	497
Stanley 2012	UK	Correlational	40.29 (13.29)	157 M, 193 F	N/S	350
Wesch 2012	UK and New Zealand	Prospective observational (observational)	42.41 (18.44)	57 M, 33 F	N/S	90
Wilson 2003	Canada	Cross-sectional (observational)	20.71 (2.69)	165 F	N/S	165