A multiple methods study exploring the impact of a community initiative on motivation and the influence of motivational profiles on physical activity habits.

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Declaration

I confirm that the work submitted is my own and that appropriate credit has been given where reference has been made to the work of others.

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Abstract

Around one third of the UK population are insufficiently active and despite attempts to increase population activity levels, many individuals have difficulty maintaining a physically active lifestyle. Two mechanisms for supporting physical activity maintenance are motivation and habits; the literature on physical activity motivation is vast but less is known about more person-centred approaches, e.g., motivational profiling, and the facilitating or inhibiting effect on physical activity levels. A systematic literature review on motivational profiles was needed to inform the research questions. In addition, little is known about the change in physical activity habit strength as a result of motivational profile membership.

The systematic literature review revealed a heterogeneous body of studies on motivational profiles, revealing that between 2-4 profiles are most generalisable to the whole population. Gaps included insufficient evidence of the between group differences (age, gender, ethnicity, educational attainment).

Latent profile analysis results revealed 4 distinct motivational profiles for each sample (general population: profile 1: high identified mixed, profile 2: high combined autonomous, profile 3: low to moderate motivation, profile 4: amotivated. Community sample: profile 1: high identified/intrinsic, profile 2: high combined autonomous, profile 3: moderate mixed, profile 4: low overall motivation). The results represent the complex, multi-dimensional nature of physical activity behaviour but the potential universality of motivational profiles. Moderation analysis found that physical activity only predicted habit in the general population sample and there was no significant moderating effect in both samples. Individuals in the general population with weak habits are most at risk of disengagement, exacerbated by low quality motivational profiles and may require more support in sustaining exercise.

Six distinct themes emerged from the qualitative study; Theme one: the social capital of BeStrong. Theme two: physical and psychological improvement. Theme three: rewarding outcomes. Theme four: situational barriers to being physically active. Theme five: personal barriers to being physically active. Theme six: processes to overcome barriers to being physically active. Results are discussed in relation to theory and practical implications, with reference to future directions.

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Abbreviations

PA	Physical Activity
WHO	World Health Organisation
CMO	Chief Medical Officers
UK	United Kingdom
GP	General Practitioner
SDT	Self-Determination Theory
CET	Cognitive Evaluation Theory
OIT	Organismic Integration Theory
COT	Cognitive Orientation Theory
BPNT	Basic Psychological Needs Theory
GCT	Goal Contents Theory
RMT	Relationships Motivation Theory
MET	Metabolic Equivalent of Task
SRBAI	Self-Report Behavioural Automaticity Index
BMI	Body Mass Index
M	Means
SD	Standard Deviations
IQR	Interquartile Range
LPA	Latent Profile Analysis
BLRT	Bootstrapped Likelihood Ratio Test
BIC	Bayesian Information Criteria
ANOVA	Analysis of Variance
SPSS	Statistical Package for the Social Sciences

Chapter 1: Introduction and literature review

1.1 Statement of the problem

Sustained participation in physical activity (PA) and exercise should be considered a global health priority as many challenges are faced in ensuring people are being sufficiently active. Estimates on physical inactivity, with data from 122 countries, states around 88.9% of adults globally are considered inactive (Booth et al., 2017). More recently, the World Health Organisation (WHO) stated that more than 80% of adolescents and 27% of adults do not meet the recommended levels of physical activity (World Health Organization, 2022). Physical activity is defined as any bodily movement produced by skeletal muscles that requires energy expenditure (World Health Organization, 2010), whereas exercise is a subcategory of physical activity and defined as planned, structured, repetitive and purposefully focused on improvement or maintenance of one or more components of physical fitness (Dasso, 2019). With the aim of promoting physical activity behaviours in the United Kingdom (UK), in 1996 the UK Chief Medical Officers (CMO) provided physical activity guidelines for promoting health. These recommendations advise that adults engage in at least 150 minutes of moderate intensity (e.g. activities that will raise your heart rate, cause you to breathe harder but still hold a conversation) physical activity per week or 75 minutes of vigorous intensity (e.g., where holding a conversation is much harder) activity per week. Specific guidelines were updated among different population groups (children and adolescents, older adults, women during and after pregnancy and adults with a disability) (UK Chief Medical Officer, 2019).

Specifically in England, only around 67.3% of adults are physically active (Official Statistics, 2022) meaning many insufficiently active individuals are at risk of adverse health implications. Exercise and physical activity contribute to improvement in physical and mental health, in individuals with and without underlying health conditions (Warburton et al., 2006; Eynon et al., 2019). Indeed, physical inactivity has been recognised as a contributing factor to the severity of many health conditions such as increased cardiovascular mortality (Barengo et al., 2004; Al Tunaiji et al., 2019), heart and circulatory disease (Lee et al., 2012; BHF, 2017; Lippi and Sanchis-Gomar, 2020), a risk factor for type 2 diabetes (Admiraal et al., 2011; González et al., 2017), cardiovascular disease (Barbiellini Amidei et al., 2022), cancer

(Wolin et al., 2009), hypertension (Gambardella et al., 2020; Zhang and Xu, 2020), obesity (Cleven et al., 2020) and osteoporosis (Pinheiro et al., 2020). In addition, physical activity improves mental well-being (Fox, 1999; Solberg et al., 2014; Caddick and Smith, 2014; Arbinaga et al., 2018) and stress (Nguyen-Michel et al., 2006). Despite the well-documented advantages and disease prevention capabilities of a physically active lifestyle and health promotion campaigns (e.g., NHS Better Health, Change4Life, This Girl Can, One You) over the last 20 years physical activity levels in the UK have remained relatively low (Guthord 2018). Policy actions from a governmental level have been insufficient and strategies used have not impacted overall inactivity levels (Barengo et al., 2004).

The reasons behind inactivity are complex and multifactorial, though it does remain clear that many individuals have difficulty maintaining a physically active lifestyle. Physical activity promotion strategies often result in increased levels of activity for a short period, followed by reduced activity and drop out (Antoniewicz and Brand, 2016; Clavel San Emeterio et al., 2020). One proposition as to why public health attempts at increasing activity levels in England have been relatively unsuccessful at long term change is the over-importance placed upon initiation with little attempt to promote strategies to maintain a physically active lifestyle (Head and Noar, 2014; Reis et al., 2016). Previous research has made the assumption that the antecedents of physical activity adoption are continued into maintenance but this is not necessarily true (Hagger, 2010; Rhodes and Nasuti, 2011; Head and Noar, 2014). Many individuals have high intentions to be active at the point of adoption, but this is often not translated into action and results in drop out. Research suggests that maintenance is less associated with conscious processes such as intentions and health behaviour and likely has a non-conscious and automatic component that drives the behaviour over a longer period of time (Rothman et al., 2009).

Two determinants associated with PA maintenance are motivation and habits (Duncan et al., 2010; Gardner, 2015). In relation to motivation, research suggests that individuals often initiate PA, for externally motivated reasons, meaning the behaviour is driven by some form of tangible and externally driven reward. For example being recommended to engage in PA from your General Practitioner (GP) to improve health (Ryan and Deci, 2000a; Kinnafick et al., 2014). This is evident in many exercise promotion strategies as encouragement is often

advertised through the gain of external rewards (E.g., first month free) and intervention schemes tend to be operating within a small-time frame (I.e., 4 weeks). Whereas, a person will often maintain a physically active lifestyle for reasons that are much more internally driven such as enjoyment, pleasure and importance, as externally motivated behaviour is difficult to maintain over a long period of time (Miquelon and Castonguay, 2017). Indeed, more autonomously motivated physical activity is more likely to be sustained over time (Daley and Duda, 2006; Teixeira et al., 2012). Research on PA motivation has used predominately variable-centred methods meaning single types of motivational regulations and their association with PA behaviour are tested. Such approaches do not measure the effect of multiple types of motivational regulations operating simultaneously, which is likely as motivation is dynamic (Forbes, 2011). In this field of study, adopting more person-centred approaches, such as motivational profiling, whereby a combination of motivation scores are considered, are lacking which presents a gap in the literature. Motivational profiles reveal more information about PA behaviour compared to scores on separate motivational regulations (Vansteenkiste et al., 2009).

In relation to habits, habits are a mechanism for behavioural maintenance and are thought to aid physical activity maintenance (Feil et al., 2021). Repeated performance in the same setting creates context-specific associations that in the future activate the behaviour, without much conscious awareness (Gardner, 2015). Forming habits should protect physical activity from potential drops in motivation (Lally et al., 2011) meaning the formation of habits should be a priority at the point of initiation. Physical activity habits are complex to form but strong physical activity habits are associated with higher physical activity levels (Hopkins et al., 2022) and thought to operate outside of conscious awareness. Research has also found that motivation may facilitate habit formation, particularly self-determined motivation may strengthen physical activity habits (Gardner and Lally, 2013; Hopkins et al., 2022). Indeed, autonomous motivation may act as a facilitator of habits whereas low self-determined motivation may act as a habit inhibitor, though the current literature does not clarify this. Therefore, habits and autonomous motivation are likely to be two key determinants of physical activity maintenance.

Unfortunately, physical activity promotion attempts do not draw on the determinants of PA and the principles of successful behaviour change, such as advertising the internal value of PA, because it does not seem tangible and is not attractive to the consumer (Withall et al., 2011). Interventions with aims to promote PA maintenance should draw on the principles of sustained motivation and habit formation and reduce the dependence on external contingencies (Silva et al., 2010). Therefore, successful behaviour change methods that promote PA maintenance is imperative and will largely benefit from a more comprehensive understanding of the psychological determinants that drive PA maintenance.

1.2 Purpose of study

The purpose of the current project was to further explore two of the key psychological determinants associated with physical activity behaviour, motivation and habits. Whilst motivation and habits have been a topic of interest in the literature for well over a decade, there are some key gaps that needed to be addressed to make a significant contribution to the literature, such as the relationship between types of motivational regulations operating together and habits. Physical activity is a complex behaviour that varies in frequency, duration and intensity and is often adopted and maintained for many different reasons and usually individualised to a person. Therefore, this study aimed to understand motivation from a person-centred perspective by analysing the different motivational profiles evident in physical activity behaviour. In addition, the project aimed to understand whether motivational profiles play an important role in the relationship between physical activity and habit strength in two different samples and what this could mean for intervention development. Lastly, from a cohort of a successful, community based physical activity initiative, the study aimed to explore their experience of motivation.

1.3 Overview of thesis

This thesis contains 7 chapters in total. Chapter 2 is an in-depth literature review of the relevant literature for the context of this thesis. This includes an exploration around research within the areas of interest from the past few decades up to present day and the progression in understanding. The chapter reviews the concepts and theories that are relevant to this thesis and provides a detailed rationale for the study at hand, stating why such methods were necessary to address the gaps in current knowledge. Chapter 3 is a

systematic review on PA motivational profiles, a full rationale will be provided in the literature review. Due to motivational profiling being a relatively new area of research within the field, no comprehensive review of the literature has been conducted and for this research to be novel, it was necessary to understand what is currently known and where the gaps lie. Chapter 4 provides the reader with an understanding of how I conducted this project and the reasoning for such methods. Due to the mixed-methods nature of this study, the methods section provides an overview of mixed-methods research and the rationale in this particular context and then describes the methods and methodology that guided both quantitative and qualitative data collection and analysis. In addition, this chapter describes the ethical considerations that were considered for both quantitative and qualitative data collection. Chapter 4 will present the quantitative findings of the research, pertaining to the two research questions that were aiming to be answered. Chapter 5 will discuss the findings of research question 1 and 2 (research question 1 comparing the motivational profiles and characteristics of such profiles from a general adult population and a cohort of a community exercise initiative, focusing on the similarities and differences that have occurred between groups. Research question 2 testing whether motivational profiles can be used to moderate the relationship between physical activity levels and habits, again comparing a general adult population with a sample from a community exercise initiative). Chapter 6 provides an integrated results and discussion from a qualitative exploration based solely on data from the community-based exercise initiative, describing participants experience of motivation, and potential facilitators and barriers. Chapter 7 will discuss the overall findings and implications of the study and conclude the thesis.

1.4 Literature review

1.4 Overview

The previous chapter aimed to provide the reader with an insight into the current health issues surrounding lack of physical activity. The focus of the thesis is more narrowly related to two psychological processes that are involved in physical activity behaviour, motivation and habits. The content within this thesis covers a number of psychological theories and concepts across multiple fields, such as physical activity, motivation, habit formation and

community-based initiatives. This chapter aims to provide a comprehensive review of the current literature surrounding these concepts; firstly, motivation and specifically the key theoretical underpinning of this research, the Self-Determination Theory (SDT) will be discussed in depth and the literature in support, whilst also addressing the key gaps and rationale for the thesis. In addition, motivational profiles and the relevant literature will be discussed. A section on habits will follow, whereby habits will be defined and the literature on PA and habits and motivation and habits will be scrutinised, again addressing the gaps. Lastly, a section on community-based PA initiatives will follow which will set the scene for one of the population samples used in this thesis, whereby participants from a community exercise initiative (Bestrong) were recruited. The chapter will end by providing a thorough rationale of the research project and highlighting the research aims and objectives.

1.5 Motivation

Motivation is an important factor in supporting physical activity and exercise behaviour (Texieria et al., 2012). Motivation describes the driving force behind human actions and denotes the 'why' behind a person's action (Cherry, 2018). Motivation has been described as a measurement of quantity, suggesting that a person possesses high, low or perhaps no motivation at all (Roth, 2019). However, these distinctions are too simplified and based on the complexity of motivation, particularly from a health perspective, a quantity measurement does not provide context as to why the determinants and consequences of motivated behaviour are often very different (Scott Rigby et al., 1992). More recent research has demonstrated that motivation is more complex and suggests that the quality of motivation has a greater influence on behaviour (Wasserkampf et al., 2018; Roth, 2019). Additionally, a person's motivation has a tendency to change dynamically, and this is dependent on a number of trait and/or situational factors influencing a person's drive to action the behaviour, as opposed to possessing a high or low amount of motivation (Thøgersen-Ntoumani and Ntoumanis, 2006; Roth, 2019). Indeed one theory that accounts for quality of motivation as well as the differing reasons why people engage in behaviour is Self-Determination Theory (Deci and Ryan, 1985; Ryan and Deci, 2000b).

1.6 Self-Determination Theory (SDT)

SDT is an organismic, macro theory and presents a broad framework used to understand human motivation and personality (Miller et al., 1988). As an organismic theory, SDT's basic tenants assume that humans are inherently predisposed to psychological growth and integration which thrive under conditions towards learning, mastery and connection with others (Ryan and Deci, 2000b; Ryan and Deci, 2000a). However, SDT also acknowledges that growth and activities do not occur in isolation. Rather, SDT posits that the social environment influences motivation (Ryan and Deci, 2000b). They propose that supportive environments can encourage active engagement and psychological growth, and thwarting environments can result in ill-being and non-optimal functioning. Development, functioning, and growth are dependent on psychological needs being satisfied; specifically, how the social environments act to satisfy or thwart the three basic psychological needs of autonomy (feelings of volition and choice in their thoughts, feelings and action), competence (feelings of mastery and that their behaviour and actions are effectively enacted) and relatedness (feelings of connection to others and meaningful involvement with the social world). The theory argues that environments supporting all three psychological needs will foster higher quality forms of motivation and result in many positive effects including enhanced performance, persistence, creativity and improved wellbeing (Ryan and Deci, 2000a). In an unsupportive or thwarting social context, SDT argues that there will be negative repercussions on wellbeing in that particular setting. SDT also presents six mini theories that individually address a facet of motivation or personality, these are: (1) Cognitive Evaluation Theory, (2) Organismic Integration Theory, (3) Causality Orientations Theory, (4) Basic Psychological Needs theory, (5) Goal Contents Theory and (6) Relationships Motivation Theory.

1.6.1 Cognitive Evaluation theory (CET; Deci and Ryan, 1985,)

CET describes the facilitation of intrinsic motivation, explaining that humans have an innate tendency to experience intrinsic motivation. Intrinsically motivated behaviour is performed for its own sake and is inherently satisfying, pleasurable and enjoyed. Such behaviour can be observed in child play whereby their exploratory behaviour is performed for the satisfaction the behaviour brings, it is spontaneous and voluntary and has no externally motivated function or goal. Intrinsic motivation can evolve as curiosity and discovery of behaviours that

manifest into engagement. In relation to physical activity, an intrinsically motivated person engages in physical activity for the inherent pleasure and enjoyment experienced. CET describes that intrinsically motivated behaviour has an internal perceived locus of causality (Ryan and Deci, 2000b) meaning that the behaviour is perceived as originating from the self without any sense of control or coercion. Therefore, enjoyment is often considered a consequence of fully immersing oneself in an activity and distinctively different from hedonic activities whereby the behaviour is performed to seek immediate gratification, but the enjoyment aspect is often short-lived once the pleasure is removed. The enjoyment is thought to be experienced as a by-product of the behaviour and is personally relevant to the individual. Once internalised, it's associated with longevity and conducive to personal growth (Vansteenkiste et al., 2010). CET therefore explains the external factors that either support or undermine intrinsic motivation, for example, controlling external events such as monetary rewards, are thought to undermine intrinsic motivation as there is a pressure to think and behave in a certain way, as opposed to being spontaneous and volitional. Intrinsic motivation is therefore facilitated and supported by increasing needs of autonomy and competence and external events that are conducive to satisfying needs, increase interest and enjoyment. In the context of PA, a person may be highly interested in PA but a pressurising instructor or coach can diminish their interest or enjoyment, thus compromising autonomy or competence and ruining the foundation for sustained engagement (Standage and Ryan, 2020).

1.6.2 Organismic Integration Theory (OIT; Deci & Ryan, 1985)

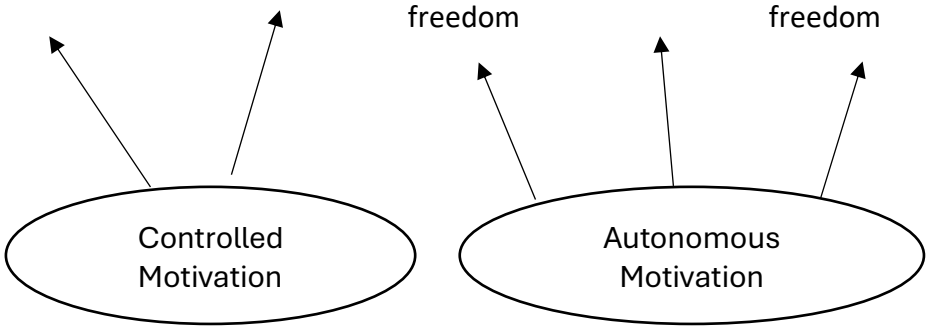
OIT describes the facilitation and internalisation of extrinsic motivation, whereby behaviour is performed for a separable outcome or an outcome that is outside of the behaviour itself (Ryan and Deci, 2000a). Many behaviours are not inherently satisfying or enjoyable and the processes outlined in CET describing the formation of intrinsically motivated behaviour is less relevant for some behaviours, for example, health behaviour change may not be interesting or enjoyable to a novice and therefore behaviour engagement largely depends on extrinsic motivation, a means to a separable outcome. However, OIT recognises that there is a more detailed trajectory between extrinsic and intrinsic motivation and there are multiple types of extrinsic motives that vary in levels of control and autonomy. OIT explains

that the type of extrinsic motive varies in relation to the value of the behaviour and the more internalised motives that are non-intrinsically motivated behaviours are critical for initiation and maintenance (Ryan & Deci, 2000). Four types of extrinsic motivation are described in OIT, see table 1. The least autonomous form of extrinsic motivation is *external regulation* whereby behaviour is motivated by obtaining a reward or avoiding a punishment, therefore, to comply with external demands. For example, an individual advised to adopt physical activity into their lifestyle in order to lose weight for an operation is externally driven. Whilst this type of regulation is powerful when contingencies are in place, there is a lack of translation to maintenance as when the controlling reinforcements are removed, there is no reason to continue. The next form of extrinsic motivation is *introjected regulation*, whereby behaviour is partially internalised and is motivated by satisfying internal conflicts, such as gaining pride and self-esteem or avoiding feelings of shame and guilt. For example, a person attending an exercise class to avoid feeling guilty for missing it. Introjection is highly related to ego involvement whereby the behaviour does not rely on external, controlling forces for engagement but instead is motivated from within the individual and the control is formed from the self. Ryan and Deci (2000) propose that this form of motivation is taxing on energy and is less predictive of long-term maintenance. The third form of extrinsic motivation whereby behaviour is more autonomous than controlled is *identified regulation*. Behaviour is experienced as personally valuable, meaningful and significant to the individual, for example, an individual adopting physical activity to reap the health benefits would display identified regulation. The regulation of the behaviour has almost been fully internalised as there is no feelings of pressure and the drive is through personal importance and value. Lastly, the most internalised form of extrinsic motivation is *integrated regulation*, whereby a person understands the personal importance of the behaviour, however behaviour also involves assimilation of identified values and goals that align with the person's sense of self. For example, a person that exercises to improve their health so they can live to see their grandchildren grow up displays integrated regulation. In relation to physical activity behaviour, the controlling types of motivation (external and introjected regulation) are associated with short-term engagement but are less predictive of long-term maintenance, due to the maladaptive effect on behaviour. In particular, external regulation is driven by some form of external contingency and once the controlling contingency is removed, complete or no longer rewarding for the individual, the behaviour

will cease or be significantly reduced as the behaviour is unable to be transferred overtime unless internalised. Introjection is also weakly related to long-term engagement, when measured as a single variable. Although introjected regulation is slightly more internalised than external regulation, the invasive, internal conflicts experienced still have a maladaptive component and are associated with negative outcomes on behaviour. (Thøgersen-Ntoumani and Ntoumanis, 2006). Identification and integration, on the other hand, have an adaptive component and are associated with sustained physical activity engagement. Both types of motives have been internalised and are driven by congruence, value and importance.

Table 1. SDT continuum with six types of motivation and schematic relation. *Source* adapted from Ryan and Deci (2000).

Type of regulation	*Amotivation*	*External regulation*	*Introjected regulation*	*Identified regulation*	*Integrated regulation*	*Intrinsic regulation*
Level of motivation	Low	High	High	High	High	High
Internalisation	None	None	Partial	Almost full	Full	N/A
Motivational force	Discouragement and disinterest	Expectations, rewards and punishment	Guilt, shame and self-worth contingencies	Personal value and relevance	Harmonious and coherent commitment	Enjoyment, pleasure and interest
Underlying feelings	Futility and apathy	Stress and pressure	Stress and pressure	Volition and freedom	Volition and freedom	Volition and freedom



1.6.3 Basic Psychological Needs Theory (BPNT; (Ryan and Sapp, 2007)

The concept of BPN is intertwined within all of the mini theories, mainly CET, OIT and Cognitive Evaluation Theory (COT). BPNT proposes that all humans have innate psychological needs that are necessary for physical and psychological health and social wellbeing, while a social context can contribute to supporting or thwarting those needs. Autonomy is described as a need for volition and psychological choice in a behaviour, while aligning with a person's values and interests. An autonomy supportive environment that promotes volition and individual choice is predictive of growth and vitality; however, the theory emphasises that autonomy supportive environments are not free from guidance with complete freedom but instead a person feels volitionally free and is likely to follow a personally endorsed societal norm that is autonomy supportive. For example, autonomy support would be non-controlling, empathising with struggles, challenges, and failures and seeking their input. Competence is described as the need for experiencing sufficient ability of behaviour and tasks and to engage in challenging tasks that test and extend a person's skills. A competence supportive environment is well-structured as opposed to chaotic and receiving sufficient feedback that is both dense and informational creates a balanced feeling of competency. Relatedness is described as a need for connectedness, reciprocal care and concern for important others. A relatedness supportive environment is warm, inclusive and responsive as opposed to feeling neglected. A person's need for relatedness is satisfied when they feel cared for but also when a person feels they have cared, helped or contributed to others (Ryan and Sapp, 2007). BPN's theory suggest that all three needs of autonomy, competence and relatedness should be satisfied for optimal physical, psychological, and social levels of functioning. However, when the environment for needs is thwarted, individuals may behave in a number of different maladaptive ways to cope. For example, a common coping response is to substitute needs that represent strong desires and align with perceived societal norms, such as a thin physique or material success. The desires may be satisfying for the individual

in the short-term and result in some satisfaction of needs but is unlikely to remain sustainable. The theory predicts that when three needs are not satisfied and a person seeks to satisfy needs in alternative ways, in the context of physical activity, individuals may seek extrinsically rewarding actions such as “quick fix” plans in order to see results in a short amount of time. In addition, when needs are not satisfied, it is likely that a person will terminate the behaviour, for example, dropping out of an exercise course.

1.6.4 Casualty Orientations Theory (COT; Deci & Ryan, 1985)

COT refers to the reasons behind behavioural initiation and therefore describes the personality-level differences that occur in motivational orientations. Typically, people that are high on the autonomy orientations will behave in a way that aligns with their own interests and self-endorsed values and behaviour is likely regulated autonomously. A person high on the control orientation will typically behave in a way that aligns with external and internal demands and behaviour is regulated in a controlling way. Lastly, a person high on the impersonal orientation typically behave in a way that corresponds with feelings of helplessness and passive, whereby life experiences are perceived as beyond their personal control. Causality orientations are not described as stable personality constructs and are instead described as surface level personality constructs that are malleable and dynamic with a high influence from socialisation experiences. All of the three personality constructs exist within everybody but vary in quantity, all of which are developed as a result of need support alongside genetic factors (Ryan and Deci, 2000a).

1.6.5 Goal Contents Theory (GCT; (Deci and Ryan, 2000)

GCT distinguishes between intrinsic goals (e.g., personal growth, physical health, and improving relationships) and extrinsic goals (e.g., money, fame, and image) that people pursue. Intrinsic goals are often more closely related to increasing needs of autonomy, competence and relatedness whereas extrinsic goals are unrelated to satisfying needs altogether. Prioritising extrinsic aspirations are thought to impact wellbeing significantly negatively; the theory states that people have a natural tendency to pursue intrinsic goals after extrinsic goals, but this transition does require support for need satisfaction. Whilst being related, intrinsic and extrinsic goal pursuits are distinct from extrinsic and intrinsic motivation, which are key to CET and OIT. Both intrinsic and extrinsic goals can be performed

for autonomous motives, for example, a person may aim to have a thinner body physique because her partner praises a particular body shape, a controlled motive, or because they personally value this goal, an autonomous motive. However, intrinsic goals typically are completed for autonomous reasons and extrinsic tend to be more controlled (Gunnell et al., 2014).

1.6.6 Relationships motivation theory (RMT; (Ryan and Deci, 2000b)

RMT describes the development and maintenance of close relationships and interactions with others. Relationships and interactions are essential and provide satisfaction of the need for relatedness. Specifically, the need for relatedness is satisfied when people experience high-quality relationships (e.g., best friends, romantic partners, belonging to a group). In relation to competence and autonomy, high quality relationships are thought to be experienced as a combination of all parties supporting autonomy, competence and relatedness needs of one another (Vansteenkiste et al., 2010). In relation to physical activity, group-based activity provides interpersonal support which is necessary for the satisfaction of the need for relatedness because it fosters a need for connection and common understanding with others. RMT theorises that a sense of relatedness is an intrinsic psychological need and is valued for its own sake, therefore, connection with others directly satisfies this need. A relatedness supportive environment is associated with positive outcomes, such as, increased social competence, secure attachments and empathy. RMT proposes that not all relationships are high quality, a significant indication that the need for relatedness is being supported is that the interaction is making a person feel accepted and supportive of the self.

1.7 Self-Determination theory and physical activity

The SDT framework has been supported by evidence across a number of domains including healthcare (Deci and Ryan, 2012), sport (Fenton et al., 2016) and physical activity (Lauderdale et al., 2015; Fenton et al., 2016) and exercise (Hagger and Chatzisarantis, 2008; Duncan et al., 2010). The theory most pertinent to this thesis and will be discussed using the literature as supporting evidence is OIT and the distinction between different types of motivational regulations.

As noted before, SDT outlines that the quality of motivation rather than the quantity that drives people's behaviour, still alluding to how much they are motivated (Ryan and Deci, 2000b; Vansteenkiste and Mouratidis, 2016). A key principle outlined within SDT assumes that motivation is dynamic rather than static, but what is particularly important is the notion that the type of motivation reflects the degree to which the behaviour is self-endorsed by the individual. For example, depending on whether the behaviour is driven by internal propensities important to the self, such as pleasure and satisfaction, or driven externally by demands, such as gaining rewards or avoiding punishment (Ryan and Deci, 2000b). SDT describes the quality and therefore desirability of motivation and distinguishes between autonomous and controlled motivation falling along a single continuum, as outlined in OIT. Autonomous motivation is perceived as the most desirable dimension of motivation (i.e., high quality motivation) and controlled being the least desirable (i.e., low quality motivation), thus varying in levels of self-determination. When considering the motivational regulations outlined in OIT, controlled motivation is comprised of external and introjected regulations and autonomous motivation is comprised of identified, integrated and intrinsic regulation. The four extrinsic motivational regulations (external, introjected, identified and integrated) represent, to differing degrees, less than fully self-determined behaviour, when individuals identify with the importance of PA, assimilate it into their sense of self, and accept it for its own value the internalisation process is fully developed. However, when the internalisation process is interrupted, regulations and values associated with PA may either remain external or be only partially internalised to form introjects or unintegrated identifications (Wilson et al., 2003).

The distinction between both autonomous and controlled motivation is key to explaining why some individuals engage in positive and adaptive health behaviours and others do not and is likely associated with their degree of relative autonomy (Rodgers et al., 2010; Scioli-Salter et al., 2014). From a wider health promotion perspective, there are several practical reasons for distinguishing between autonomous and controlling regulations in PA participation (Scioli-Salter et al., 2014). Past research in the physical activity domain and other settings has indicated that positive motivational consequences (e.g. behavioural persistence, task involvement, enhanced psychological well-being, and quality of life) are

positively associated with more autonomous regulations (Miquelon and Castonguay, 2017; Friel and Garber, 2020). In line with tenants of SDT (Ryan and Deci, 2000a), evidence consistently shows that more autonomous motivation predicts higher levels of physical activity (Teixeira et al., 2012). Autonomous motivation is highly correlated with increased physical activity levels and long-term participation (Duncan et al., 2010; Rodgers et al., 2010; Teixeira et al., 2012; Kinnafick et al., 2014; Lauderdale et al., 2015; Ednie and Stibor, 2017; Weman-Josefsson et al., 2017). A systematic review of 66 empirical studies indicated that more autonomous forms of motivation are associated with physical activity behaviour (Teixeira et al., 2012). Geller (2018) conducted a retrospective study comparing motives of individuals of varying physical activity levels (exercise maintainers, improvers, decliners and sedentary). Maintainers were more autonomously motivated than decliners and sedentary, expressed more competence and interest in physical activity, reported exercising for fitness and health reasons. These findings support the role of autonomous motivation in fostering long-term exercise behaviour.

1.8 Types of autonomous motivation and physical activity

1.8.1 Identified regulation

Identification is promoted by encouraging the personal instrumental value of PA with regard to health, optimal functioning, and quality of life. Some research has found identified regulation to be a better predictor of exercise participation than intrinsic motivation (Thøgersen-Ntoumani and Ntoumanis, 2006; Wilson et al., 2006) and appears to increase faster overtime (Rodgers et al., 2010). Physical activity is a complex behaviour and characterised by multiple components (e.g., travelling to the gym, changing into gym clothes, devising a workout plan) that requires organisation and commitment. If a person is not feeling intrinsically motivated, then identified regulation is more sufficient for participation (Ingledew and Markland, 2008) and a person may continue participation when identifying with the benefits of the activity, as opposed to exercising purely for fun and enjoyment. In a sample of regular exercisers, identified regulation was a positive predictor of exercise frequency (Duncan et al., 2010). As physical activity adherence involves varying intrinsic appeal and a large amount of effort, internalising the physical, psychological and social benefits of physical activity is likely to lead to larger persistence (Teixeira et al., 2012).

In addition, identified regulation was the strongest predictor of exercise behaviour and the amount of effort and importance attached to exercise in a sample of undergraduates (Wilson et al., 2004). These findings are logical, as described above, when adherence of a behaviour such as physical activity requires persistence when there is a lack of interest, identified regulation is a more powerful and reliable predictor.

1.8.2 Integrated regulation

Integrated regulation plays an important role in supporting physical activity maintenance by promoting consistency (Wilson et al., 2006; Rodgers et al., 2010; Teixeira et al., 2012; Scioli-Salter et al., 2014; Miquelon et al., 2017). Teixeira (2012) found that identified regulation was a strong predictor of short-term adoption whereas intrinsic motivation was related to long-term adherence. A proposed reason for this is that many individuals, when initiating physical activity behaviour, do not feel intrinsically motivated as adopting a physically active lifestyle in comparison to being inactive requires a significant amount of effort and repetition. Whilst the notion of intrinsic motivation, (e.g., exercising purely for enjoyment and interest) is difficult to achieve for less experienced individuals, due to the organising and commitment it entails (Mullan and Markland, 1997) it does appear to be important in contributing and predicting long term maintenance. Thus, the intrinsic value of physical activity is likely to progress over time (Lauderdale et al., 2015). If a novice exerciser recognises the enjoyment of exercising, it is unlikely that they will continue solely for this reason alone. In addition, Miquelon (2017) illustrated that compared to individuals who mainly practice physical activity for intrinsic or identified motivations, those who sustain physical activity practice because the behaviour is congruent with their sense of self, have a greater chance of maintaining practice over time (Miquelon and Castonguay, 2017), thus highlighting the strong relation with integrated regulation. Data from three studies with regular exercisers and three longitudinal studies with initiates found that in comparison to intrinsic motivation integrated regulation was associated with positive exercise results, such as enhanced mood and satisfaction and ensured sufficient exercise patterns. In addition, integrated regulation developed faster than intrinsic motivation overtime suggesting that individuals are likely to value and attach personal importance on exercise sooner than enjoying exercise for its own sake, an important indication for intervention designing

whereby encouraging initiates to develop a sense of personal value to increase chances of long-term action (Rodgers et al., 2010).

1.8.3 Intrinsic regulation

Intrinsic regulation is the most self-determined type of motivational regulation and is associated with long-term exercise maintenance (Thøgersen-Ntoumani and Ntoumanis, 2006; Mata et al., 2009; Rodgers et al., 2010; Teixeira et al., 2012; Scioli-Salter et al., 2014; Geller et al., 2018). Geller's (2018) longitudinal study found that in a sample of exercise maintainers, all participants displayed the psychological framework needed to facilitate successful regular physical activity. Specifically, participants reported high intrinsic motivation and possessed high interest in exercising, whilst also rating fitness and social support as important determinants of their physical activity behaviour. More recently, intrinsic motivation rated as feelings of enjoyment for exercise in Physical Education (PE) classes increased in an autonomy supportive environment, suggesting that the psychological antecedents of exercise enjoyment directly correlate with psychological need satisfaction (Leisterer and Gramlich, 2021). Whilst need satisfaction is beyond the scope of this study, these results do support the role of autonomy-support in facilitating intrinsic motivation, which is closely associated with long-term adherence. It can be appreciated that an autonomy-supportive environment is likely to facilitate intrinsically motivated behaviour more successfully in some circumstances than others, such as with children in a PE class compared to a group of inactive individuals exercising for the first time(Symons Downs et al., 2013). The latter group would benefit from internalising the intrinsic value of exercise whilst developing interest and enjoyment overtime.

In regard to understanding adherence and comparing to dropout, intrinsic motivation can promote feelings of pleasure and satisfaction, such pleasant feeling often resulting in reinforcement of the behaviour or avoidance when unpleasant (Nielsen et al., 2014). Enjoyment has been reported as having the largest effect on exercise persistence in a sample of gym exercisers, supporting the role enjoyment and pleasure has on long term commitment (Rodrigues et al., 2019). Whilst intrinsic regulation is largely related to long term adherence, research indicates that experiencing intrinsic motivation in the form of

enjoyment as pleasure, is dependent on a person's preference and tolerance (Teixeira et al., 2021). This presents a challenge in promoting certain exercise regimes as enjoyable because not everybody has the same affective experience and different types of exercise impact enjoyment. For example, a systematic review comparing moderate-intensity exercise to high intensity exercise found that during high-intensity exercise individuals reported higher levels of negative affect but post-exercise reported higher levels of enjoyment compared to moderate intensity (Niven et al., 2021). Research also shows that intrinsic motivation, such as pleasure and enjoyment increase over time, presumably as a person's tolerance and fitness capacity increases, so does their affective experience ultimately increasing enjoyment (Magnan et al., 2013). Whilst experience of enjoyment and pleasure are likely experienced at the point of initiation, it is unlikely that novice exercisers can solely rely on such intrinsic motives to reinforce the behaviour, as they tend to experience higher levels of negative affect and fatigue (Kwan and Bryan, 2010). Health promotion strategies should continue to promote the intrinsically motivating aspect of physical activity whilst encouraging the development of personal importance and identification of exercise, to rely on when exercise is not experienced as pleasurable or enjoyable.

1.8.4 Motivational change

Stages of change research is informative and has revealed that autonomous regulations increased across the stages. PA behaviour is thought to range from a number of stages; precontemplation, contemplation, preparation, action and maintenance, showcasing the stages from inactivity through to adoption and adherence of exercise behaviour (McAuley et al., 1993; Mullan and Markland, 1997; Ingledew et al., 1998; Rose et al., 2005; Thøgersen-Ntoumani and Ntoumanis, 2006; Kinnafick et al., 2014; Zamarripa et al., 2018). Research that has measured the stages of change for exercise behaviour has found that early research into the stages of change reported that intrinsic and integrated regulation were associated with active individuals, within the action and maintenance stages of change (Mullan and Markland, 1997) and less so than the contemplation stages. More recent findings are in line with Mullan and Markland (1997). For example, Zamarripa and colleagues (2018) analysed the motivational regulations of a sample of Mexican individuals in relation to their stage of exercise and found that those in the early stages of exercise initiation endorsed higher

controlled motivations. Whereas those who were active and in maintenance stages had low controlled motivation and higher in autonomous motivation. However, the cross-sectional nature of the abovementioned studies makes it difficult to determine whether self-determined motivation increases, and controlled motives decrease as a result of progression through the stages of changes or because individuals in the maintenance stage adhered to activity because they had high self-determined motivation to begin with. Research does suggest that high self-determined motivation is not commonly associated with early stages of exercise (Ingledew and Markland, 2008) meaning the former explanation is more likely.

1.8.5 Controlled motivation and physical activity

Studies that have found a relationship between controlled motivations and physical activity, (e.g., external and introjected regulation) have found an association with the adoption of physical activity and a negative relationship with adherence (Wilson et al., 2004; Daley and Duda, 2006; Thøgersen-Ntoumani and Ntoumanis, 2006; Rodgers et al., 2010; Teixeira et al., 2012). Controlled motives, particularly external regulation are not typically associated with physical activity maintenance, which would indicate that controlled motivation is reduced overtime or that motivation becomes fully internalised within the self (Thøgersen-Ntoumani and Ntoumanis, 2006). This is true for external regulation which fosters maladaptive outcomes, such as drop out intention, boredom and negative affect (Ryan and Deci, 2000a; Lewis and Sutton, 2011; Sáez et al., 2021; Howard et al., 2021). A meta-analysis on student motivation found that external motives, thus behaviour driven by the desire to obtain a tangible reward or avoid punishment (external regulation) was negatively associated with persistence and performance and predicted decreased well-being (Howard et al., 2021). In the context of physical activity, an example is, a person being advised to exercise for an operation, endorsing a feeling of “I exercise because my doctor says I should”. In comparison to a person initiating physical activity to increase fitness levels in order to feel healthier, endorsing a feeling of “I exercise to feel healthier”. Both reasons are health driven but the second individual is driven by the importance they have placed on physical activity and therefore the behaviour is fuelled by volition and aligns with personal importance, whereas in the case of the first individual, the behaviour is driven by coercion by their doctor and to avoid a negative end state (not being able to have an operation). It can be presumed that

the individual in the first example would be more likely to stop exercising post-operation, as the contingency was no longer present to drive the behaviour.

1.8.6 Introjected

Introjected regulation refers to a more internal cause of behaviour whereby the individual internalises reasons for behaviour, but it is not truly self-determined. Typically, in this case, the individual is acting out of avoidance of negative feelings (e.g. guilt) or when individuals want to prove to themselves and others that they can demonstrate a positive attribute or state (increased self-esteem). People who feel internally pressured to exercise are likely to experience some degree of guilt or shame if they do not exercise, and the potential to enjoy it and experience the positive well-being consequences of this behaviour will be decreased (Teixeira et al., 2012). A number of studies infer that introjected regulation makes a beneficial contribution to physical activity behaviour when supported by autonomous motivation (Hartmann et al., 2015; Laroche et al., 2019; More and Phillips, 2021). Introjection is motivation from within the person but is also described as external to the self (Ryan and Deci, 2000b) and may not always be considered maladaptive, particularly if a person exhibits autonomous motivation too.

More recent research exploring of the function of introjected regulation indicates that the two forms of introjection are either adaptive or maladaptive. Specifically, introjected regulation that is associated with either the approach of positive feelings (increasing pride and/or self-esteem) is more adaptive, whereas introjected regulation that is associated with the avoidance of negative feelings (guilt) towards oneself is maladaptive for behavioural engagement (Ryan and Deci, 2000b). Indeed, introjected avoidance and introjected approach are statistically different from one another (More and Phillips, 2021). More and Phillips (2021) demonstrated that when exercising to experience positive feelings such as pride, the behaviour experienced is adaptive whereas avoidance approaches (such as avoiding guilt) result in negative repercussions and are therefore maladaptive for engagement. It is questionable that experiencing pride and improved self-esteem would occur with strong identifications of physical activity and could be classified as autonomously motivated. In support of this, Hartmann, Dohle and Siegrist (2015) found that introjected

regulation predicted long-term adherence to vigorous (not moderate) recreational exercise, though this was only the case in females. Indeed, introjected approach has been positively associated with health promotion whereas introjected avoidance is associated with avoiding health losses and feelings of external pressures (Laroche, Roussel, Cury & Boiche, 2019). When considered as single regulations and therefore independent entities, introjected regulation is not associated with maintenance (Teixeira et al., 2012) suggesting introjection is adaptive when experienced alongside autonomous motivation.

1.8.7 External Regulation

External regulation is the least self-determined motive and controlled by an external source. An externally regulated motive often reported by novice exercisers is wanting to exercise to change appearance or weight management (Vlachopoulos and Karageorghis, 2005). Individuals often initiate physical activity in order to alter appearance, which negatively impacts physical activity adherence (Ingledew and Markland, 2008; Scioli-Salter et al., 2014; Ednie and Stibor, 2017; Sáez et al., 2021). For example, body size discrepancies in women had a negative influence on physical activity by reducing feelings of value and enjoyment (Markland, 2009). This makes sense in relation to SDT perspective as a discrepancy between actual and ideal appearance is likely to result in people feeling less autonomous towards their physical activity behaviour (Guszkowska, 2015). Appearance motives are typically perceived as a means to an end and are not associated with stable, long term adherence for this reason, Often, once the improved appearance or tangible reward is achieved, if motives have not developed self-determination, the behaviour will stop (Teixeira et al., 2012). This is commonly seen in weight loss interventions, through which individuals are persistent throughout the intervention, but when the reinforcing nature of the intervention is removed, physical activity levels decline or stop altogether at follow up (Homan and Tylka, 2014; Ostendorf et al., 2021).

Markland & Ingledew (2008) cite that motives influence behaviour and found that appearance/weight motives, through its positive effect on external regulation, result in reduced exercise participation. Ryan et al (1997) concluded in a longitudinal study of new users of a fitness centre, that high adherers (attending at least 1 day in every 5 over the first

10 weeks) and low adherers (attending less than this) differed significantly on baseline enjoyment, competence, and social motives but not fitness or appearance/weight motives. Although motives relating to appearance and weight management could be experienced as autonomous (i.e., identified regulation), they tend to be experienced as controlling whereby an individual will feel "I need to exercise to lose weight" and does not equal to long-term engagement (Markland and Tobin, 2004) Motives relating to personal challenge or social affiliation are experienced as autonomous as an individual will feel "I want to exercise to see my friends" and thus equals to long term engagement (Ingledew et al., 1998). In relation to encouraging individuals to be more physically active, health promotion strategies have the potential to appeal to a range of motives but often focus on harnessing the attractiveness of losing weight and changing appearance (Fletcher et al., 2018). These externally appealing attempts are unlikely to engage participation in the long term and thus the well-being and enjoyment benefits of physical activity should be advertised, which is especially important during the early stages in adoption whereby autonomous motivation is likely beginning to materialise (Hartmann et al., 2015).

1.8.8 Limitations of motivation research

Much of the current literature describes results from studies using predominately cross-sectional methods meaning the cause and effect cannot be assessed. Research using longitudinal designs are sparse but have contributed to some of the key gaps within the literature. Longitudinal research has found a significant relationship between physical activity maintenance and autonomous motivation (Rodgers et al., 2010; Kinnafick et al., 2014; Hartmann et al., 2015; Miquelon and Castonguay, 2017; Geller et al., 2018). Rodgers (2010) analysed longitudinal data measuring motivational regulations and physical activity from a period of 0 to 24 weeks. Regular exercisers had stronger self-determined regulations than initiates and weaker controlled regulations. Time periods ranging from 6 weeks to 6 months found very little change in controlled motives, whereas autonomous motives increased with identified regulation appearing to increase at a faster rate than intrinsic regulation. Their findings are logical as people would come to value exercise and its positive benefits quicker than enjoying it for its own sake. Qualitative longitudinal research, three distinctive categories of people were found in a 30 week exercise walking intervention. The

nonadherence category was characterised by a lack of enjoyment, limited competence, feeling of coercion and a lack of autonomy, displaying controlled motivation. The lapse and readoption category were characterised by identified regulation and some controlling motives surrounding guilt. The adherence category was characterised by controlled motives when signing up to the intervention that decreased over time and during follow up possessed high self-determined motivation (Kinnafick et al., 2014). Longitudinal research has also found integrated regulation to be a stronger predictor of physical activity behaviour than intrinsic regulation in a group of adults measured over 3 months. Compared to individuals who were intrinsically or motivated for identified reasons, exercise maintainers remained active for reasons associated with congruence with their sense of self and had a greater chance of maintaining over time (Miquelon and Castonguay, 2017)Such longitudinal data are in support of the cross-sectional data though there are still gaps that ought to be addressed.

1.8.8 Motivational profiles

As described, motivation research in the realm of physical activity is not limited, however, research that considers the multidimensionality of motivation and addresses the ways in which different types of motivational regulations work simultaneously together, to drive physical activity adherence, using person-centred approaches, is less established. Key concepts of the frameworks within SDT requires closer scrutiny as physical activity behaviour is multi-determined and therefore assessing different dimensions of motivations and how they cooperate together as opposed to being considered completely separate.

The majority of research employing SDT has focused on variable-centred approaches which involves comparing single motivational regulations and their prospective influence on physical activity behaviour (Howard et al., 2016; Howard and Hoffman, 2018). Variable-centred approaches are associated with a number of limitations, for example, such approaches fail to recognise that motivation is not linear and does not operate along a chronological continuum (Laursen and Hoff, 2006). In addition variable-centred approaches limit the consideration of how certain motivational regulations co-exist and operate at the

same time (Fernández-Ozcorta et al., 2019). Important individual level differences are missed when motives are considered as operating completely independently at a single point in time, as opposed to being considered as mechanisms operating together (Laursen and Hoff, 2006). In addition, the continuum component of SDT has been extremely informative in understanding human motivation, but has been recognised as overly simplistic and inaccurate as there is a strong differentiation between controlled and autonomous motivation, which are not necessarily mutually exclusive and endpoints of the continuum (Covington and Müeller, 2001). A person-centred approach may improve understanding of motivation and physical activity as it allows for the identification of sub-groups of people based on a similar set of motivational regulations and understand how different exercise regulations co-exist within an individual (Teas et al., 2019). Specifically, this sub-grouping concept means that interactions that occur within motivational regulations will be observed and make important distinctions not just between types of motivational regulations, but within subgroups (Ostendorf et al., 2021). A person-centred approach with respect to SDT, is motivational profiles.

Human motivation by nature is dynamic and constantly fluctuating situationally which suggests that different dimensions of motivation are likely to co-exist within a single individual (Teas et al., 2019). While variable centred approaches indicate that a person who is intrinsically motivated is more likely to maintain physical activity with high levels of frequency, duration and intensity (Duncan et al., 2010) a person-centred approach would consider additional motivation for participation, such as introjected regulation operating simultaneously as intrinsic motivation. Within physical activity research the crucial ingredient to exercise longevity is considered to be autonomous, or ideally intrinsic motivation. However, many individuals do not achieve intrinsic motivation to exercise therefore considering the potential of motives operating together strengthens the applicability and generalisability of the results to inform intervention designing.
In addition, advantages of motivational profiling include the potential for a more fine-grained analysis and to explore how the social context impacts engagement and motivation (Vansteenkiste et al., 2009; Vansteenkiste and Mouratidis, 2016). Profiles will inform intervention designing in greater detail than focus on individual regulations and gives a greater insight into the way a motivational profiling style should be tailored to aid the best

results, in relation to persistence and adherence. Motivational profile can be advantageous for longitudinal research whereby the identification of motivational trajectories of physical activity behaviour could be used to predict specific outcomes. Such motivational trajectories would be beneficial in revealing the level of stability and/or change in profile membership, particularly in relation to demographic information to further predict specific outcomes. Specifically, motivational profiling would allow demographic distinctions to be made by identifying the profiles associated with certain age and gender groupings. Given that physical activity is critical in improving all aspects of health and well-being, both physically and psychologically, it is crucial for researchers to better understand ways to promote physical activity interventions to maximise sustained engagement and reduce drop out. Inconsistencies in regard to the number of physical activity motivation profiles present a number of gaps in interpreting the literature. Cross sectional studies have identified between 2-6 profiles (Freidrichs, Goulan et al., 2016; Guerin , 2021; Matsumoto & Takenaka, 2004; Stephan et l., 2010; Lindwall et al., 2017; Friel & Garber 2020). For instance, some papers have identified between two and six profiles (Lindwall et al., 2017; Zhong and Wang, 2019; Fernández-Ozcorta et al., 2019). Indeed, Zhong & Wang (2019) reported two overall physical activity motivational profiles: autonomous/introjected profile and external/amotivation profile. Whereas, Miquelon, Chamberland & Castonguay (2017) identified four motivational profiles: self-determined profile, high combined profile, moderate motivation profile and non-self-determined profile.

In a sample of 2473, Freiderichs et al (2015) found that individuals in the autonomous motivation profile, comprised of high intrinsic and identified regulation, moderate introjected and low external regulation, reported significantly higher physical activity levels than those in controlled motivation profiles. In addition, combined profiles scoring high on autonomous motives and introjected regulation, and low on external regulation reported high physical activity levels (Stephan et al., 2010; Ferrand et al., 2012; Lindwall et al., 2017; Zhong and Wang, 2019; Friel and Garber, 2020). The beneficial aspect of introjected regulation still remains unclear in the literature, but it appears that when introjected regulation is combined with autonomous forms of motivation, as opposed to being experienced alone or in conjunction with external regulation, physical activity levels are high (Ostendorf et al., 2021). However, studies have found that lowest reported physical activity

levels are associated with profiles high in controlled motives (external and introjected regulation) and low in autonomous motives (Altintas et al, 2018; Fernandez-Orcorta et al, 2019; Friederichs et al, 2015; Friel & Garber, 2019; Lindwall et al, 2017; Miquelon et al, 2016; Shen et al, 2019; Zhong & Wang, 2019; Valenzuela et al, 2021; Ferrand et al, 2012; Matsumoto & Takenaka, 2004).

When considering introjection, two forms of introjected regulation have been highlighted in the literature (approach and avoidance), both having different relationships to physical activity behaviour (More and Phillips, 2021). Introjected approach is linked to positive feelings (e.g., improving pride or self-esteem) and is more adaptive, thus explaining that when combined with autonomous motives, the thwarting of the behaviour is overridden as the positive feelings probably encourage effort and persistence (More and Phillips, 2021). However, avoidance introjection is linked to negative feelings (guilt) towards oneself and is therefore characterised as maladaptive. The experience of negative feelings will result in thwarting of the behaviour due to the focus on negative and undesired experiences and is experienced as more controlling and pressurising (Assor et al., 2009). A study comparing introjected approach and avoidance found that avoidance was positively associated with feelings of external pressures whereas approach was positively associated with health promotion (Laroche et al., 2019), suggesting that approach is more autonomously regulated than avoidance. In relation to motivation profiles and physical activity, profiles high in introjected regulation and autonomous motives have a positive impact on physical activity behaviour in multiple papers, whereby physical activity levels are highest (Stephan et al., 2010; Ferrand et al., 2012; Ferrand et al., 2014; Lindwall et al., 2017; Friel and Garber, 2020). However, none of the abovementioned studies measured introjection as approach or avoidance, making it difficult to interpret whether introjection had a positive impact on physical activity behaviour due to approach or avoidance tendencies. These are the gaps within the literature that are often unaddressed due to the lack of measures assessing introjection as two separate constructs.

Motivational profiling is a relatively new concept, particularly in the field of physical activity research, meaning studies are lacking. In particular, a comprehensive and systematic review of the motivational profile literature within the field of PA has not yet been conducted. In

order for this thesis to be novel, it is important to have a detailed understanding of what is currently missed in the literature. Therefore, it was necessary to conduct a systematic review on the PA motivational profiles literature (Chapter 2 of this thesis).

As described in more detail in chapter 2, the limitations of previous work make this current project necessary; a limitation of the current motivational profiling research is the failure to test motivational profiles on specific physical activity groups, for example, differentiating between individuals of varying physical activity levels, or differentiating between group-based activity such as community-based initiatives. Many social and environmental influences are likely to be contributing to profiling tendencies and thus should be considered separately (Richards et al., 2017). As mentioned above, satisfying psychological needs of autonomy, relatedness and competence are essential for physical activity maintenance and optimal well-being and it is likely that individuals exercising within a group possess higher relatedness than those exercising alone, which will be discussed further into the literature review. In addition, the issue of heterogeneity within the person-centred approaches, whereby motivational profiles are stagnant and should be considered as distinct as objective criteria, such as gender and age (Vansteenkiste and Mouratidis, 2016). Even though we would consider motivational profiles to be an advancement on previous motivation research that considered motivational regulations to operate independently, the results should be interpreted with caution, particularly in relation to individual membership. Each individual in a subgroup has a specific probability of their group membership meaning some individuals will be more prototypical than others and those that are less prototypical may shift to a different group depending on a number of characteristics, such as thwarting or supporting of psychological needs. Therefore, motivational profiles should be interpreted as probable with a tendency to change as opposed to determined.

Due to motivational heterogeneity, motivation and motivational profiling may well be a good predictor of physical activity levels and will potentially expand our knowledge on intervention development, but they are unlikely to be capable of completely defining and explaining exercise behaviour, particularly the distinction between initiation and maintenance. The reason for this, is perhaps that physical activity behaviour is reliant on multiple processes (Rebar et al., 2016; Rebar et al., 2020). One process in particular that has

gained insight and interest in the field of physical activity is habits, that when developed can be beneficial particularly when motivation is low.

1.9 Habits

Many everyday behaviours occur habitually (Hagger, 2019). While the topic of habits has been studied for many years, historically, habits were thought to be an evolutionary advantage adapted as an energy saving function that freed up mental resources and left room for other activity and stimulus (Mazar and Wood, 2018). Habits are defined as a process whereby a stimulus automatically generates an impulse towards an action based on learned stimulus response association (Gardner, 2015). Through repetition of a behaviour (e.g., walking) in a stable context (e.g., after dinner) a mental cue-behaviour association triggers an impulse to perform, and the context eventually becomes sufficient enough to activate the association without an cognitive effort or awareness (Gardner, 2015; Verplanken, 2018).

Researchers have defined habit in different ways within the literature, in particular defining habit as a determinant or an association or a process (Mullan and Novoradovskaya, 2018). As described above, habits occur when a behaviour is paired with a stable contextual cue and overtime, via repetition, triggers an automatic impulse to enact that behaviour, when exposed to the same contextual cue. Two important considerations of habit formation are *repetition,* which reinforces the behaviour-context association and *reinforcement* which strengthens the repetition. With continuous, consistent repetition, the stable contextual cue becomes strong enough to activate the learned association. In other words, the context triggers the impulse to perform the behaviour, with minimal cognitive effort or intention meaning the habit has become more automatic and enacted outside of conscious awareness (Verplanken, 2018). However, not all repeated behaviours develop into habits. Gardner & Lally (2018) proposed a theoretical framework on habit formation and its determinants, consisting of three stages: stage 1: deciding to act (intention formation), stage 2: self-regulating (action initiation), stage 3a: repeating behaviour and stage 3b: developing cue-behaviour associations (habit formation). At stage one, the action is being consciously deliberated and a decision on whether to perform the behaviour is being made. At stage

two, a person may act on their intentions by initiating the behaviour and translate the intention into action. Stage 3a represents the behaviour being repeated, consciously and usually as a result of continued motivation and self-regulation. Stage 3b represents the strengthening of cue-behaviour associations which may represent a directional relationship before the habit reaches automaticity. Specifically, repeated behaviour leads to habit formation. However, when the behaviour becomes habitual it is the established habit that determines behaviour (Feil et al., 2012). While the framework appears chronological, an individual can revisit previous stages, though when a habit has developed automaticity, i.e., an established habit, changes in motivation are less likely to impact behaviour. For example, a person may experience reduced motivation to act in stage 3a and move back to deliberating and intending to act (stage 1).

When considering physical activity habits and the role of motivational profiles, an important component of this thesis, the research is vast, however, it may be that a person epitomising a high-quality motivational profile, and therefore placing high value on physical activity, might be less likely to revisit previous stages. We know from previous studies, that individuals with high autonomous PA motivation possess stronger PA habits (Hopkins et al., 2022; Gardner & Lally, 2013), however, these studies used a variable centred approach meaning single motivational regulation scores were compared. In motivational profile research, a person-centred approach, the findings may be different. A person associated with a lower quality motivational profile might value physical activity much less meaning their intention to act is weakened or the gap between intention and behaviour is broadened. Deliberation of a behaviour, particularly when motivation is of low quality has been associated with this gap in intention to action (Kidwell & Jewell, 2010). This will occur when the habit is in the process of forming but is unlikely to happen when a habit is fully formed (Lally & Gardner, 2018). Similarly, as the framework states, a number of factors or determinants can influence the behaviour at different stages for example, pleasure/enjoyment that characterizes intrinsic motivation might increase the speed at which a person intends to act (stage 1), the speed at which they act on the intentions (stage 2) and the sustained motivation/effort when carrying out the behaviour (stage 3a) which will strengthen the mental associations when repeated in a cue-context environment (stage 3b). While there is no research yet to assess the distinction between motivational profiles and

habit, it is expected that the findings will tell us more about the directional relationship between habits and PA motivation, further supporting the promising association between different types of motivational profiles and the stages involved in habit formation.

Whilst understanding the process of habit formation is crucial, it is also necessary to describe some of the factors that determine habit associations. One behaviour related factor is consistency. Consistent action is conducive to the habit formation process (Gardner, 2012) as the relationship between habit and behaviour is thought to be directional during the habit formation process, whereby the behaviour determines the strength of the habit forming and how much the behaviour is reinforced and repeated in a stable contextual context (Feil, 2021). For example, a study found that gym members that exercise consistently with specific cues present (e.g., every evening after dinner) had stronger physical activity habits after 12 weeks as a result of the cue association formation being maintained in a familiar setting and repeated (Kaushal & Rhodes, 2015). Although, failure to remain consistent may hinder habit formation because while a habit is forming, it is possible for the process to be interrupted particularly if the behaviour being performed is complex and requires motivation to enact, such as physical activity. In this circumstance, it may be that motivation or more specifically, specific motivational profiles, are likely to contribute to the habit formation process by reinforcing the behaviour to be enacted in the stable environment, as discussed above when referring to digressing back to previous stages. However, it is not yet known how much interruption to the habit formation process has an impact, for example, missing one physical activity session is likely to have negligible effects. A more autonomous motivation profile might be beneficial in ensuring the behaviour is repeatedly performed (Gardner & Lally, 2013). The role of motivational profiles may be less important when habits are established because the direction of the relationship is different to that of habit formation (Gardner & Lally, 2018).

In reference to contextual cues, another factor also associated with the development of habit associations cue salience and stability. Cues can take multiple forms meaning contextual cues that are salient are more likely to be associated with habits (Gardner & Lally, 2018). Contexts may include a physical location, or the same time of the day or more abstract contexts are often individualised and specific to a person's routine include "after

work" or "at home". Contextual cues are therefore crucial for the activation of habitual responses and stable performance, or repetition of the behaviour which promotes the habit formation process (Mazar and Wood, 2018).

A third factor that is associated with the development of habit associations is reward value, which supports the idea of intentions (in stage 1) and promoting the maintenance of behaviour (in stage 3a). However, in the context of rewards, both extrinsic and intrinsic rewards are thought to support the development of automaticity, though external rewards are associated with goal-directed automatic action and not independent of goals (Wood & Neal, 2007). Intrinsic rewards, such as pleasure or enjoyment, may strengthen the repetition of behaviour and therefore the contribution of each action (in stage 3a particularly) (Lally & Gardner, 2015).

The automaticity component of habits is also thought to have several key defining features; these are efficiency, unawareness and uncontrollability (Marien et al., 2018). Efficiency refers to habits often featuring without paying direct attention or needing mental processing. In research, dual-task settings are used to test whether participants can perform a second task alongside a learned habitual task and if the task if habitual, they will be able to perform the second task simultaneously with little or no interference (Brown and Bennett, 2002). When a person experiences the context-specific association, this elicits a signal to enact, and the habitual behaviour is performed. For example, a person may have developed a habit for eating chocolate when watching television in the evening and sitting down to the turn the television on would trigger an impulse to go to the fridge for chocolate. A second feature is uncontrollability; automatic habitual mechanisms can occur without any control, for example, research has cited the notion of action slips, whereby the behaviour is enacted even when usually actioned in a different context (Wood et al., 2022), which can be difficult for individuals attempting to change or replace habits or create new ones. For the previous example, if this person wanted to reduce their chocolate eating habit, the behaviour change techniques involved in habit theory have multiple components. For the disruption or breaking of this habit, the person could undergo habit substitution (e.g., buying fruit instead of chocolate), habit discontinuity (e.g., remove watching TV at night) or habit inhibition (e.g., intentionally, and consciously not eating chocolate when watching TV). However, none of

these processes target the habit and instead focus on the habitual behaviour. Conscious behaviour is usually goal-directed whereas habitual behaviour is actioned in the absence of goals (Hollands, Marteau & Fletcher, 2016). Goals are important in the initial stages of habit formation but become less important as automaticity develops, by which the behaviour is performed as an unconscious response, for example, a person buying a high calorie snack (response) on their way to work (context) even if they do not have any cravings (Mazar and Wood, 2018). In the context of physical activity, research found that individuals with strong physical activity habits still enacted the behaviour even without intentions to follow through (Lally et al., 2011) suggesting that when automaticity develops, people become less sensitive to the goal-directed behaviour that initially developed the habit (Gardner, 2015).

1.9.1 Physical activity and habit

Physical activity is a complex behaviour and to adopt a physically active lifestyle, particularly after being inactive, constitutes as a whole behaviour change. Habit-formation is relevant to behaviour change, as described above, as the contextually consistent reinforcement means the cue-behaviour association should be self-sustained (Gardner et al., 2014). Research suggests that physical activity can become habitual when repeated in the same contextual environment over time, long enough for a cue-based association to form in order to trigger the behaviour (Gardner and Rebar, 2019). It is thought that physical activity habits are strengthened with increased engagement and activity levels, which is plausible therefore the research indicates higher physical activity levels are associated with stronger habits (Kaushal and Rhodes, 2015). This was evidenced in a study on gym members whereby exercise maintainers reported stronger physical activity habits than initiates (Kaushal and Rhodes, 2015). The role of behavioural complexity is a notion that ought to be discussed and in order to understand the drivers of behaviour, it is important to note that some behaviours are simple in nature, such as attaching your seat belt when getting into a car in comparison to complex behaviour such an incorporating physical activity into daily life. For example, physical activity for a novice may involve choosing the type of activity, intensity, when and where to be active, and preparatory behaviours such as change of clothes (Lally and Gardner, 2013). Therefore, for long-term physical activity maintenance it is thought that developing non-conscious, automatic processes for physical activity is a sustainable

approach, however, as physical activity is deemed a complex behaviour, the automatic and unintentional features of habit contradict the effort needed for being physically active (Rhodes and Rebar, 2018).

Behaviours become habitual when they are trigged automatically by the context (Rebar et al., 2020). As described above, habits are learned, cue response associations and overtime as cue exposure is repeated and performed in the same context, there is an association between the certain cues and the initiation of a behaviour (Gardner, 2015). In the context of physical activity, when a person is exposed to the cue there is an urge to perform in the habitual behaviour, however, the strength of the learned response and any supportive or unsupportive influences will impact behaviour engagement. For example, feelings of tiredness or shift in motivation on a certain day may lead to some deliberation as to whether they will go to their usual gym class after work. There may be an urge to skip the exercise class but if the strength of the association is high, the countering influences will have less of an impact, leading to the enactment of the habitual behaviour. Due to the complexity of physical activity, the performance requires more deliberative input, and the initial habit formation process is likely experienced as conscious and wilful, however, overtime the behaviour is described as second nature.

In relation to how a physical activity habit is formed, research suggests that people can develop strong links between contextual cues and behavioural actions relatively quickly (Mazar and Wood, 2018). Research on the development of habits for more complex behaviours like physical activity in every day settings suggests that rates of habit development are highly variable, and dependent on a number of key factors during development. For example, Lally et al (2010) asked participants to perform a health behaviour (physical activity participation, healthy eating, or drinking water) of their choice in the same context every day and log in a daily diary whether or not they had performed the behaviour and describe the extent to which they experienced it as ‘automatic’ or habitual. Results found that behavioural automaticity at the start developed quickly but tailed off over time. In addition, some participants reached their ‘peak’ at different times, though the average was 9 weeks, it indicates there is huge variation in the time it takes to reach behavioural automaticity. When analysing the results more specifically, the simpler

behaviours such as drinking water, developed automaticity much quicker than the more complex behaviour such as physical activity. The results found that health behaviour habits take between 18 and 354 days to become habitual, though it is expected that physical activity habits will be towards the longer end of that timeframe (Lally et al., 2010).

The trajectory of physical activity habit formation is thought to be dependent on the person and the behaviour, regardless of equal repetitions. In addition, one study suggests physical activity habits are formed in between 1 and 4 months (Lally et al, 2019) and a study specifically looking at habit formation in gym-based exercisers found between 6 weeks and 2 months (Rhodes & Kaushal, 2015). This particular longitudinal study on first time gym attenders over a course of 12 weeks found that exerciser were most likely to report the developing of automaticity in physical activity behaviour when they had attended at least four sessions a week over a 6 week period (Kaushal and Rhodes, 2015). Their results suggested that the first 5 weeks of attendance is crucial for the development of habits. Whilst these studies offer huge advancements in the habit field, there are still many gaps left unaddressed, in regard to the factors that may facilitate or impede the developmental process. The time taken to form physical activity habits have been documented by a number of scholars and the exact time is not yet known. Studies comparing health behaviour (physical activity or dietary behaviour) habit formation of 96 participants over the course of 12 weeks in response to a once daily cue found a huge variation in the time at which habit strength plateaued. The median time reported was 66 days, however, behaviours took anywhere between 18 and 354 days depending on the complexity of the task (Lally et al., 2010).

There are a number of important factors that are thought to contribute to the strengthening of physical activity habits, for example, cue salience stability; some contexts can be more successful in promoting the habit formation process, for example exercising in the same context, with the same people. Pimm et al (2016) found that individuals that exercised with the same people consistently, in the same routine reported stronger habits. For physical activity, event-based behaviour i.e. “after work” may be more manageable than time-based behaviour “6pm” as there is room for plans to fluctuate without conscious monitoring. Secondly, consistency is key in developing contextual associations; pairing cue-behaviour

associations means the behaviour needs to be performed consistently in response to the cue and performing different behaviours in response to that cue will reduce the strength of association, reducing the likelihood of becoming habitual. Thirdly, the reward value of performing the behaviour is thought to impact the development of physical activity habits, as the experience of rewards prompts maintenance (Thorndike, 1911). There has been a distinction between extrinsic rewards (monetary incentive) and intrinsic rewards (e.g. pleasure from the behaviour itself). Whilst both forms of rewards elicit automaticity development, extrinsic rewards become dependent on expected rewards meaning the behaviour is less likely to be continued when the reward is removed but habitual action would not. As discussed above, intrinsic rewards are more closely associated with positive affect and alleviating negative affect suggesting that intrinsic rewards may strengthen the association between behaviour and habit development.

The relationship between physical activity and habit has been explored over the last decade; systematic review studies have found moderate to strong associations, in 13 out of 15 studies (Rebar et al., 2016) and a meta-analysis found 23 habit-behaviour relationships with a moderate to strong correlation between PA and habit (Gardner et al., 2011). In addition, a systematic review investigating the relationship between habits and physical activity behaviour and found that a majority of studies found a positive correlation between habit and physical activity. They concluded that habit plays an important role in physical activity promotion though it still remains unclear the directional relationship between habit and physical activity (Feil et al., 2021). Rebar and colleagues (2016) found evidence for a direct affect whereby people with strong habits are more physically active than those with weaker habits. In addition, a systematic review in 2021 found that 8 studies confirmed a positive correlation between PA and habit. More specifically, they reviewed studies that found a directional relationship; 3 studies found that an increased level of PA leads to a stronger habit, 2 studies found a direct effect of habit on PA whereby higher habit strength results in an increased level of PA and 5 studies found an indirect effect of habit on PA (Feil et al., 2021). Gardner (2015) explains that the relationship between habit and behaviour may be bidirectional and could evolve over time, whereby the behaviour is determined by habit and the habit is determined by the behaviour.

The consideration as to whether physical activity has the potential to be habitual has been argued for a number of reasons; physical activity takes a long time to be performed in terms of preparation (planning exercise, packing workout clothes), travel considerations (transport to location, changing clothes), wind down actions (stretching, showering, travelling home) (Mazar and Wood, 2018). Therefore, habitual physical activity has been described as a sequence between habitual preparation and habitual performance (Gardner et al., 2021) and the behaviour is activated automatically by a number of sub-actions (Gardner, 2015; Rebar et al., 2020; Gardner and Lally, 2022). These sub-actions may become automated with repeated exposure and practice, the same process as more simple habitual behaviours. It is theorised that as time goes on with repeated exposure of the sequential sub-actions, the actions will no longer require any deliberation and will trigger the behaviour automatically (Verplanken, 2018). In addition, physical activity has also been described as having two distinctive behavioural phases, a preparatory and performance phase (Phillips & Gardner, 2015). These distinctions have been explained in the literature, for example, a preparation habit would be built in the decision to go to the gym such as packing a bag in preparation to going to the gym (Kaushal et al., 2017) and is used to transition a person to an exercise ready state. Such phases are thought to predict habit and change of exercise, which could be helpful in establishing an exercise habit (Kaushal, Rhodes, Meldrum & Spence, 2017). Whereas a performance habit begins when a person starts exercising and the preparation habit ends, for example, exercising in the same environment (e.g., gym, exercise group) (Kaushal, Rhodes, Meldrum & Spence, 2017).

In a recent study on cue behaviour associations, action predicted behaviour frequency, but performance did not, across all four behaviours that differed in complexity. Thus, even more complex behaviours are repeated by the selection of the habitual behaviour itself as opposed to the performance component. In relation to physical activity, it may be evident that the preparation of the behaviour is more predictive of repetition and may be more important to promote maintenance (Gardner, 2022). Building preparation habits are thought to be more valuable for maintenance as it directly activates the behaviour in comparison to a performance habit and automatically generated habits PA are assumed to be regulated by preparation (Gardner and Lally, 2018). There have been justified counter arguments in relation to such considerations; individuals that regularly engage in physical activity are likely to do as part of a routine which involves repeating the behaviour, in consistent or the same

contexts (Verplanken and Melkevik, 2008). Routine does not necessarily assume habit, but is going to contribute to that person being repeatedly exposed to the same contextual cue, which in time may kick-start and continue the habit formation process (Gardner, 2015; Gardner and Lally, 2022).

1.9.2 Motivation and physical activity habits

Habits offer a mechanism for physical activity maintenance when motivation is insufficient (Mullan et al., 2021). The relationship between habits and motivation has been explored and offer insight into the determinants alongside repetition that determine physical activity habits. Kaushal & Rhodes (2015) in their sample of gym-based exercisers found that intrinsic motivation plays an important role in the habit formation process and such habits were more likely to be formed if the activity was deemed pleasant and enjoyable. A key factor conducive to habit formation is the rewarding value of the behaviour, therefore, pleasure and enjoyment are likely to regulate consistency and repetition (Gardner & Lally, 2012). As regulatory style determines maintenance it is presumed that more autonomously regulated activity is likely to be sustained over time and may suggest a tendency for self-determined physical activity to become habitual (Gardner and Lally, 2013). In addition, SDT states that autonomously regulated behaviour satisfies basic psychological needs of autonomy, competence and relatedness which are associated with many positive well-being benefits. These may contribute to being highly rewarding for people in comparison to external incentives, which are likely to only be rewarding for a certain period or lose rewarding tendency over time (Ryan and Sapp, 2007).

Research has found a direct effect of intrinsic regulation on habit strength irrespective of past behavioural frequency, whilst also confirming the relationship between habit strength and intrinsic interest in physical activity (Gardner and Lally, 2013). It was found that habits were stronger in individuals that were more intrinsically motivated, and that self-determined motivation strengthened habits. In addition, finding physical activity intrinsically rewarding were more likely to form stronger habits (Cheval, 2017; Phillips et al., 2016). The distinction between intrinsic rewards and habits was explored more recently, Hopkins and colleagues (2022) gathered data from a sample of gym exercisers and analysis indicated a significant

difference in motivation between individuals with weak and strong habit strength. More specifically, individuals with stronger physical activity habits reported being autonomously motivated (intrinsic, identified, and integrated regulation). In addition, physical activity enjoyment positively predicts exercise habit as it is thought that they will exercise more frequently due to the perceived rewarding component (Teixeira et al., 2022). Similarly, a randomised controlled trial conducted in 2017 gave 49 participants access to twice-weekly, 1-hour tailored physical activity sessions for 28 weeks, with one group, around half of participants, also sent SMS reminders targeting intrinsic motivation and consistent performance to the intervention group to foster habitual attendance. Physical activity habit strength increased for both groups immediately post-intervention, however, the group with SMS reminders experienced quicker habit gains. Higher physical activity was observed in the SMS group at 12 months (Fourtier et al., 2017).

The research into motivation and habits have demonstrated that intrinsic motivation (e.g., enjoyment) are like to strengthen physical activity habits and promote adherence. This may suggest that intervention designing aiming to promote exercise maintenance could use the processes linked to habit formation (E.g., frequent practice, stable contexts) whilst also developing autonomous motivation (Gardner et al., 2022). However, there are several gaps left unaddressed in the literature surrounding which specific motivational regulations may predict habit strength. The current literature specifically assessing the relationship between multiple types of motivational regulations on PA habits is lacking and this leaves a lack of understanding as to what role motivation plays in the PA and habit relationship. We know that intrinsic regulation may strengthen PA habits (Gardner and Lally, 2013) but not all individuals are motivated solely for enjoyment and pleasure and often types of motivational regulations operate simultaneously, therefore, it is necessary to understand the relationship between other types of motives and PA habits. With the proposed research gaps in mind and to my knowledge based on the results of this review of the literature, no research to date has been explored the relationship between multiple types of motivational regulations from a person-centred perspective (i.e., motivational profiles) and PA habits.

1.9.3 Community based initiatives

Community based physical activity initiatives are gradually increasing in popularity and commonly target neighbourhoods, families and other relevant social groups with an aim to increase physical activity or improve overall lifestyle (Sharpe, 2003). The community driven component utilises the role of social support and group-based classes to embed a healthier and more active lifestyle into member's lives. Social support is crucial for all aspects of individual development and is thought to act as a protective factor against poor physical and psychological health (Ozbay et al., 2007). However, social support has more beneficial effects that go beyond increasing physical activity levels; grounded theory research found that adolescent girls perceived physical activity more enjoyable and had a direct influence on their performance and motivation (Laird et al., 2018). Social support was facilitated through coaches and teachers creating positive environments and participating with friends, thus contributing to sustained engagement. Participants also emphasised the importance of connectedness whereby having shared interests and making friends strengthened relationships and increased participation in activities. Similarly, participants reported improvements in mental wellbeing during an organised parkrun due to the supportive factors from others such as, feeling safe and communication (Dunne et al., 2021). In research with older adults, social support is crucial in maintaining health, independence and social interaction, particularly for individuals living alone (Killingback et al., 2017). A sense of togetherness and belonging has positive impacts on the approach to physical activity whereby individuals are engaging in the behaviour for more than receiving tangible rewards. One way to improve the positive benefits of social support in physical activity is to increase accessibility of physical activity programs within communities.

Community driven and group based physical activity initiatives are a key focus in the current thesis as such initiatives directly draw on the principles of SDT in relation to the psychological needs of relatedness, competence, and autonomy. Research supports the role of the three psychological needs and their relationship with physical activity behaviour, whereby supporting needs drive physical activity behaviour longevity (Springer et al., 2013; Gunnell et al., 2013; Gunnell et al., 2014; Brunet et al., 2016; Rodrigues et al., 2020). According to SDT, the psychological need of relatedness emphasises the crucial role of experiencing connectedness and feeling significant to others and relatedness frustration can

result in feelings of loneliness, exclusion and alienation (Deci and Ryan, 2014). Satisfying relatedness has been found to be salient at adoption, whereby the importance of friends establishing regiments, activities could be mirrored and family support were highlighted (Springer et al., 2013). Findings also indicated that relatedness needs feature in adherence and are strengthened by feeling connected and supported by their activity-minded group. These results suggest that feeling supported by a social group can be invaluable for adherence to physical activity. Relatedness has also emerged as a significant predictor of well-being in the physical activity context whereby in the presence of competence and autonomy, sharing a meaningful connection is beneficial for well-being (Gunnell et al., 2013; Gunnell et al., 2014).

Research on the impact of community based physical activity initiatives are mixed, mainly due to the gap in how such initiatives are conceptualised within the literature. Firstly, results comparing community driven intervention studies whereby participants are active volunteers have found positive results during intervention, such as increased physical activity levels, but post intervention behaviour changes (Scioli-Salter et al., 2014). A systematic review measuring the effectiveness of community based physical activity interventions in women found a limited number of articles meeting the inclusion criteria (Farahani et al., 2015). Of the included studies, many had limited effectiveness due to small sample size, baseline differences between groups and lack of an adherence measurement, making it difficult to conclude which type, intensity and frequency of intervention could significantly improve physical activity. More recently, a systematic review on physical activity community interventions measuring both physical activity levels and 12 months follow up, found evidence of sustained intervention effects 12 months post intervention and up to 4 years, in group-based physical activity interventions (Wahlich et al., 2020). In addition, a community based lifestyle intervention in Hong Kong successfully increased physical activity levels, family communication and perceived health in deprived families (Lai et al., 2020). Despite having prominent feature in the literature, there are some gaps in relation to community driven physical activity initiatives impact on psychological processes and physical activity. There is a lack of research with data from community-based initiatives in a natural setting as opposed to an intervention setting which could influence their effectiveness. The

current thesis collected data from members of a community-driven physical activity and lifestyle initiative in the north of England, which will be discussed in the next sub-section.

1.9.4 BeStrong

BeStrong are a fully registered not for profit organisation in the North-West of England that adopt a whole lifestyle approach. The organisation aims to help inactive and overweight individuals seeking to learn and create healthier lifestyle behaviours, mainly nutrition and physical activity. BeStrong founders have created a social and supportive environment whilst simultaneously abolishing the “quick fix” mentality. Their programme is devised to create strong, healthy habits using evidence-based techniques in exercise and diet that are manageable and sustainable. Members have the autonomy to have as much or as little guidance and support, as memberships range from just digital (access to online programs, tracking and recipes), coaching (digital plus attendance to weekly coaching class), and all in (digital, coaching plus attendance to weekly exercise classes). All the above-mentioned memberships are less than £30 per month. Their research-supported processes aim to aid individuals in adopting a healthier, more active lifestyle whilst learning to adhere to this lifestyle on a long-term basis, by drawing on the principles of SDT and habit formation. Lastly, members receive weekly educational videos and talks on topics relating both broadly and specifically to healthy lifestyle, to ensure the rationale behind their program is understood.

1.9.5 PhD project: Rationale, aims and research questions

Physical inactivity is one of the leading risk factors for major non-communicable diseases and a sedentary lifestyle, is likely to be contributing to the strain on healthcare services. While there are many evidence-based intervention schemes that aim to encourage individuals to adopt physical activity, many individuals are still insufficiently active, suggesting that current attempts to improve physical activity levels likely only target behaviour on a short-term basis and many are not able to maintain such behaviours. The ethos behind community-driven physical activity initiatives are often research-supported, drawing on principles from SDT whereby health behaviour maintenance is often achieved through the satisfaction of psychological needs, such as relatedness. Whilst community-

driven interventions are often cited in the literature, there is a gap in the literature whereby data is collected from members of a community-based initiative in a non-intervention setting. In addition, the literature is lacking a direct comparison between physical activity behaviour, and in particular the psychological processes involved in physical activity behaviour of those within a community-based initiative and a sample of the general population. The psychological mechanisms involved in physical activity maintenance are complex and multifaceted, however, this thesis focuses on mechanisms of motivation and habits. In addition, whilst the extant literature is not lacking in qualitative studies on physical activity interventions, there certainly is a lack of studies on real life community based physical activity initiatives, specifically ones with low cost and low dropout rates. Before the study commenced it was important to spend some time with the founders of Bestrong to gain a deeper understanding of their ethos and positionality, to then infer what that research could do to benefit them. The qualitative study, whilst important from a research perspective, was advantageous from a practical perspective for Bestrong as it informed the successes of the programme using rich and descriptive data, more so than the quantitative data could have alone. In addition, the qualitative interviews were an opportunity for members to discuss freely, perhaps in an environment and without other members around, this was an opportunity they would not have had during visits to Bestrong, which led to gaining even more rich and descriptive data.

Firstly, motivation has been cited as a key determinant of physical activity behaviour, whilst more recently, the notion of motivation profiling has expanded on previous findings. Motivational profiling research in the realm of physical activity is still relatively under-researched in comparison to other mechanisms, which highlights the need to develop understanding, and testing on two separate groups is advantageous. A second key focus of this thesis is habits, whereby the relationship between motivational profiles and physical activity habits has not been explored, therefore this thesis will be a novel contribution to the literature. The rationale for exploring the relationship between profiles and physical activity habits is inspired by the current literature, whereby intrinsic motivation is inherently linked with the strengthening of physical activity habits (Judah et al., 2018; Hopkins et al., 2022). However, there is a lack of research that assesses the relationship between other motivational regulations, as well as intrinsic motivation and how they simultaneously impact

habits. This is important considering strong habits offer a mechanism for physical activity maintenance (Rothman et al., 2009). Understanding the types of profiles associated with strong habits mean physical activity development and planning can be specifically designed to foster motivation profiles closely related to positive behaviour, such as increased physical activity levels and strong habits. We know that habits are key to physical activity maintenance and intrinsic motivation is a strong predictor in habit strength. However, less is understood about other types of autonomous motives and their prospective relationship with habits. Lastly, this thesis aims to understand, from a qualitative standpoint, how members of a community-driven initiative experience motivation and the processes they follow to promote habit formation. The nuances of motivation cannot be interpreted from quantitative data alone and given the reasons for engaging in physical activity and even more so, sustaining the behaviour, are complex and multifaceted, it was necessary in this thesis to use qualitative methods to further understand the multiple factors involved in physical activity motivation in this specific and unique group, which has not been explored in the literature. Mixed-method research surrounding this topic is sparse and the contribution of both qualitative and quantitative methods offer a full exploration, this will be discussed more further into this thesis.

The aims of this study were to (a) understand the distinct motivational profiles of a general adult population and a community-driven physical activity sample; (b) understand whether motivation profiles moderate or impact the relationship between physical activity and habits, in two different samples (general population vs community-driven initiative); (c) explore how motivation is experienced and what facilitates or impedes PA engagement.

The overarching research question of this thesis is to assess the physical activity motivation in a community-based exercise initial and the influence of motivational profiles and physical activity habits. To assess this the following research questions were investigated:

(1) What are the physical activity motivational profiles from a general adult population and a sample of community-driven exercise initiative members?

(2) Can motivational profiles moderate the relationship between physical activity levels and habits?

(3) How do members of a community-driven exercise initiative experience motivation and what are the facilitators or barriers to PA engagement?

Chapter 2 systematic literature review

2.1 Overview

This chapter aims to report the findings from a systematic literature review on PA motivational profiles, undertook to understand the current progress in this area if research and the gaps. As discussed in the previous chapter, in comparison to habits, the topic area of motivational profiles is quite novel and research understanding is somewhat lacking due no current systematic review of the literature, to our knowledge a complete and systematic review of the literature in this area does not exist. To understand the gaps within the literature and thus to explain how this thesis has addressed the current gaps, it was necessary to conduct a systematic literature review and include within this thesis. The review will briefly outline the rationale and study aims, followed by the methods, results, and discussion. The following chapter will describe the methods for the current study and how this project aimed to address the gaps noted in this review.

2.2 Introduction and rationale

Motivational profiles are a relatively new conceptualisation and research has predominately been conducted within work, sport, and educational domains (Friederichs et al., 2015; Howard et al., 2016; Vlachopoulos et al., 2000). The development of motivational profiling research indicates that previous approaches (I.e., variable-centred approaches) focus on examining relationships between single motivational regulations, which are insufficient in explaining how multiple regulations interact and operate together resulting in specific behavioural outcomes (Lindwall et al., 2017). Differentiating between sub-groups of individuals, thus adopting a person-centred approach, in relation to motives and PA

behaviour, allows a clearer distinction between which motives collectively result in higher PA levels and any variables that facilitate or thwart PA. Indeed, this information will inform us on the motives that may collectively facilitate adherence and which motives are likely to impede PA resulting in disengagement. Motivational profiling also allows demographic distinctions to be made by identifying the profiles associated with certain age and gender groupings. Given that the reasons for physical activity engagement are multi-factorial, it is expected that motivational profiles differ across demographic groups and characteristics, such as age, gender, ethnicity, and education. For example, in the literature, older adult's key motivational influences are often associated with health and alleviating age-related symptoms whereas younger adults are more motivated to achieve personal goals such as fitness or performance related (Steltenpohl, Shuster, Peist, Pham & Mikels, 2019). Indeed, whilst the research on the age trajectory of PA levels is unclear, it is evident that PA declines with age (Schutzer & Graves, 2004; Van Dyck et al., 2015). Understanding whether motivational profiles are predictive of age cohorts presents an advantage when tailoring PA interventions to demographic groups. We know that types of motives that facilitate PA behaviour are likely to differ between demographic groups, but it is not clear how motivational profiles differ between such populations. Given that motivational profiles offer more information than the measurement of single motivational regulations, the findings could inform the development of more targeted PA approaches for less active populations.

Addressing the gaps and inconsistencies in motivational profiling research, as highlighted in chapter 1, warrants the need for a systematic assessment and synthesis of findings, which does not currently exist. Addressing such gaps will also provide direction for future research beyond this thesis, such as providing information that may enhance PA promotion strategies by facilitating long-term PA adherence. The aim of this systematic literature review was to assess the existing literature in order to 1) identify the methods that have been used in motivational profiling and physical activity research, 2) identify the motivational profiles in adult populations (undergraduate students, general adult populations, older adults) and 3) determine the association between profile membership and PA levels.

2.3 Methods

This systematic literature followed the PRISMA review guidelines. The review was prospectively registered in the PROSPERO register of systematic reviews (ID: CRD42021256228).

2.3.1 Search Strategy

A comprehensive literature search was conducted in PsychInfo, Web of Science, Scopus, and Sport Discus databases, between July-September 2021. Search terms were based on the essential concepts of the review: 'motivation profiles', 'physical activity' and 'exercise'. Each database search term was adapted accordingly. The search strategy used for each database is presented in Table 2. The fields searched were title and abstract.

Table 2. Database search strategies.

	Search strategy
PsychInfo	Motivation profiles AND physical activity OR exercise
Scopus	TITLE-ABS ("motivation* profile*") AND ("physical activity") OR ("exercise") AND (LIMIT-TO (LANGUAGE , "English"))
SportDiscus	TI motivation* N3 profile* AND AB (exercise or "physical activity")
Web of Science	(TS=(motivation* near/3 profile*) AND TS=(exercise or "physical activity"))

A process of deduplication was carried out to remove duplicate records from merged search databases. Articles retrieved from each database were exported to EndNote reference manager to follow the stages of selection. The inclusion criteria displayed in Table 2 was used to assess relevant articles and exclude those that did not meet the criteria. The stages of screening, eligibility and inclusion were completed by two authors independently. The PICO's (population, intervention, control, and outcome) framework was used to explain the

eligibility criteria. The problem was defined by measuring adults over 18 from a general, healthy population, ranging from less active to moderately active. The intervention was defined by studies with a cross-sectional and/or longitudinal method measuring the relationship between physical activity and motivational profiles. A 'motivational profiling' intervention was therefore defined as a study which aimed to measure types of motivational regulations with a self-report measure (e.g., BREQ-3) and measured physical activity behaviour. There was no control measure, studies were only included if they were measuring physical activity motivation profiles. The outcome was defined by measuring motivational profiles and ensuring the only studies included were those assessing physical activity motivational profiles.

2.3.2 Article selection

A single reviewer screened all article titles only accepting titles that were related to the research objectives. Two reviewers screened article abstracts and final decisions were discussed between the two reviewers. Using the same protocol, the full text of included articles were reviewed by two reviewers. The full screening process is outline in figure 1.

2.3.3 Data extraction

Data extraction involved following pre-established guidelines from PRISMA extracting data from the reviewed studies, including, title, author, year, study design, sample characteristics (age, gender, number of participants), data collection measures (type of questionnaire), method of analysis and reason for and findings on types of motivational profiles and the outcome on physical activity behaviour. Special attention was paid to the methodology in order to organise studies by study type. Raw data was collected by the lead researcher and stored in an Excel document. Raw data was then organised and synthesized in terms of study characteristics and findings into a larger table (table 4).

Table 3. Inclusion and exclusion criteria using PICOs framework.

Inclusion criteria	Exclusion criteria
1. General, healthy population adults over the age of 18, ranging from less active to moderately active.	1. Studies with participants under the age of 18.
2. Cross-sectional and/or longitudinal studies measuring the relationship between physical activity and motivational profiles.	2. Studies on populations other than the general population e.g. athletes/sports people, clinical populations
3. Studies with objective and/or self-report measures of physical activity.	3. Studies only measuring physical activity and not motivational profiling.
4. Articles available in English.	4. Studies using any other form of methods e.g. qualitative, case control and longitudinal.

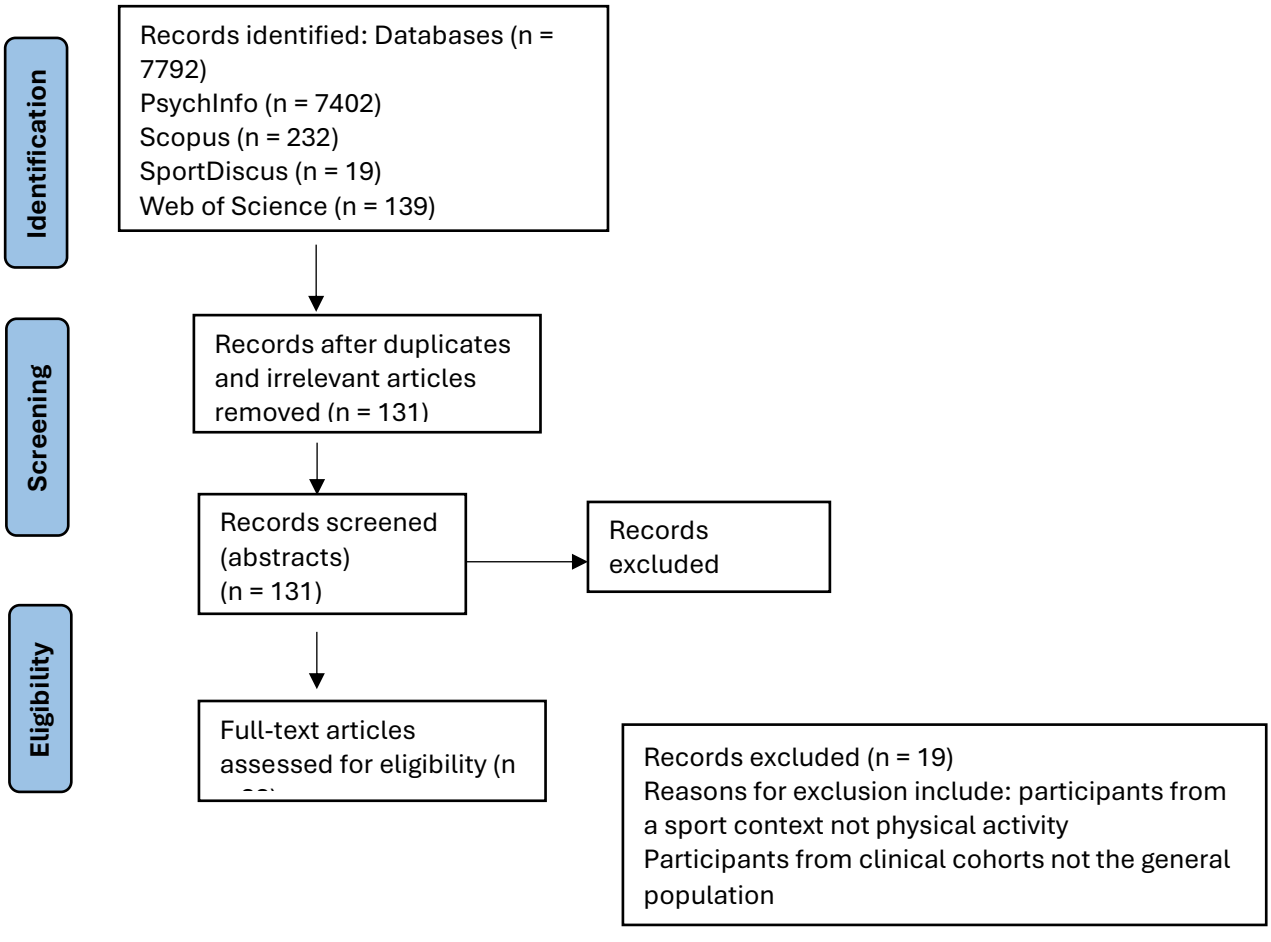
2.3.4 Quality assessment

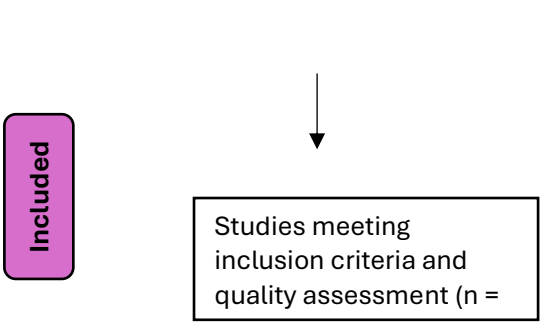
Study quality was assessed using the STROBE (STrengthening the Reporting of OBservational studies in Epidemiology) checklist. Primarily used for cross-sectional and cohort studies, the checklist items should be present in journals and was therefore used to assess the quality of the included studies. STROBE is a guideline consisting of 22 checklist items that an author should fulfil to surpass as high-quality research paper and thus determines the quality of each included study. Proper assessment of the studies included in the review is essential to ensuring the papers and therefore the data being assessed in the review are of high quality are a true reflection of the results. Systematic reviews offer a high level and meticulous summary of the current research and if such reviews included papers with low internal and external validity, this would decrease the power of the review. In terms of the STROBE

checklist, this was used for descriptive purposes, as the papers being assessed were used cross-sectional and self-report methods, as opposed to complex interventions or trials, therefore it was deemed more appropriate for the type of papers being assessed. There was a total of two discrepancies found between researchers but were rectified by re-examining the articles for clarification, as it was deemed there was a less than 5% disagreement rate between reviewers, discrepancies were resolved by discussion and re-examination.

There are 22 checklist items, and each paper was scored as high, medium, or low quality. In summary of the results in table 4a, of the 13 articles included, 10 papers described the setting, location, and relevant dates e.g., period of recruitment and data collection. 8 papers described sources and methods of selections of participants. All 13 papers gave sources of data for each variable of interest. 11 papers (and two non-applicable) described how subgroups were devised. All papers reported the demographics within motivational profiles. 8 papers reported method of analyses of subgroups. All 13 papers reported key results and summarised with reference to the main objectives. All 13 papers discussed the limitations and provided a cautious overall interpretation of results.

Figure 1. Flow chart summarising the review process with number of articles reviewed and retained at each stage (PRISMA group, 2009).





From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71

For more information, visit: http://www.prisma-statement.org/

2.4 Results

2.4.1 Study selection

Overall, 15,584 articles were identified from the four databases. After removing duplicates and irrelevant articles by screening the title, 131 articles were deemed acceptable based on title relevance for abstract screening. Abstracts were screened using the inclusion and exclusion criteria, an unconfirmed decision based on the abstract was advanced to the next stage (full-text screening) to be assessed. 33 full text articles were assessed for eligibility, resulting in a final decision (Figure 1).

Table 4. Results for STROBE checklist quality assessment.

Authors and study year Item		Altintas et al, 2018	Fernandez-Orcorta et al, 2019	Ferrand et al 2012	Friederichs et al, 2015	Friel & Garber, 2020	Lindwall et al 2017	Miquelon et al, 2016	Shen et al, 2019	Stephan et al, 2010	Zhong & Wang, 2019	Valenzuela et al 2021	Ferrand et al 2012
Title and abstract	1a	N	Y	Y	N	Y	Y	Y	Y	Y	N	Y	Y
	1b	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Introduction													
Background Rationale	2	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Objectives	3	Y	Y	Y	Y	N	N	Y	Y	Y	N	N	Y
Methods													
Study design	4	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Setting	5	Y	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y

Participants	6	N Y	N N	Y Y	Y Y	Y Y	Y N	Y Y	N Y	N Y	N Y	Y Y	Y Y
Variables	7	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Data sources & measurement	8*	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Bias	9	Reduced response bias (anonymously completed)	Completed anonymously	Randomly selected sample	Use of split files	Completed anonymously	Completed anonymously	N	N	Randomly selected sample	Completed anonymously, told it was voluntary	N	Randomly selected sample
Study size	10	N	N	N	Y	N	N	N	N	N	N	N	N
Quantitative variables	11	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y
Statistical methods	12 a	Y Y	Y Y	Y Y	Y Y	Y Y	Y Y	Y Y	Y	Y Y	Y N	Y N/A	Y Y

	12b	N	N	N	N	Y	N	Y	N/A	N	N	N	N
	12c								N				
Results													
Participants	13*	N/A	N/A	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Descriptive data	14a*	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	14b	N	N	N	N	N	N	N	N	N	N	N	N
Outcome data	15*	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Main results	16a	N	N	N	N	N	N	N	N	N	N	N	N
	16b	N	N	N	N	N	N	N	N	N	N	N	Y
Other analyses	17	N/A	N/A	Y	Y	Y	Y	Y	N/A	Y	Y	N/A	N/A
Discussion													
Key results	18	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Limitations	19	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Interpretation	20	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Generalisability	21	Y	Y	Y	Y	N	Y	N	N	Y	N	N	Y

Table 5. Study characteristics and findings on motivational profiles and physical activity levels.

Author(s) (year, country)	Design	Sample	Data collection measures	Data analysis methods	Findings and comments on types of profiles and proposed outcome on physical activity behaviour
Altintas, Guerrien, Vivicorsi, Clement & Vallerand (2018, France)	Cross-sectional,	113 French participants in nursing homes, 93 female, 20 male (M age = 84.11, SD = 6.93 years, age 65-99)	Elderly Motivation Scale, Nottingham Leisure Questionnaire.	Latent profile analysis (using subscales of EMS), one-way MANOVA with motivation profiles as IV and PA and age as difference variable	Profile 1 (n=39) = high self-determination (high levels of Intrinsic (M=83.74) and SD EM (M=87.44) and low levels non-SD EM (29.95) and amotivation M=20.77) age (M=83.56,SD7.01) Profile 2 (n=36) = additive profile (high Intrinsic (M=70.78), SD EM (M=83.74), non-SD EM (M=63.31) & low amotivation (M=27.63) Profile 3 (n=19) = low, self-determined profile (moderate IM (54.37), SD EM (67.11) and amotivation (18.05) Profile 4 (n=19) = moderate profile (moderate IM (51.47), SD EM (52.11), non-SD EM (46.89) and amotivation (34.58) No significant difference between profiles on age (p=.94)

					Profile 1 frequency PA (M=21.26,SD=5.62), profile 2 (M=19.11,SD=6.98), profile 3 (M=14.53,SD=6.57), profile 4(M=11.31,SD=5.05) profile 1 significantly more active (p=.01)
Fernandez-Orcorta, Ferriz, Arbinaga, Garcia-Martinez (2019, Spain)	Cross-sectional, self-report	615 undergraduate Spanish students, 334 female, 281 male (M = 21.42, SD = 3.53 18-30 years)	Behavioural Regulation in Exercise Questionnaire 3 and Physical Exercise in Leisure questions	Cluster analysis of motivational regulations, t-test to compare clusters for level of PA	Profile 1 (n=267) = high levels of all SDM (intrinsic (M=3.85), integrated (3.65) and identified (3.83)) and low levels non-SDM (1.15, .11) and amotivation (.11) Profile 2 (n=348) = moderate SDM (2.45, 2.87) PA score higher in profile 1 (M=6.74,SD=0.88) than profile 2 (M=6.11,SD0.88), p<.001
Ferrand, Martinent & Bonnefoy (2012, France)	Cross-sectional, self-report	100 older adults, 57 female, 43 male	Motivation for Exercise and Sporting activity (PA frequency)	Cluster analysis for motivation profiles.	Cluster (n=54) highly self-determined: high SDM (4.46, 4.92) and introjected (5.97), low ER (2.30) and amotivation (2.03).

		(M=75.34, SD = 4.89 years)		A MANOVA to compare differences between clusters and differed in PA participation, age, gender, education and BMI	Cluster 2 (n=46) moderately introjected: low SDM (1.42, 1.08, moderate IR (4.37) and low ER (1.38) and amotivation (1.70). Significant difference on PA level (.02), cluster 1 more exercise minutes per week (M=464.44,SD=179.50) than cluster 2 (M=387.39,SD=142.94). No significant differences between gender (p=.48), age (p=.53), BMI (p=.69), education (p=.42).
Ferrand, Nasarre, Hautier & Bonnefoy (2012, France)	Mixed-methods, cross-sectional, self-report and qualitative interviews	92 French older adults, 56 female 36 male (M = 74.95, SD = 4.6 years 63-89)	Sport Motivation Scale, report of sporting activity	Cluster analysis for motivation profiles, test of difference on PA, age, gender and BMI	High combined motivation (n=44) - high SDM (IM (5.35), identified regulation (5.08) & introjected regulation (6.00) Low to moderate motivation (n=48) - low IM (3.03), identified regulation (2.93), high introjected (4.51), low ER (1.59) High combined were more active in minutes per week (M=475.8,SD=3.08) than low to moderate (M=386.3,SD=2.23), p=.01.

					No significant difference between cluster 1 in age (M=74.59,SD=4.64) and BMI (M=24.09,SD=3.16) and cluster 2 in age (M=75.27,4.59) and BMI (M=23.94,SD=2.28)
Friederichs, Bolman, Oenema & Lechner (2015, Netherlands)	Cross-sectional, self-report (baseline data from intervention study)	2473 adults from 18-70, 1692 female, 781 male (M = 44.6, SD = 12.9 years)	Exercise Self-Regulation Questionnaire, Dutch Short Questionnaire to Assess Health Enhancing Physical Activity	Cluster analysis for motivational regulations (hierarchical and non-hierarchical), double split cross validation procedure (for stability of clusters), MANOVA for between cluster differences in PA, age, gender, education, BMI	Cluster 1 (n=1310) autonomous cluster = high identified regulation (5.81) & IM (5.39), moderate IR (3.00) and low ER (1.23) Cluster 2 (n=610) controlled cluster = high introjected (4.15) & moderate ER (2.75), high identified (5.28)& IM (4.55) Cluster 3 (n=553) low motivation = low ER (1.50) moderate to low rest of regulations intro to intrinsic (1.93, 3.23, 2.54) Cluster 1 more weekly PA minutes (M=537,SD=575) and cluster 3 the lowest (M=362,SD=506), p<.001 No significant difference between profiles in age or gender. BMI significantly highest in profile 3 (M=27,SD5.4) and lowest in profile 1 (M25.5,SD=4.4), p<.001

					Education significantly higher in profile 1 (63%) and lowest in profile 2 (56.1%), p<.01.
Friel & Garber (2019, USA)	Cross-sectional, self-report	320 18+ adults, 243 females, 77 male (M = 35.6, SD = 12.8 years)	Godin Lesiure PA questionnaire, Behavioural Regulation Exercise Questionnaire 3	Cluster analysis for motivation profiles (hierarchical and non-hierarchical), MANOVA for PA, age, gender, education, ethnicity and BMI between genders	Cluster 1 (n=30) high Amotivation (high amotivation (1.61) & ER (1.51), low SDM (1.84, 2.16, 1.44, 1.58) Cluster 2 (n=101) autonomous with high introjected (low AM (.06) & ER (.36), high Introjected (3.18) & SDM (3.73, 3.37, 3.25) Cluster 3 (n=61) low overall motivation (low on all subscales, especially autonomous) amotivation to intrinsic (.16,.61, 1.63, 2.25, 1.08, 1.36) Cluster 4 (n=47) high controlled M (high ER (2.12) & introjected (3.20), low AM (0.28) and SDM (3.20, 3.26, 2.63, 2.57) Cluster 5 (81) autonomous with low introjected (low AM (0.07), ER (0.43)and introjected (1.63) high SDM (3.28, 2.74, 3.05)

					MVPA highest in profile 2 (M=47.90,SD=25.54) and lowest in profile 1 (M=16.90,SD=18.83), p<.001 BMI significantly highest in profile 3 (M=29.63,SD=7.63) and lowest in profile 2 (M=25.58, SD=5.83) No significant difference in age (p=.08), gender (p=.137), education (p=.173)
Lindwall, Ivarsson, Weman-Josefsson, Jonsson, Ntoumanis, Patrick, Thogerson-Ntoumani, Markland & Teixeira, 2017, Sweden	Cross-sectional, online survey, between subjects (2 samples)	Sample A 1084 middle aged adults, 279 male, 805 female (M = 45.0, SD = 11.7 years) Sample B 511 university students, 226 male and 285 female (M = 22.0, SD 3.3)	Behavioural Regulation in Exercise Questionnaire, Godin Leisure-Time Exercise Questionnaire	Latent profile analysis for motivation profiles. Test of association using Wald's test and pairwise profile comparisons for PA.	(negative scores = lower than average of that sample, positive scores = higher than average of that sample) (sample A) (sample B) **Profile 1** (A, n = 194, B, n = 140): **A** low motivation profile AM (-.24), External (-.032), introj (-.078), ident (-.092), intrins (-.58) **B**: AM (-.25), Exter (-.34), introj (-.32), identi (-.36), intrin (-.33 AM (-.29), Exter (-.08), introj (.56), identi (.21), intrin (-.06) **Profile 2** (A, n = 87, B, n= 101): **A** self-determined with high introjected profile AM (-.031), ext (-.40), introj (1.56), ident (1.09), intrins (0.81),

B: AM (-.40), Exter (-.45), introj (1.03), identi (.77), intrin (.63)

Profile 3 (A, n = 200, B, n = 75):

A SD with low introjected profile AM (-.29), Extern (-.41), introj (.16), identi (.95), intrin (.87),

B: AM (-.45), Exter (-.52), introj (-.71), identi (.58), intrin (.79)

Profile 4 (A, n = 115, B, n = 21):

A SDM profile AM (-.33), extern (-.44), introj (.16), identi (.96), intrin (.87),

B: AM (-.53), Exter (-.65), introj (-.09), identi (1.22), intrin (1.12)

Profile 5 (A, n = 263, B, n = 90):

(**A**) introjected & identified profile AM (-.29), Exter (-.08), introj (.56), identi (.21), intrin (-.06) (

B) extrinsic profile AM (-.12), Exter (1.50), introj (.77), identi (.35), intrin (.11)

Profile 6 (A, n = 230, B, n = 84):

(**A**) amotivation and controlled profile AM (1.03) extrin (1.05) introj (.10) identi (-.76), intrins (-.85), (

					B) amotivated profile AM (1.56) extrin (0.08) introj (-.84) identi (-1.49), intrins (-1.28), Sample A: Profile 2 (M=54.28,SD=4.29) and 4 (M=49.99,SD=2.02) scored highest on PA Sample B: profile 4 (M=54.38,SD=4.29) scored highest and profile 1 (M=36.75,SD=2.51) sored lowest.
Miquelon, Chamberland & Catonguay (2016, Canada)	Cross-sectional, self-report	1092 adults 18-65, 83.3% female (M = 34.62, SD = 11.24 years)	Behavioural Regulation in Exercise Questionnaire 2, Godin Leisure-Time Exercise Questionnaire	Multivariate hierarchical multiple regression for variance on PA outcomes, cluster analysis for motivation profiles. MANCOVA for differences between motivation profiles and PA	(negative scores = lower than average of that sample, positive scores = higher than average of that sample) Cluster 1: Self-Determined (n=456) (high scores for intrinsic (.66) and identified regulation (.71) integrated (.34) and low scores for external (-.41), introjected (-.47), and amotivation (-.27) Cluster 2: High Combined (n=274) (moderate scores for intrinsic (.20), identified (.11), integrated (.56) and introjected regulation (1.18) and a moderate score for external regulation (.51) low for AM (-.18)

					Cluster 3: Non-Self-Determined (n=56) (high scores for amotivation (3.7), external (1.16), low introjected regulation (-.24), and low scores for intrinsic (-1.71) and identified regulation (-1.63) and integrated (-1.15) Cluster 4: Moderate (n=306) (moderate scores for all self-regulations). Intrin-AM (-.85, -.95, -.71, -.30, -.05, -.10) Self-Determined (M=293.22,SD7.59), High Combined (M=233.33,SD=9.88), Moderate (M=140.17,SD=9.24), and Non-Self-Determined (M=87.73,SD=21.56) profiles showed the highest to lowest scores on PA outcomes.
Shen, Luo, Bo, Garn & Kulik, (2019, China)	Cross-sectional, self-report	292 undergraduate university students 18-21 (M = 18.8	Behavioural Regulation in Exercise Q 3, International Physical Activity Questionnaire	Two stage cluster via hierarchical cluster and k-means cluster analysis. Test of difference for PA	No quantified means for behavioural regulations. C1 (n=55) low SD/high control - high amotivation & ER, low IM C2 (n=77) low combination - low IM, identified, introjected & EM

				and BMI between profiles.	C3 (n=87) high combination - high IM, IR, ER, extremely high introjected C4 (n=73) high SD/low control - high IM & identified regulation, low ER & AM Cluster 4 (M=56.01,SD=25.17) had significantly higher scores in PA involvement than any other clusters (<.001) but no differences between cluster 1, 2 and 3. Lowest PA cluster was 1 (M=28.04,SD=18.02)
Stephan, Boiche & Scanff (2010, France)	Cross-sectional, self-report, two samples (persistent old women and ceased participation)	574 retired older women aged 58-87, sample 1 (M = 70.88, SD = 6.43 years) sample 2 (M = 71.65, SD = 6.13 years)	Sport Motivation Scale, duration PA per week	Cluster analysis for motivation profiles (hierarchical), one-way ANCOVA for PA participation differences and age	Cluster 1 High combined Motivation (n=45) - high SD (5.41, 5.60), introjected (5.65) and moderate ER (4.29) Cluster 2 High introjected M (n=158) - moderate IM (4.60) & IR (4.71), high introjected (5.32), low ER (1.51) Cluster 3 Moderate introjected M (n=129) - low IM (2.97) & IR (2.97), average introjected regulation (3.78), low ER (1.33)

					Cluster 1 (M=221.6,SD=146.2) more active than cluster 3 (M=166.2,SD=81.1), P<.001 Significant difference between cluster 1 (M=73.26,SD6.10) age and cluster 3 (M=70.72,SD=6.24) age
Zhong & Wang (2019, China)	Cross-sectional, online survey	636 office workers in China (M = 30.50, SD 5.13 years), 249 females and 386 males.	Behavioural Regulation in Exercise Questionnaire 3, Global Physical Activity Questionnaire	Latent profile analysis for motivation profiles. Test of difference for PA between profiles.	P1 Autonomous/introjected motivation profile (n=521) AM (1.30) extrin (2.40) introj (3.04) identi (4.56), integr, (3.96) intrins (4.09) P2 External/amotivation profile (n=115) AM (2.63) extrin (3.06) introj (2.60) identi (3.49), integr, (2.98) intrins (3.08) Profile 1 (M=177.57,SD=142.47) higher PA than profile 2 (M=109.94,SD=147.52), p<.001
Valenzuela, Codina & Pestana (2021, Spain)	Cross-sectional, self-report	423 undergraduate university student, 203 male and 191	Motives for Physical Activity Measure, PA frequency and level	Hierarchical cluster analysis for motivation profiles. Test of difference	Extrinsic motives (n=103) Enjoyment (5.13), competence (5.25), social (2.44), fitness (6.19), appearance (5.46) All motives (n=140) Enjoyment (6.42), competence (6.33), social (5.57), fitness (6.56), appearance (5.92)

	female, 29 no gender. Aged between 18-30 (M=19.91, SD=1.97 years).	between profiles for PA.	Intrinsic motives (n=119) Enjoyment (6.42), competence (5.89), social (5.69), fitness (5.70), appearance (3.63) Low motives (n=61) Enjoyment (5.13), competence (4.04), social (4.00), fitness (4.13), appearance (2.95) Significant difference between profiles on PA (p=.049), profile 3 was most active per week (M=320, SD=365) and profile 1 least active (M=256,SD=266) No difference between profile 2 (M=357,SD=346) and profile 4 (M=360,SD=562)

2.4.3 Study characteristics

The final analysis included twelve studies that met the inclusion criteria for the purpose of this review (table 4b). All studies adopted a cross-sectional design. All studies used self-report measures to collect data, one study used both quantitative self-report methods and qualitative interviews techniques in a mixed methods study (Ferrand, Nasarre, Hautier & Bonnefoy 2012).

2.4.4 Participants

Overall, the twelve studies included a total sample size of 7946 (2515 males and 5778 females). Age ranged from 18-99 years, four of the twelve studies used an undergraduate university student sample (Shen, Luo, Bo, Garn & Kulik, 2019; Valenzuela, Codina & Pestana, 2021; Fernandez, Orcorta, Ferriz, Arbinaga & Garcia-Martinez, 2019; Lindwall et al., 2017), four studies used an older adult sample (Altintas, Guerrien, Vivicorsi, Clement & Vallerand, 2018; Stephen, Bioche & Scanaff, 2010; Ferrand, Nasarre, Hautier & Bonnefoy, 2012; Ferrand, Martinent & Bonnefoy, 2012) and the remaining studies involved adults over the age of 18 years (Friederichs, Bolman, Oenema & Lechner (2015; Friel & Garber (2019; Lindwall et al., 2017; Miquelon, Chamberland & Catonguay (2016; Zhong & Wang, 2019). Two studies used a female only sample (Shen, Lou, Bo, Garn & Kulik, 2019; Stephen, Boiche & Scanff, 2010). Lindwall et al. (2017) compared a sample of middle-aged adults to a sample of undergraduate students.

2.4.5 Outcome measures

Motivational profiles are measured using validated surveys that measure motivational regulations as outlined in SDT or types of motivation, ranging from low to high self-determination (Amotivation, external regulation, introjected regulation, identified regulation, integrated regulation and intrinsic regulation). Several of the measures used have high reliability; Behavioural Regulation in Exercise Questionnaire 2 and 3 were used in six studies (Fernandez-Prcorta, Ferriz, Arbinaga & Garcia-Martinez, 2019; Friel & Garber, 2019; Lindwall et al, 2017; Miquelon, Chamberland & Castonguay, 2016; Shen, Lou, Bo, Garn & Kulik, 2019; Zhong & Wang, 2019). In addition, to measure BREQ measures, the Sport Motivation Scale (Stephen, Boiche & Scanff, 2010; Ferrand, Nasarre, Hautier & Bonnefoy,

2012), Motivation for Exercise (Ferrand, Nasarre, Hautier & Bonnefoy, 2012), Exercise Self-Regulation Questionnaire (Friederichs, Bolman, Oenema & Lechner, 2015), Intrinsic Motivation Inventory (Shen, Lou, Bo, Garn & Kulik, 2019; Friederichs, Bolman, Oenema & Lechner, 2015), Motives for Physical Activity Measure (Valenzuela, Codina & Pestana, 2021). High to low motivation scores were quantified differently based on the measure used: BREQ 2 (Miquelon & Castonguay, 2017)& 3 (Fernández-Ozcorta et al., 2019; Friel & Garber, 2020; Lindwall et al., 2017; Shen et al., 2019; Zhong & Wang, 2019) (scores between 1-5), Elderly motivation scale (mean score of 4 types of motivation) (Altintas et al., 2018), Motivation for Exercise and Sporting activity (Ferrand et al., 2014) (scored between 1-5), Sport Motivation Scale (Ferrand et al., 2012; Stephan et al., 2010) (scored 1-7), Exercise Self-regulation Questionnaire (Friederichs et al., 2015) (scored 1-4), Motives for PA measure (Valenzuela et al., 2021) (scored 1-7). Two papers quantified motivational regulations using z-scores where negative scores represented lower scores than the average of that sample and a positive score was higher than average of that sample (Lindwall et al., 2017; Miquelon et al., 2017).

Physical activity was measured using a range of validated measures; three articles used Godin-Leisure Questionnaire (Friel & Garber, 2019; Lindwall et al, 2017; Miquelon et al 2016), (scored 0-13 insufficiently active, 14-26 moderately active, 26+ sufficiently active). Several papers used either the Nottingham Leisure Questionnaire (Altintas, 2018) (scored 0-60, higher scores = more frequent weekly engagement), Physical Exercise in Leisure (Fernandez et al, 2019) (scored 1-5), Short Questionnaire to Assess Health Enhancing Physical Activity (scored 1-5 on three questions) (Friederichs et al, 2015) or International Physical Activity Questionnaire (scored as MET-minutes/week, high = <1500, moderate <600, low >600) (Shen et al, 2019), Global Physical Activity Questionnaire (Scored using Met-minutes) (Zhong & Wang, 2019). The remaining four studies used ad hoc self-report of physical activity participation and frequency (Ferrand et al, 2012; Stephan et al, 2010; Ferrand & Nasarre et al, 2012; Valenzuela et al, 2021). Ferrand (2012) and Ferrand (2012) scored by total PA minutes per week. Stephen (2010) added the frequency and duration of PA sessions per week in minutes. Valenzuela (2021) scored using total minutes per week.

2.4.6 Analysis methods

Three studies used a latent profile analysis to calculate motivational profiles from the data (Altintas, Guerrien, Vivicorsi, Clement & Vallerand, 2018; Lindwall et al., 2017; Zhong & Wang, 2019) whereas ten studies used a cluster analysis (Fernandez-Orcorta, Ferriz, Arbinaga, Garcia-Martinez, 2019; Ferrand, Martinent & Bonnefoy, 2012; Friederichs, Bolman, Oenema & Lechner, 2015; Friel & Garber, 2019; Miquelon, Chamberland & Catonguay, 2016; Shen, Luo, Bo, Garn & Kulik, 2019; Stephan, Boiche & Scanff, 2010; Valenzuela, Codina & Pestana, 2021; Ferrand, Nasarre, Hautier & Bonnefoy, 2012. For differences between motivation profiles and physical activity levels (per week), a range of methods were used depending on the analysis method for the profiling. Three studies used a one-way Multivariate Analysis of Variance (MANOVA) to test the relationship between profiles and physical activity levels (Altintas, Guerrien, Vivicorsi, Clement & Vallerand, 2018; Ferrand, Martinent & Bonnefoy, 2012; Friederichs, Bolman, Oenema & Lechner, 2015; Shen, Luo, Bo, Garn & Kulik, 2019). Remaining studies used either a t-test (Fernandez-Orcorta, Ferriz, Arbinaga, Garcia-Martinez, 2019), pairwise profile comparisons (Lindwall et al., 2017), Analysis of Variance (ANOVA) (Zhong & Wang, 2019), Multi-variate Analysis of Covariance (MANCOVA) (Miquelon, Chamberland & Catonguay, 2016) or Analysis of Covariance (ANCOVA) (Stephan, Boiche & Scanff, 2010; Ferrand, Nasarre, Hautier & Bonnefoy, 2012) methods to explore differences in PA levels between profiles.

2.4.7 Motivational profiles

The number of profiles in all thirteen studies ranged from a minimum of two to a maximum of six profiles. Five studies identified two distinct motivational profiles (Fernández-Ozcorta et al., 2019; Ferrand et al., 2012, 2014; Zhong & Wang, 2019), two studies identified three motivational profiles (Friederichs et al., 2015; Stephan et al., 2010), four studies identified four motivational profiles (Altintas et al., 2018; Miquelon & Castonguay, 2017; Shen et al., 2019; Valenzuela et al., 2021), one study identified five motivational profiles (Friel & Garber, 2020), and one study identified six profiles (Lindwall et al., 2017). Four distinct profiles were found in at least six of the studies: a high self-determined profile and a low controlled profile was found in nine studies. A high combined profile was found in ten studies. A low self-determined/high controlling profile was found in eight studies and a low motivation/amotivated profile was found in six studies.

2.4.8 High and low self-determined profiles

All twelve studies identified a profile high in self-determined motivation, scoring high on autonomous motives of intrinsic regulation, identified and integrated regulation, though studies varied in classifying controlled motives, as shown in table 4b. Eight studies in total identified high self-determined profiles defined as scoring high on self-determined or autonomous types of motivation (intrinsic, identified and integrated regulation) and low on controlled motives (introjected, external and amotivation) (Altintas et al, 2018; Fernandez-Orcorta, 2019; Friederichs et al, 2015; Friel & Garber, 2019; Lindwall et al, 2017; Miquelon et al, 2016; Shen et al, 2019; Valenzuela et al, 2021). In five studies, profile membership total within the self-determined profiles (high autonomous and low controlled) was highest (Altintas, 2018; Fernandez-Orcorta, 2019; Ferrand, 2012; Friederichs, 2015; Miquelon, 2016). This did not differ depending on population; for example, within these high self-determined, low controlled profiles, two studies used an older adult sample (Altintas, 2018; Ferrand, 2012), one study used an undergraduate student sample (Fernandez-Orcorta, 2019) and three studies used an 18+ adult sample, with a mean age of 44 years (Friederichs, 2015) and 34 years (Miquelon, 2016). One paper reported the lowest number of participants (n=29) was the high self-determined/low controlled profile (Lindwall et al., 2017) in a sample of university students.

Eight studies with high self-determined profiles, reported high intrinsic, identified, and integrated regulation and high introjected regulation with moderate or low extrinsic regulation (Ferrand, 2012; Stephan, 2010; Zhong & Wang, 2019; Ferrand, 2012; Friel & Garber, 2019; Lindwall, 2017; Miqueleon, 2016; Shen, 2019). Such profiles with high introjected regulation were commonly referred to as high combined profiles.

Five papers in total reported profiles high in self-determined motives and introjected regulation (combined profiles) with the largest number of participants (Friel & Garber, 2019; Lindwall, 2017; Shen, 2019; Stephan, 2010; Zhong & Wang, 2019) whereas two papers found this profile to have the lowest number of participants (Lindwall, 2017; Stephan, 2010). All papers reporting a high combined profile (high self-determined and high introjected) differed in terms of population sample. Three studies used an older adult sample (aged 65+)

(Ferrand, 2012; Stephan, 2010; Ferrand, 2012), four papers used an adult sample with a mean age of 35 years (Friel & Garber, 2019), 45 years (Lindwall, 2017), 34 years (Miqueleon, 2016) and 30 years (Zhong and Wang, 2019).

Eight of the twelve papers reported a low self-determined profile, characterised as low to moderate self-determined motives and high non-self-determined motives (Altintas, 2018; Fernandez-Orcorta, 2019; Friederichs, 2015; Friel & Garber, 2019; Lindwall, 2017; Miquelon, 2016; Shen, 2010; Valenzuela, 2021). In addition, four papers reported a profile of low overall motivation, characterised by low to moderate external regulation and scoring low on the remaining regulations (Friederichs, 2015; Friel & Garber, 2019; Lindwall, 2017; Zhong & Wang, 2019). Two papers reported profiles named moderately introjected (low intrinsic, moderate introjected and low external) (Ferrand et al, 2012; Stephan et al, 2010). Four papers identified profiles with the lowest participant membership were categorised as low in self-determination (low to moderate self-determined motives and high non-self-determined) (Altintas, 2018; Miquelon, 2016; Shen, 2019; Zhong & Wang, 2019) and the two remaining papers reported profiles with the lowest participant membership as low overall motivation profile (Friederichs, 2015; Valenzuela, 2021). All papers identifying a low motivation profile used sample populations of adults with a mean age of 44 years (Friederichs, 2015), 35 years (Friel & Garber, 2019), 45 years (Lindwall, 2017), 30 years (Zhong & Wang, 2019).

2.5 Study findings

2.5.1 Physical activity level and motivational profiles

All of the studies found a significant difference in physical activity levels between profiles, as displayed in table 4b. Nine of the twelve papers indicated that profiles high in self-determined motivation (intrinsic, integrated and identified) and low in non-self-determined motivation (introjected and external) displayed the highest levels of physical activity (Fernandez-Orcorta et al, 2019; Shen et al, 2019; Valenzuela et al, 2021; Altintas et al, 2018; Ferrand et al, 2012; Friederichs et al, 2015; Miquelon et al, 2016; Lindwall et al, 2017).
In terms of demographics, all three papers using an undergraduate population found that highest levels of physical activity were associated with profiles high in self-determination

and low in controlled motives (Fernandez-Orcorta et al, 2019; Shen et al., 2019; Valenzuela et al, 2021). Two papers using an adult population found those with a high in self-determination and low in controlled motives profile reported highest levels of physical activity (Altintas et al, 2018; Ferrand et al, 2012). Two papers using an adult population with a mean age of 44 (Friederichs et al, 2015) and 34 (Miquelon et al, 2016) found that profiles high in self-determined motives reported highest levels of physical activity.
In addition, five papers found evidence for profiles high in self-determination, high in introjected regulation and low in non-self-determined motives engaged in highest levels of physical activity (Ferrand, 2012; Friel & Garber, 2019; Lindwall, 2017; Stephan, 2010; Zhong & Wang, 2019; Ferrand, 2012).

Two papers using an older adult sample reported individuals in a high combined profile (high intrinsic, integrated and introjected) engaged in the largest amount of physical activity (Stephan et al, 2010; Ferrand et al, 2012). Three papers using an adult sample with a mean age of 35 (Friel & Garber, 2019), 45 (Lindwall et al, 2017) and 30 (Zhong & Wang, 2019) found that individuals in the high autonomous motivation and high introjected regulation profile reported highest levels of physical activity. High physical activity levels were associated with high intrinsic, identified and integrated regulation. Though just under half of the papers in the adult and older adult samples engaged in the highest physical levels in profiles reporting high introjected regulation.

Profiles associated with the lowest levels of physical activity scored low on self-determined types of motivation (intrinsic, integrated and identified) and high on controlled motives (introjected and external) in ten papers consisting of varying populations (Altintas et al, 2018; Fernandez-Orcorta et al, 2019; Friederichs et al, 2015; Friel & Garber, 2019; Lindwall et al, 2017; Miquelon et al, 2016; Shen et al, 2019; Zhong & Wang, 2019; Valenzuela et al, 2021; Ferrand et al, 2012). Two papers found profiles named moderately introjected (low intrinsic, moderate introjected and low external) as engaging in the least amount of physical activity (Ferrand et al, 2012; Stephan et al, 2010), both populations being older adults.

Table 6. p values for test of difference between profiles on demographic information

		P value for test of difference between profiles				
Author	Physical activity	Age	Gender	Educational attainment	Ethnicity	BMI
Altintas et al., 2018	.010*	.94	N/A	N/A	N/A	N/A
Fernandez et al., 2019	.001**	N/A	N/A	N/A	N/A	N/A
Ferrand et al., 2012	.020*	.53	.48	.42	N/A	.69
Friederichs et al., 2015	.001**	.79	.80	.01	N/A	.001**
Friel & Garber, 2019	.001**	.08	.137	.173	.252	.001**
Lindwall et al., 2017	Sample A .010* Sample B .010*	N/A	N/A	N/A	N/A	N/A
Miquelon et al., 2016	.001**	ns	.018*	N/A	N/A	N/A
Shen et al., 2019	.010*	N/A	N/A	N/A	N/A	.04*
Stephan et al., 2010	.030*	.02*	N/A	N/A	N/A	N/A
Zhong & Whang et al., 2019	.001**	N/A	N/A	N/A	N/A	N/A
Valenzuela et al., 2021	.020*	N/A	N/A	N/A	N/A	N/A
Ferrand et al., 2012	.010*	ns	N/A	N/A	N/A	ns

Note: N/A represents no data/no difference test was conducted for that variable.

Ns represents no significant finding but author did not report the p value.

*<.05 **<.001

2.5.2 Differences in demographic information (age, gender, education, ethnicity and BMI)

Six studies tested the difference between profiles on age (Altintas et al., 2018; Ferrand et al., 2012, 2014; Friederichs et al., 2015; Friel & Garber, 2020; Stephan et al., 2010), with one study finding a significant difference (Stephan et al., 2010) whereby participants in the high combined cluster were significantly older than the high introjected and moderate introjected

cluster (p=.05). Three studies tested differences between profiles on gender (Ferrand et al., 2012; Friederichs et al., 2015; Friel & Garber, 2020). Friederichs (2015) found a significant between profile difference in educational attainment whereby individuals in the autonomous profile where more highly educated and individuals in the controlled profiles were least educated (p=.01). Three studies tested between profile difference on educational attainment (Ferrand et al., 2012; Friederichs et al., 2015; Friel & Garber, 2020) and no significant differences were found. One study tested between profile differences on ethnicity (Friel & Garber, 2020) and no significant difference was reported. Five studies tested differences between profiles on BMI (Ferrand et al., 2012, 2014; Friederichs et al., 2015; Friel & Garber, 2020; Shen et al., 2019), two studies reported significant differences. Friederichs (2015) found BMI was significantly different between profiles and highest in profile 3 and lowest in profile 1 (p<.001). Friel & Garber (2020) found significant between profile differences on BMI whereby the high amotivation (29.33) and low motivation (29.63) profiles had the highest BMI and autonomous with high introjected (25.58) and autonomous with low introjected (26.82) had the lowest BMI (<.001). Test significance values are displayed in table 6.

2.6 Discussion

The present systematic literature review sought to examine the empirical literature on physical activity motivational profiles, associated patterns of physical activity levels and differences between groups on demographics. Motivational profiles are a relatively new but expanding concept within physical activity research with many studies included in the review (8 of the 12) being published in the last five years. A review was necessary to address the inconsistencies in the literature regarding number of potential profiles, as such information would be beneficial to address research to practice gaps. Results found that just under 40% of the included papers (5 of 12) reported two motivational profiles and 23% (3 of 12) reported four profiles indicating that categorising people into between 2 and 4 different profiles is most realistic. One study reported six motivational profiles (Lindwall et al., 2017), however their study involved two different populations of interest and some profiles were unique to samples whereas some were found in both. Quantifying the average number of motivational profiles is necessary to both inform and update the current literature.

Identifying motivation profiles that are ubiquitous to all populations that people can be categorised into is crucial to further develop understanding of the determinants of each profile and what facilitates or hinders physical activity behaviour.

In addition to identifying all population profiles, population specific profiles may be informative for intervention development. The identification of profiles and consideration of objective criteria (age, gender) from a diagnostic and intervention designing perspective have the potential to be advantageous as information on each profile type may be instructive to know whether a person is motivationally at risk, characterised by low motivation and associated with less desirable outcomes, such as low physical activity or attrition. Therefore, the presence of motivational deficits in PA may put people in a vulnerable position for PA sustainability. However, there is currently no research that we know of that has assessed or utilized motivational profiles in real life PA interventions.

The current review included studies that were systematically chosen and deemed appropriate to address the research questions, many with large sample sizes. Therefore, profiles most commonly emerging from the studies can be generalised to the general population which is an advancement of this research area. The most common emerging profiles emerging from all papers were: high self-determined profile (characterised by high autonomous and low controlled motives), high self-determined and introjected or combined profile (high autonomous and introjected and low controlled motives), low self-determined profile (high controlled and low autonomous motives) and a moderate profile (moderate levels of all controlled and autonomous motives).

The current findings are in support of SDT and reflect that higher physical activity engagement is associated with profiles high in self-determined motivation, such as intrinsic, identified and integrated regulation. In relation to the motivational profiles identified, all twelve studies identified a profile high in self-determined motives and low in controlled motives. These findings support the current literature whereby autonomous and controlled motives tend to be disconnected, particularly in relation to longevity of physical activity behaviour (Ednie & Stibor, 2017; Standage et al., 2008; Teixeira et al., 2012) and therefore it is unsurprising that all of the included papers reported a profile high in autonomous and low

in controlled motives as the different types of motives are rarely linked. In relation to physical activity levels, individuals in this profile engaged in significantly larger amount of physical activity compared to other profiles, thus clarifying consistent relationships in the literature between autonomous motivation and physical activity engagement (Hagger, 2012). These findings were evident in the different populations of interest, for example, Altintas et al (2018) used an elderly population and individuals in a high self-determined profile were much more active (M=21.26) than those in the moderate profile group (M =11.31). Friederichs et al (2015) used a general adult population and found those in the high autonomous profile (M=537) were more active on average than the low motivation profile (M=362). Lastly, in an undergraduate sample, the intrinsic motive profile reported higher physical activity levels (M=320) than the extrinsic motives profile (M=256). These results were consistent throughout all the studies which corroborates previous findings on autonomous motivation and physical activity levels.

As autonomous motivation is related to more favourable outcomes on physical activity behaviour, such as increased frequency, duration and intensity (Duncan et al., 2010) whilst simultaneously increasing positive emotions, perceived competence and high reflective self-endorsement (Teixeira et al., 2012), it would be advantageous to endorse autonomous motivation to combat levels of inactivity, though this notion is extremely complex. Autonomous motivation is often developed overtime and rarely the dominant drive for a novice's engagement in exercise (Rodgers et al., 2010). Research suggests that autonomous motives that are not reliant on enjoyment and satisfaction, such as integrated regulation, may promote greater need satisfaction and endorsement thus contributing to long term adherence (Wilson et al., 2007). Specific profiles may reveal information about physical activity behaviour that can lead to tailoring motivating styles according to a person's motivational profile. For example, SDT states that social contexts nurture an individual's engagement and motivation (Ryan & Deci, 2000b) but enhancing a person's engagement, wellbeing and performance may be dependent on a person's motivational profile type. Individuals within a controlled profile will likely require specific focus on increasing need satisfaction, particularly feelings of competence and autonomy. Psychological need satisfaction is associated with exercise adherence (Eynon et al., 2019; Leisterer & Gramlich, 2021) and ensuring individuals are engaging and adhering to exercise is of high importance,

thus distinguishing between specificities in profiles that may enhance a person's likelihood of adherence should be further explored. In addition, relying on other psychological processes such as habits are proven to be beneficial, particularly when motivation is low (Gardner & Lally, 2013), however these processes also rely on consistent engagement and for individuals with limited experience in physical activity participation, such processes alone may not be substantial for maintaining exercise. To consider all of these processes, further longitudinal exploration is needed, as motivational profiling can reveal motivational trajectories that may describe a person's development over time (Vansteenkiste & Mouratidis, 2016).

The current review highlights that high levels of physical activity are dependent on several motivational regulations, not necessarily following the pattern proposed in the SDT continuum whereby controlled and autonomous motives are considered opposing ends of the continuum. A second profile that displayed high levels of physical activity in a significant number of papers (5 of 12) was a profile high in self-determined (intrinsic, identified and integrated) and high in introjected regulation, namely, a high combined profile. Traditionally, introjected regulation is considered a controlling motive, alongside external regulation, and therefore thought to motivate behaviour in the short term but hinder physical activity behaviour over longer periods of time (Ryan & Deci, 2000a; Thøgersen-Ntoumani & Ntoumanis, 2006). Introjected regulation is less controlling than external regulation meaning the intrapersonal conflicts that hinder volitional resources such as sustaining effort, occur less so with introjected regulation as the behaviour is partially internalised (Silva et al., 2010). In relation to the high self-determined high introjected motivational profile, for introjected regulation to facilitate physical activity behaviour it seems there must be an element of autonomy and volition, otherwise the internal conflicts derived from introjection will eventually thwart sustained effort and longevity of behaviour (Gillison et al., 2009). Introjected avoidance and introjected approach are statistically different from one another in terms of physical activity engagement, whereby a person motivated to exercise because they feel prideful or improve self-esteem is more predictive of physical activity engagement than feelings of avoiding guilt. It is perhaps the introjected approach, associated with positive feelings, that is not considered to be maladaptive (Ntoumanis et al., 2010). Gillison and colleagues (2009) found that introjected regulation was associated with highly adaptive

levels of physical activity without any negative effects when co-existing with self-determined motivation which is a necessary process of internalising physical activity motivation. Therefore, introjected regulation, particularly introjected approach, when supplemented with high levels of self-determined motivation (as seen in the high self-determined and introjected profile) may not hinder exercise behaviour and actually facilitate it, an important finding to present when applying this research to practice. Many physical activity interventions highlight the importance of autonomous motivation and the detriment of controlled motivation, whereas it seems introjected regulation could be used to facilitate the internalisation of physical activity in becoming more volitional over time. For example, SDT instructional interventions had a positive effect on intrinsic and identified regulation and a negative effect on external regulation (Manninen et al., 2022). However, approach and avoidance were not specially tested in any of the included studies and a majority of the measures used are based on introjected avoidance (e.g., BREQ-3) which makes it difficult to interpret the connection. In future, researchers would benefit from directly measuring both introjected avoidance and approach in reference to physical activity behaviour. When considering how research on motivational profiles specifically can inform intervention work, it is suggested that stakeholders or intervention designers would benefit from a design that supports a transition from low quality to more adaptive motivational profiles, for example, by protecting peoples enjoyment and making them feel valued, which might involve developing a sense of identity or belonging (Saward, Harrison, Healy & Sarkar, 2023). Whilst this may be difficult to inhabit from a whole population approach, this could also be instilled by the motivational climate of physical activity from promotion campaigns and health bodies to remove the focus on external outcomes (such as weight loss) and shift the focus on improvement, enjoyment and the long-term value of being active.

It was important for this review to compare the number of studies that tested the differences between demographic tendencies. Only one study tested the differences between all five demographic variables (age, gender, ethnicity, education and BMI) (Friel & Garber, 2020) meaning all other studies did not justify for cofounding variables, a limitation of the studies. It is plausible that motivational profiles differ within populations of individuals, further highlighting the need to adopt person-centred approaches over variable centred. Chemoli and Gagne (2014) argue a person is not only on one location of the SDT

continuum at any given time and the theory should reflect that individuals engage in behaviours for multiple reasons. This is necessary to determine which patterns of motivational profiles are in need of behaviour change methods that can be effectively instilled.

In the current review, profiles in function (i.e., high self-determined, low self-determined, high combined) did not differ and were prevalent in all populations, displaying that profiles are both stable across samples and universally generalizable. However, some demographic differences were found among physical activity levels and motivational profiles. Firstly, highest physical levels were associated with profiles high in self-determined motivation and low in controlled (introjected and external) in all undergraduate students papers, in support of previous research whereby students physical engagement in males was more self-determined (Sáez et al., 2021). This consistency suggests that individuals at university, a population particularly vulnerable to being less active due to a number of lifestyle changes (Kljajević et al., 2022), possess motivation high in self-determination equating to higher levels of physical activity engagement. However, for the elderly and middle-aged adult samples, high physical activity participation was associated with profiles either high in self-determined motives and low in controlled or high in self-determined and high in introjected motives. The differences between populations are unsurprising, particularly as older adults represent a unique cohort of individuals whereby maintaining physical activity for health reasons and is likely to be of higher importance and different to that of undergraduate or middle-aged adults, for example to improve mobility, function and quality of life (Solberg et al., 2014). Stephan (2010) found that individuals in the high introjected profile were significantly older than those in the moderate profile. Results suggest that this sample of elderly women are motivated by internally imposed controls related to the self, though need to be combined with autonomous motives (such as intrinsic motivation) about physical activity for participation to remain high. Perceived competence of ability decreases as individuals age, particularly in relation to exercising (Overdorf et al., 2016) and therefore improving perceptions of competence and choice towards performing exercise is important. though all individuals in this sample were older adults and female, and the results may be specific to this population, which should be investigated further.

One study found that individuals in the autonomous motivation profile were more highly educated than those in the controlled motivation profile (Friederichs et al., 2015). Research does suggest that PA level and engagement is dependent on educational attainment (Droomers et al., 2001) but the literature fails to clarify whether lower educational attainment actually causes lower PA levels. Further investigation is needed to prevent socioeconomic differences in physical activity.

In relation to BMI, two studies found that profiles high in autonomous motivation had significantly lower BMI than those with low motivation or high in controlled motivation (Friederichs et al., 2015; Friel & Garber, 2020), this is excepted given that profiles high in autonomous motivation are linked with higher levels of PA, it can be assumed that individuals within these profiles have a healthier BMI due to engaging in more PA on a weekly basis. In comparison to those with low motivation or more controlling motivation, individuals are less likely to express a need or want to engage in PA resulting in an unhealthier BMI. Three studies found no significant difference in BMI between profiles which warrants further investigation.

Indeed, we know that individual differences exist in a person's preference to engage in a particular type of activity in relation to motivational regulations (Lewis & Sutton, 2011). Therefore, future research should aim to examine the distinct motivational styles between populations to understand differences further and perhaps address differences beyond the scope of this review such as personality or situational influences. These results present an opportunity to direct intervention designing for specific demographic groups, largely related to gender and age. However, person-centred analyses do risk the problem of reification and assuming that each person in a subgroup has a certain probability of group membership, it is likely that people may shift to different groups overtime and therefore group membership based on objective criteria (gender or age) should be viewed as probable as opposed to determined.

2.6.1 Strengths and limitations

There is potential methodological weakness in the studies described and it remains unclear the causation of the relationship between profiles, for example the profiles high in self-determination may have higher physical activity levels due to being autonomously motivated or increased physical activity levels overtime may have increased autonomous motivation. Due to measurement at one time point, the exact relationship between the two variables is difficult to infer. More recently, during an 18-month weight loss intervention study involving 6 months of supported exercise and 6 months unsupported exercise, three motivational profiles were found (high autonomous, high combined and moderate combined). No differences emerged across motivational profiles in baseline or change in physical activity during 6 months of supervised exercise, however, individuals in the autonomous profile (high in identified and intrinsic motivation) were most likely to sustain physical activity during unsupervised exercise (Ostendorf et al., 2021). These findings support that profiles high in self-determined motivation are predictive of long-term engagement, in comparison to profiles with controlling motives. When exercise was supervised, all individuals engaged but when the controlling element was removed and exercise was no longer supervised, the profiles with controlling motives dropped out, which aligns with the current literature. This presents some evidence of a motivational trajectory and is limited in the literature and therefore presents key novel findings. However, the sample size was relatively small (N=169) in comparison to cross-sectional studies using samples with over 2000 participants (Friederichs et al., 2015) and should be interpreted with caution. In addition, the methods used only measured physical activity levels longitudinally and motivational profiles were measured at baseline. No research has explored whether or not a person's motivation profile changes over time, particularly when transitioning from adoption to maintenance though it is highly likely that a person will shift to a different group depending on contextual motivational support or thwarting of needs (Vansteenkiste & Mouratidis, 2016). Second, a number of the studies used cluster analysis, which in comparison to latent profile analysis is deemed less accurate as it is based on finding clusters with an arbitrary chosen distance measure. Latent profile analysis is a probabilistic model that describes the distribution of the data based on the probability that certain cases belong to certain latent classes (Teas et al., 2019). Therefore, latent profile is perceived to be more appropriate for motivation profiles

as it uses a top-down approach as opposed to a bottom-up approach whereby you find similarities between cases.

Regarding gaps in the literature, all studies in the current review used samples specific to age, all of varying physical activity levels. There is a lack of exploration into motivation profiles comparing individuals of varying activity levels (E.g., inactive, initiate and maintenance exercisers). Understanding whether there are substantial differences between types of profiles and/or function of profile between activity levels may contribute a unique perspective to the topic of study. This research is necessary to determine which individuals, demographically, require exercise interventions but also to determine how such interventions can be developed and function in a way that benefits individuals in different profiles. For example, a person scoring high on avoidance introjected would likely benefit from interventions aiming to challenge the avoidant feelings and favouring the pursuit of enjoyment and acknowledgement of its usefulness, thus removing the external pressures. Future research would also benefit from exploring the multidimensionality of introjected regulation and using measures of data collection that constitute both positive and negative introjected.

2.6.2 Future directions

Future directions should continue to explore how specific motivational profiles impact physical activity longitudinally and within populations of varying physical activity levels. As discussed, motivational profiles can build understanding on the motivational trajectories, particularly within groups, that can be used to predict important outcomes related to exercise behaviour such as stability of persistence and likelihood of sustainability over the long term. Longitudinal studies would allow exploration into changes in an individual's profile membership over time and the factors that impact such changes. The physical and psychological effects of regular physical activity, particularly for inactive individuals, is well evidenced and therefore using the information provided by motivational profiles research to develop new and sustainable ways for individuals to adhere to a physically active lifestyle is hopeful.

The present review has several strengths and limitations. Strengths include a rigorous and systematic methodology that was prospectively registered with PROSPERO. All papers were relatively new and conducted within the last 20 years, between 2004-2021. This is the first systematic review on motivational profiles that explored physical activity levels and therefore the results could strengthen the evidence-base for research in this field. All studies were judged to be strong in quality of reporting in the context of cross-sectional designs. Due to the pre-set exclusion criteria, the review was subject to publication and language bias and did not include unpublished studies or studies that were not in the English language thus excluding some relevant evidence. Exclusion of specific populations such as clinical samples impacted the number of papers included in the review though this was justified and may be an avenue to explore in the future.

2.6.3 Conclusions

The findings of this review revealed that between two and four stable motivational profiles are evident in populations of undergraduate students, middle aged and older samples, however, only profiles high in self-determination and low in controlled or high in self-determination and high in introjected regulation are associated with high physical activity levels. This was particularly the case in middle and older adults suggesting that introjected regulation may play a key role in physical activity engagement, when co-existing with autonomous motivation. The exploration of introjected regulation should be expanded in future research, particularly the role of high introjected regulation and autonomous motivation profiles and longevity of physical activity. The review does not indicate whether individuals in the high self-determined/high introjected profiles, with higher physical activity levels, continue participation over a longer period of time which is what the ultimate goal of physical activity participation should be. Ultimately, the development of successful physical activity initiatives for less active populations is key and this review has provided a synthesised understanding of the literature to distinguish between different types of motivational profiles and their prospective impact on physical activity levels. Future research should prioritise exploring the stable motivational profiles identified longitudinally.

Chapter 3: Quantitative study methods, results and discussion

3.0 Overview

In this chapter, I will outline the methods present the results of the quantitative studies and discuss findings for research questions 1 and 2. I begin by describing the ways in which I collected and analysed the quantitative data appropriately and meaningfully for the project. This will include information on the design, participants, measures, procedures, and statistical analysis. I aim to provide a detailed justification throughout each section of why I adopted the chosen methodology and its purpose for the nature of this project. Next, I will present the statistical results for both research questions before discussing the research findings in the following chapter.

The research questions in this chapter are:

1) What are the physical activity motivational profiles from a general adult population and a sample of community-driven exercise initiative members.

2) Can motivational profiles moderate the relationship between physical activity levels and habits?

3.1 Quantitative methodology

3.1.1 Design

Study 1 and 2 adopted a cross-sectional design by distributing a single online survey to participants. Parts of the survey response data were also used in study 3, in concurrence with qualitative data. The project originally proposed a longitudinal design whereby participants were going to complete the same survey concurrently over the period of 9 months, however, due to the delay in research progression and accessing participants as a result of the COVID-19 pandemic, it was decided that to ensure the project could be completed, that a cross-sectional design would be appropriate. The survey was distributed using the online survey tool, BISC OnlineSurveys. This platform was designed specifically for academic research and public sector organisations and was an appropriate tool used to create and distribute surveys to participants with ease of completion. OnlineSurveys allows

researchers to create surveys as simple or complex as needed with adaptable features for alternative survey questions (e.g., Likert Scale, rating questions, open-ended questions).

3.1.2 Participants

3.1.2a Study 1

295 participants in study 1 were recruited online through Prolific Academic, a crowd sourcing web platform used to recruit participants for online research and paid £3.00 for their time. Recruitment began on 4th July 2022 and was closed 31st August 2022. Prolific Academic accounts for missing data by only paying participants when full surveys are completed, meaning there were no missing data for this population. Participants were required to be over the age of 18 years old and living in the United Kingdom to be included and were only able to complete one survey. Participants included 295 adults (59 males, 232 females and 4 non-binary individuals) between 18 and 71 years (M=35.97, SD=11.72).

3.1.2b Study 2 Participants in study 2 were recruited from BeStrong, a physical activity and lifestyle community initiative in Blackburn, North England. BeStrong is a group-based exercise initiative that supports the journey of physically inactive individuals to becoming active. Before COVID-19, BeStrong had around 530 members, however, the repercussions of the pandemic caused many members to cancel their membership. Recruitment began in December 2020 and ended August 2022. Inclusion criteria where participants must be aged 18 years or over, there were no top end age restrictions, and current members of BeStrong, gaps in memberships were accepted but current active membership was necessary so data could be measured in real time as opposed to retrospective. Participants included 132 adults (11 males and 121 females), between 23 and 71 years old (M = 47.41, SD = 10.50).

3.1.2b Measures

Demographics

Participants were asked to self-report their age (years), gender (e.g., male/female/nonbinary) ethnicity/race (Asian/Asian British, Black/African/Caribbean/Black British, Mixed/Multiple ethnic groups, White Caucasian, Prefer not to say), highest level of education (Doctorate degree, Master's degree, Bachelor's degree, Trade/technical/vocational training, college graduate, diploma or equivalent, A-Levels, GCSE's, other), and their current weight in kilograms and height in meters.

Physical activity levels

To measure PA levels, the Godin Leisure-Time Physical Activity Questionnaire (Godin, 2011) was used which reports typical weekly frequency of leisure-time strenuous (heart beats rapidly), moderate (not exhausting) and mild/light (minimal effort) physical activity in bouts of 15 minutes or longer. Participants were asked to report based on a typical 7-day period. For example, "During a typical 7-Day period (a week), how many times on average do you do the following kinds of exercise for more than 15 minutes during your free time (write the appropriate number). STRENUOUS EXERCISE (heart beats rapidly): e.g., running, high intensity interval training, football, vigorous swimming, high impact strength training". Validity and reliability have been demonstrated by Amireault and Godin (2015) whereby a large to moderate effect was found, when reporting Cohen's d measure of effect sizes (Cohen, 1992). (d =0.77). VO2max, body fat percentage and electronic records of fitness centre attendance were used to validate variables. In test-retest assessments, satisfactory Cohen's Kappa (k) coefficients were obtained at two time points, 15 days (0.65) and 30 days (0.45). Scores were calculated by multiplying each frequency and intensity of exercise in a typical week by its corresponding Metabolic Equivalent of Task (MET) value (mild exercise score x 3, moderate score x 5 and strenuous score x 9). Scores for mild, moderate and strenuous activity were added to get the leisure score index which is used to distinguish whether participants are sufficiently active, moderately active or insufficiently active. People who report ≥24 of moderate to strenuous leisure score index are classed as sufficiently active (meeting the recommended PA guidance and gaining sufficient benefits from PA), those who reported 14-23 are moderately active (not meeting the recommended PA guidelines but gaining some benefits from PA) and those who scored ≤14 are insufficiently active (sedentary and gaining less than substantial benefits from activity). Scoring was followed using Godin (2011) scoring scale. Tests of validity for this calculation found a moderate to large effect against Cohen's d standard (Cohen, 1992) (d = 0.77) (Amireault and Godin, 2015).

Exercise motivation

Exercise motivation was measured using the Behavioural Regulation in Exercise Questionnaire-3 (BREQ-3) (Mullan, 1997). The BREQ-3 is a 24-item scale that measures the six subscales of amotivation, external regulation, introjected regulation, integrated regulation, identified regulation and intrinsic regulation. Participants respond on a 5-point Likert scale ranging from 0 (not true for me) to 4 (very true for me) how true the items listed were regarding their reasons for engaging in exercise. The measure included 4 items for each of the six subscales. Example items for the subscales include: Amotivation, e.g., "I don't see why I should have to exercise", External Regulation, e.g., "I exercise because other people say I should", Introjected Regulation, e.g., "I feel guilty when I don't exercise", Identified Regulation, e.g., "It's important for me to exercise regularly", Integrated Regulation, e.g., "I exercise because it is consistent with my life goals", Intrinsic Regulation, e.g., "I exercise because it is fun". Mean scores for each set items in the BREQ-3 survey were calculated, there were 4 items for each of the six motivational regulations. Subscale reliability and factor structure for BREQ-3 was supported by Mullan and colleagues (1997), Cronbach's $\alpha \geq .70$. In addition, the ability of BREQ-3 scores to distinguish between physically active and inactive groups was deemed appropriate (Landry & Solomon, 2004).

Physical activity habits

Habit strength was assessed with the Self-Report Behavioural Automaticity Index (SRBAI) (Gardner, 2012), a subscale of four items from the Self-Report Habit Index that has been identified to reliably measure automaticity (Gardner, Abraham, et al., 2012). The scale was used to assess behavioural automaticity of physical activity behaviour and participants indicated to what extent they agree by rating 1 to 5(1 = strongly disagree to 5 = strongly agree). Following the statement, "physical activity is something...": (1) "I do automatically", (2) "I do without having to consciously remember", (3) "I do without thinking", and (4) "I start doing before I realise, I am doing it". Mean scores for the 4 items on the habit scale were calculated to give an automaticity score. The SRBAI is reliable, and valid with evidence supporting its convergent and predictive validity (Gardner, Abraham, Lally & de Bruijn, 2012).

3.1.3 Procedures

3.1.3a Study 1

Interested participants from Prolific Academic were directed to the online survey and were asked to read the participant information and provide informed consent before completing the survey on the next page. Eligible participants gave their consent to participate at the beginning of the survey and if consenting "yes" proceeded to complete the survey. Surveys were estimated to take a maximum of 15 minutes. The survey contained 37 questions. Participants were paid £3.00 after full completion of the survey meaning if any respondents did not complete an acceptable amount of the survey they were removed, and their place was re-recruited. This ensured maximum power of responses.

3.1.3b Study 2

All current and new members of BeStrong (community sample) were sent study information and a link to the survey in an email from the founders. Members were asked to follow the link to the survey and follow the instructions. To gain informed consent, participants needed to read the participant information and confirm their participation in the research. Using the same survey as study 1, which lasted around 15 minutes and contained 37 questions. At the end of the survey, participants were given the option to enter a prize draw with the potential to win a £100 Amazon gift voucher for 5 randomly selected participants. Participants were also asked to leave their email address if they were interested in being involved in a semi structured interview to expand on survey responses.

3.1.4 Ethics

Prior to collection of data, permission to conduct the study was approved by the University of Leeds Faculty of Biological Sciences Ethics Committee (ref BIO-SCI 19-033). Amendments to the original ethics application were approved to include recruitment from Prolific Academic as this was not originally planned when designing this study, but due to COVID-19 and the difficulty in gaining a substantial sample size from BeStrong such changes were deemed necessary to increase power of the study. Ethics were first accepted in June 2020 and application for an amendment to recruit from Prolific Academic were accepted in April 2022.

3.1.5 Statistical Analysis

Very little research has assessed the sample size adequate for a highly powerful latent profile analysis and according to the literature, there is no formula to estimate the required sample size (Mathew & Doorenbos, 2022). One study found that the effect of sample size on power was minimal and larger sample sizes did not equate to results with higher statistical power. Sample size was specifically unrelated to power for AIC and Entrophy (Tein, Coxe & Cham, 2013). Research has also found that some model classifications (e.g., Entrophy) perform well under small sample sizes (50-100) (Wang et al., 2017). A general rule of thumb is a sample of 250 or more participants is considered powerful, though there is no research to say that samples less than this lack power.

A G-power calculation was conducted for the sample size of the moderation analysis. For a two tailed test a sample of 395 was needed.

3.1.6 Data cleaning and manipulation

Several procedures were used to clean and prepare the data for analysis. Raw data sets for both samples were cleaned in terms of changing label names, removing questions based on ID and consent. Whilst it may be considered implausible to score extremely low (e.g., zero) on the PA measure, given the measure asks how many bouts of light, moderate and strenuous activity for more than 15 minutes a person engages in, it was decided it could be possible for participants to score zero and therefore these values were not investigated. Height and weight were converted to kg and cm and a new variable for Body Mass Index (BMI) (kg/m^2) was created.

3.1.7 Missing data

The data from Prolific Academic suffered from very little missing data as participants are required to complete surveys in full before receiving a payment, though there were some cases with implausible data that were converted to missing. However, the community sample suffered missing data on several important variables (age, weight and physical activity levels). For both data sets, a Little's Missing Completely at Random (MCAR) test was conducted to quantify whether the data were missing in a random or non-random way. Case deletion would be used if less than 10% were missing and multiple imputation if between

10-25% were missing (Scheffe, 2002). The case deletion is not thought to cause bias as there is a large enough sample size and power would not an issue. Case deletion involves removing the cases (participants) with missing data to avoid bias or errors in replacing missing values. Little's missing data test results for the general population were not significant (p=.421) meaning data was missing completely at random, with less than 10% missing. In addition, results were not significant for the community sample (p=.072) meaning data were missing completely at random and less than 10% missing.
Data were assessed for normal distributions in both samples to determine which parametric or non-parametric tests were to be used. Statistical analysis was conducted using IBM SPSS v26 and Latent Gold v5.1. Descriptive statistics were ran using SPSS on all variables. All statistical analyses were conducted on both samples (general population and Bestrong) separately. All measures were normally distributed in both sample except PA, though this is common for PA data (Akram, Cerin, Lamb & White, 2023) whereby variables are often bounded and positively skewed. Statistics for parametric data were calculated as means (M), Standard Deviations (SD) whereas for non-parametric data, Medians and Interquartile Range (IQR) were calculated. A Spearman's correlation coefficients were used to calculate the relationship between PA score, 6 BREQ-3 factors, and habit scores. A Pearson's correlation was then conducted between BREQ-3 scores and habits. Effect sizes are commonly reported as small when valued between 0.10 and 0.30, medium or moderate when between 0.30 and 0.50 and large for values >0.50 (Cohen, 1992). Accepted significance level was set at $p<.05$.

3.1.8 Determining motivational profiles

To answer research question 1, which is to compare the motivational profiles from a general adult population and a sample of community-driven exercise initiative members, a three-step approach using Latent Profile Analysis (LPA) was used. Latent Gold (Vermunt and Magidson, 2013) was the software used to determine motivational profiles. Firstly, the appropriate number of profiles based on the responses was determined using a classification adjustment in the statistical analysis meaning individuals were successively assigned to a profile, and such profiles were formed in an ascending order (Schofield et al., 2021). Single models were ran increasing up to 6 (the number of BREQ subscales). The models were then analysed in comparison to different indicators of model fit and then

models are chosen that define which number of profiles best fitted to the data. Regarding model fit statistics, there is only a small amount of literature that explores the most suitable fit for LPA and therefore it was decided that the lowest values of Bayesian Information Criteria (BIC), p values below 0.05 associated to the Bootstrapped Likelihood ratio test (BLRT) and entrophy values close to one (Porcu and Giambona, 2017).

To ensure a meaningful profile classification, no profiles containing less than 5% of the sample size were included, which equates to fourteen cases in the general population sample and 6 cases in the BeStrong sample (Spurk et al., 2020; Goodman et al., 2022). Less than 5% of the population sample in a profile would not provide a meaningful distinction between profiles. Once latent profiles were devised, it was necessary to do a construct validation to calculate the usefulness of the profiles. This involved performing an Analysis of Variance (ANOVA) to determine whether or not there were significant differences between the six types of motivational regulations, across profiles. *Post Hoc* tests using the TukeyKramer method were used to calculate which profiles displayed significant differences. Tukey-Kramer is a powerful post hoc test to use when sample sizes are not equal. Using post hoc controls the family wise error rate. Post hocs are only performed when a significant result is found for the ANOVA and are used to determine where the differences came from (Armstrong, 2014).

3.1.9a Differences in participant characteristics between motivational profiles

In order to understand the differences between confounding variables (age, gender, ethnicity, educational attainment, BMI) between profiles, several analyses were conducted for both the general population and the community sample separately. Demographic characteristics of each confounding variable were calculated for each profile (number and percentage). Chi2 tests were used to test the difference between profiles on gender and ethnicity. One-way ANOVAs were used to test between group differences on age and BMI. Kruskal-Wallis tests were used to test the differences between profiles on educational attainment.

3.1.9b Moderation between physical activity and habits

Research question 2 involved testing to determine whether motivational profiles moderate the relationship between physical activity levels and habits. This was determined using a moderation analysis to understand whether a moderating variable (motivational profiles) affects the relationship between the independent variable (physical activity levels/time spent exercising) and the dependent variable (habits). The Hayes PROCESS macro (Hayes, 2017) was used on SPSS. This macro is an observed variable path analysis modelling tool for mediation and moderation. To calculate the interaction between the moderating variable and the independent and dependant variable, Hayes PROCESS uses dummy coding whereby the categorical moderation variable (motivational profiles) is incorporated into a more meaningful nominal variable. A reference category is used, in this case motivational profile 1 in both samples was used as a reference category, and the analysis was conducted comparing the remaining motivational profile to the reference category. A two tailed hypothesis was used to reflect the possibility of a bi-directional effect in the data. Previous research shows us that physical activity effects habit, but habit also effects physical activity therefore it was important to allow for the possibility of an effect in two directions.

3.2 Results

3.2.1 Overview

The following sections cover the quantitative statistical findings. Descriptive statistics of the samples are followed by the motivational profile analysis. Lastly, the moderation analysis results between PA, motivational profile and habit formation are covered.

3.2.1 Participant characteristics

The total sample consisted of 425 participants (M age =39.27 (SD=12.31) years, females=81%). The general population consisted of 295 participants (M age= 35.96 (SD=11.63) years, females = 77%) and community consisted of 130 participants (M age= 47.41 (SD=10.51) years, females = 92%). A majority of the total sample were white/Caucasian (90%). Educational attainment varied from GCSE level (13% of total sample,

14% of the general population and 15% of the community sample) to doctorate level (2.4% of total sample). Complete participant demographics are presented in table 7.

Table 7 Demographic information of the total sample and separated into the general population and the community group.

Characteristic	General population: (N=295)	Community sample (N=130)	Total sample (N=424)
Age (years), mean (SD)	35.96 (11.63)	47.41 (10.51)	39.27 (12.31)
Female, N (%)	228 (77.29)	121 (91.80)	357 (81.40)
White/Caucasian, N (%)	261 (88.47)	125 (94.7)	385 (90.60)
Education N (%)			
GCSE	39 (13.22)	20 (15.20)	58 (13.60)
A-Levels	43 (14.58)	7 (5.10)	50 (11.80)
College graduate or diploma	27 (9.15)	30 (22.70)	57 (13.40)
Trade/technical/vocational training	11 (3.73)	7 (5.30)	18 (4.20)
Bachelor's degree	104 (35.25)	44 (32.40)	147 (34.6)
Master's degree	53 (17.97)	17 (12.50)	70 (16.50)
Doctorate degree	10 (3.39)	0 (0)	10 (2.40)
Weight (kg), mean (SD)	79.40 (19.24)	89.06 (24.19)	78.08 (22.33)
Height (cm), mean (SD)	168.10 (12.76)	177.13 (13.33)	170.71 (7.81)
Body Mass Index (BMI, kg/m^2), mean (SD)	26.19 (6.90)	32.49 (9.25)	27.87 (8.08)

Note: According to BMI (kg/m^2), the total sample are on average overweight (M=27.87, SD=8.08). The general population sample are on average overweight (M=26.19, SD=6.90) and the community sample are on average obese (M=32.49, SD=9.25).

3.2.2 PA levels

The median weekly leisure activity score for the whole sample was 42.50 (IQR = 25, 62). In the general population sample, the median weekly PA score was 44.00 (IQR = 25, 63). In the community sample, the median weekly PA score was 40.00 (IQR = 25.5, 58). As shown in table 8, 75-77.5% of participants in each sample (general population, community sample and whole sample) were classed as sufficiently active whereas 14% of participants were sedentary in the community sample, 12.2% in the general population and 12.7% of the whole sample.

Table 8. Physical activity level categories for the general population, community sample and whole sample.

PA level category N (%)	General population	Community sample	Whole sample
Sufficiently active	223 (75.6)	100 (77.5)	323 (76.2)
Moderately active	36 (12.2)	8.5 (11)	47 (11)
Insufficiently active/sedentary	36 (12.2)	18 (14)	54 (12.7)

3.2.3 Correlations between physical activity, motivational regulations and habits

General population

In the general population sample, a statistically significant negative correlation was found between physical activity and amotivation ($r(293) = -.244$, $p<.001$) and external regulation ($r(293) = -.103$, $p=.077$), both correlations were medium. A statistically significant small positive correlation was found between physical activity and introjected regulation ($r(293) = .225$, $p =.001$) and a medium positive correlation between physical activity and identified regulation ($r(293) = .547$, $p<.001$), integrated regulation ($r(293) = .565$, $p<.001$) and intrinsic regulation ($r(293) = .519$, $p<.001$). A statistically significant medium positive relationship was found between habits and physical activity ($r(293) = .483$, $<.001$). No other statistically significant relationships were found. Scores and correlation coefficients for habit strength, PA and the six motivational regulations for the general population are presented in table 9.

Table 9. Correlations and p values for habit scores, weekly PA score and the BREQ-3 scores for the general population.

Variable correlations	Habit	Weekly PA score	Amotivation	External	Introjected	Identified	Integrated	Intrinsic
Habit	*1*							
Weekly PA score	*.48***	*1*						
Amotivation	*-.226***	*-.244***	*1*					
External	*-.103*	*-.103*	*.314***	*1*				
Introjected	*.191***	*.547***	*-.506***	*.184***	*1*			
Identified	*.494***	*.547***	*-.506***	*-.135***	*.484***	*1*		
Integrated	*.536***	*.565***	*-.343***	*-.059*	*.494***	*-.795***	*1*	
Intrinsic	*.531***	*.519***	*-.389***	*-.190***	*.328***	*.720***	*.724***	*1*

**Correlation is significant at p=.005*

*** Correlation is significant at p=.001*

Note: Habits refers to the level of behavioural automaticity, indicating habit strength being scored as weak (1-1.6), moderate (1.7-3.3) and strong (3.4-5), with behaviour reaching automaticity at a score of 2.8.

PA indicates the Leisure Index Score, calculated by summing weekly total minutes of strenuous, moderate and mild activity per week. A score of 24 units of more is interpreted as active. 14-23 units is moderately active and less than 14 is insufficiently active/sedentary.

Table 10. Pearson correlations for BREQ-3 and habits in the general population sample.

Variables ρ coefficient (*p* value)	Habits	Amotivated	External	Introjected	Identified	Integrated	Intrinsic
Habits	1						
Amotivated	-.262**	1					
External	-.099	.225**	1				
Introjected	.193**	-.248**	.216**	1			
Identified	.499**	-.544**	-.097	.498**	1		
Integrated	.536**	-.356**	-.053*	.497**	.789**	1	
Intrinsic	.547**	-.439**	-.179**	.337**	.740**	.724**	1
Mean (SD)	*2.52(1.05)*	*1.42(.07)*	*1.77(.86)*	*2.94(1.14)*	*3.54(.96)*	*2.71(.97)*	

**Correlation is significant at p=.005*

*** Correlation is significant at p=.001*

Pearson's correlation results for the general population between habits and the six motivational regulations showed a small negative relationship was found between habits and amotivation ($r(293) = -.262$, $p<.001$). Habits was positively associated with introjected regulation ($r(293) = .193$, $p=.001$), though the relationship was small. There was a medium positive relationship between habits and identified regulation ($r(293) = .499$, $p<.001$), integrated regulation ($r(293) = .536$, $p<.001$) and intrinsic regulation ($r(293) = .547$, $p<.001$). No other statistically significant correlations were found, as displayed in table 10.

Community sample

A statistically significant small positive relationship was found between physical activity and intrinsic regulation (*r*(127) =.176, p=.047) A statistically significant medium positive relationship was found between physical activity and identified regulation (*r*(127) =.245, p=.005) and integrated regulation (*r*(127) =.229, p=.009). There was a statistically significant medium positively relationship between habits and physical activity (*r*(127) =.471, p<.001). No other relationships were statistically significant.

Pearson correlations found a statistically significant small positive relationship between habits and amotivation (*r*(127) =.111, p=.209), introjected regulation (*r*(127) =.148, p=.095), (*r*(127), identified regulation (*r*(127) =.283, p=.001) and intrinsic regulation (*r*(127) =.327, <.001). There was a statistically significant medium relationship between habits and integrated regulation (*r*(127) =.417, p<.001). No other statistically significant relationship was found, as displayed in table 11. Scores and correlations for the community sample are presented in table 11 and 12.

Table 11. Correlations and p values for habit scores, weekly PA score and the BREQ-3 scores for the community sample.

Variable correlations	Habit	Weekly PA score	Amotivation	External	Introjected	Identified	Integrated	Intrinsic
Habit	*1*							
Weekly PA score	*.471***	*1*						
Amotivation	*.92*	*-.025*	*1*					
External	*-.133*	*-.151*	*.473***	*1*				
Introjected	*.145*	*.114*	*-.183**	*.063*	*1*			
Identified	*.303***	*.245***	*-.421***	*-.272***	*.451***	*1*		
Integrated	*.383***	*.229***	*-.348***	*-.250***	*.478***	*.842***	*1*	
Intrinsic	*.348***	*.176**	*-.424***	*-312***	*.366***	*.769***	*.767***	*1*

**Correlation is significant at p=.005*

*** Correlation is significant at p=.001*

Table 12. Pearson correlations between BREQ-3 and habits in the community sample.

Variables ρ coefficient (*p* value)	Habits	Amotivated	External	Introjected	Identified	Integrated	Intrinsic
Habits	1						
Amotivated	.111	1					
External	-.160	.500**	1				
Introjected	.148	-.113	.098	1			
Identified	.283**	-.386**	-.223**	.468**	1		
Integrated	.417**	-.268**	-.227*	.487**	.837**	1	
Intrinsic	.327**	-.401**	-.282**	.382**	.811**	.795**	1
Mean *(SD)*	*2.70(1.78)*	*1.32(0.60)*	*1.59(0.86)*	*2.93(1.14)*	*3.77(0.96)*	*3.08(1.23)*	*3.53(1.10)*

**Correlation is significant at p=.005*

*** Correlation is significant at p=.001*

3.2.4 Motivational Profiles

3.2.4a Latent Profile Analysis

In the general population sample, BIC, AIC and Entrophy decreased with the addition of every profile, therefore, model four was selected as model four BIC (8579.49) and AIC (8148.11) and model five BIC (8577.29) and AIC (8120.11) criteria were both relatively low whereas Entrophy statistic for model four was closer to 1, meaning the model was better suited as a four-profile model. Within the community sample, AIC decreased with the addition of every profile whereas BIC decreased but began to increase from the four latent profiles. Entrophy decreased up until profile four then remained the same with the addition of another profile. As BIC is considered the most accurate model fit statistic, a four-profile model was selected. Model fit statistics for latent models are presented in table 13 for general population and the community sample.

Table 13. Model fit statistics for general population and the community sample.

Number of profiles	AIC	BIC	Entropy	Smallest profile %
General population				
1	8826.50	9180.45	1.00	NA
2	8364.22	8743.97	0.86	48
3	8208.79	8614.36	0.85	15
4	8148.11	8579.49	0.83	8
5	8120.11	8577.29	0.81	8
Community sample				
1	3778.83	4031.18	1.00	NA
2	3562.24	3834.66	0.88	36
3	3478.15	3770.63	0.89	20
4	3442.50	3755.50	0.86	15
5	3423.10	3755.74	0.86	13

Note: AIC Akaike Information Criteria, BIC Bayesian Information Criteria

3.2.5 General population motivational profile characteristics

Four distinct profiles were found in the general population (N = 295); profile 1 (N = 98) was characterised by low amotivation and external regulation, moderate to high introjected, moderate integrated and high intrinsic and identified regulation and was labelled 'high identified mixed motivation'. Profile 2 (N = 99) was characterised by low amotivation and external regulation, moderate to high introjected regulation and high identified, integrated and intrinsic regulation and was labelled 'high combined autonomous'. Profile 3 (N = 83) was characterised by low amotivation, external, introjected, integrated and intrinsic regulation and moderate identified regulation, which was labelled 'low to moderate motivation'. Profile

4 (N = 23) was characterised by moderate amotivation and low external, introjected, identified, integrated and intrinsic regulation, labelled ‘amotivated’. Profile characteristics as scored by the BREQ-3 are displayed in table 14.

To test the differences in motivational regulations between profiles a one-way ANOVA was conducted, and Tukey-Kramer post hoc tests were run to indicate which profiles were significantly different to each other in relation to the six BREQ-3 subscales. ANOVA results found that all subscales were significantly different, these were amotivation ($F(2,291) = 48.94$, $p<.001$), external regulation ($F(2,291) =4.40$, $p=.005$), introjected regulation ($F(2,291) = 34.64$, $p<.001$), identified regulation ($F(2,291) = 528.77$, $p<.001$), integrated regulation ($F(2,291) = 241.85$, $p<.001$) and intrinsic regulation ($F(2,291) = 201.66$, $p<.001$). Amotivation was highest in profile 4 (M=2.63, SD=0.96) and lowest in profile 2 (M=1.09, SD=0.28). External regulation was highest in profile 3 (M=1.96, SD=0.94) and lowest in profile 2 (M=1.52, SD=0.74). Introjected regulation was highest in profile 2 (M=3.43, SD=1.07) and lowest in profile 4 (M=1.77, SD=1.03). Identified regulation was highest in profile 2 (M=4.52, SD=0.38) and lowest in profile 4 (M=1.63,SD=0.45). Integrated regulation was highest in profile 2 (M=3.82, SD=0.67) and lowest in profile 4 (M=1.07, SD=0.14). Intrinsic regulation was highest in profile 2 (M=4.12, SD=0.58) and lowest in profile 4 (M=1.09, SD=0.16). Tukey-Kramer’s test for multiple comparisons found the mean value of subscales were statistically significantly different between profiles in most cases, as shown in table 14 whereby only statistically significant results are displayed.

Table 14. Profile count and BREQ-3 scores for each profile in general population (N = 295)

BREQ-3 scores: mean (SD)	Profile 1 *N* = 98	Profile 2 *N* = 99	Profile 3 *N* =74	Profile 4 *N* = 24	*P* value	Tukey-Kramer post hoc test
Amotivation	1.35 (0.58)	1.09 (0.28)	1.55 (0.67)	2.63 (0.96)	<.001	1>2**; 1<4; 2<1**, 2<3**, 2,4**; 3>2**; 3<4**; 4>1**, 4>2**, 4>3**
External	1.88 (0.86)	1.52 (0.74)	1.95 (0.94)	1.76 (1.07)	.005	1>2*; 2<3*; 3>2*
Introjected	3.24 (0.93)	3.43 (1.07)	2.25 (0.92)	1.77 (1.03)	<.001	1>3*,4**; 1<2**; 2>3*,4**; 3<1,2**; 3>4*; 4<1,2,3**
Identified	3.65 (0.91)	4.52 (0.38)	2.70 (0.36)	1.63 (0.45)	<.001	1<2**; 1>3**,4**; 2>1**,3**,4**; 3<1**,2**; 3>4**; 4<1**,2**,3**
Integrated	2.73 (0.63)	3.82 (0.67)	1.73 (0.48)	1.07 (0.14)	<.001	1<2**; 1>3**,4**; 2>1**,3**,4**; 3<1**,2**; 3>4**; 4<1**,2**,3**;
Intrinsic	3.09 (0.68)	4.12 (0.58)	2.35 (0.72)	1.09 (0.16)	<.001	1<2**; 1>3**,4**; 2>1**,3**,4**; 3<1**,2**; 3>4**; 4<1**,2**,3**

Note: Tukey-Kramer post-hoc tested the difference at p <.05 between each profile on each of the BREQ-3 subscales (1 = high identified mixed, 2 = high combined autonomous, 3 = moderate mixed motivation, 4 = amotivated). E.g., for high identified and the amotivated subscale '1>2' means that profile 1 has a mean score larger than profile 2 on amotivation and it is statistically significant at p <.05. * The mean difference is significant at the 0.05 level., ** The mean difference is significant at the 0.001 level.

In the community sample, profile 1 (N = 49) was characterised by low amotivation and external regulation, moderate introjected regulation and integrated and high identified and intrinsic regulation and was labelled 'high identified/intrinsic'. Profile 2 (N = 33) was characterised by low amotivation and external regulation and high introjected, identified, integrated and intrinsic and was labelled 'high combined motivation'. Profile 3 (N = 29) was characterised by low amotivation and moderate external, introjected, identified, integrated and intrinsic and was labelled 'moderate mixed motivation'. Profile 4 (N = 19) was characterised by scoring low on amotivation, external, introjected, identified, integrated and intrinsic and was labelled 'low overall motivation'. Profile characteristics for the community sample are presented in table 15.

A second one-way ANOVA was conducted to test the differences between profiles in the community sample. ANOVA results found that all subscales were statistically significantly different, these were amotivation ($F(3,126) = 14.78$, $p<.001$), external regulation ($F(2,291) = 17.60$, $p<.001$), introjected regulation ($F(2,291) = 15.09$, $p<.001$), identified regulation ($F(2,291) = 163.20$, $p<.001$), integrated regulation ($F(2,291) = 173.85$, $p<.001$) and intrinsic regulation ($F(2,291) = 161.32$, $p<.001$). For amotivation, we see the same highest score in profile 4 (M=1.74, SD=0.82) but profile 1 now has the lowest score (M=1.06,SD=1.55). For external regulation, we see the same highest score in profile 3 (M=2.34,SD=1.14) but now a lowest score in profile 1 (M=1.18,SD=0.42). For introjected regulation, we see the same highest score in profile 2 (M=3.72, SD=1.02) and the same lowest score in profile 4 (M=1.83,SD=0.97). For identified regulation, there was the same lowest score in profile 4 (M=2.13,SD=0.67) and the same highest score in profile 2 (M=4.80,SD=0.48). For integrated regulation, we see the same lowest score in profile 4 (M=1.18,SD=0.20) and the same highest score in profile 2 (M=4.60,SD=0.49). Finally, for intrinsic regulation we see the same lowest score in profile 4 (M=1.59,SD=0.60) and highest score in profile 2 (M=4.62,SD=0.44). Tukey-Kramer's test for multiple comparisons found the mean value of subscales were statistically significantly different between profiles in most cases, as shown in table 15 whereby only statistically significant results are displayed.

Table 15. Profile count and BREQ-3 scores for each profile in the community sample (N = 129)

BREQ-3	Profile 1 *N* = 49	Profile 2 *N* = 33	Profile 3 *N* = 29	Profile 4 *N* = 19	*P* value	Tukey HSD post hoc test
Amotivation	1.06 (1.55)	1.14 (0.56)	1.70 (0.62)	1.74 (0.82)	<.001	1<3**,4**; 2<3**,4**; 3>1**,2**; 4>1**,2**
External	1.18 (0.42)	1.38 (0.63)	2.34 (1.14)	1.87 (0.70)	<.001	1<2**,3*; 2<3**; 3>1**,2**; 4>1*
Introjected	2.88 (1.02)	3.72 (1.02)	2.84 (0.95)	1.83 (0.97)	<.001	1<2*; 1>4**; 2>1**,3*,4**; 3<2*; 3>4*; 4<1**,2**,3*
Identified	4.00 (0.47)	4.80 (0.48)	3.23 (0.55)	2.13 (0.67)	<.001	1<2**; 1>3**,4**; 2>1**,3**,4**; 3<1**,2**; 3>4**; 4<1**,2**,3**
Integrated	3.18 (0.62)	4.60 (0.49)	2.36 (0.65)	1.18 (0.20)	<.001	1<2**; 1>3**,4**; 2>1**,3**,4**; 3<1**,2**; 3>4**; 4<1**,2**,3**
Intrinsic	3.84 (0.49)	4.62 (0.44)	3.00 (0.54)	1.59 (0.60)	<.001	1<2;** 1>3**,4**; 2>1**,3**,4**; 3<1**,3**; 3>4**; 4<1**,2**,3**

*Note: Tukey-Kramer post-hoc tested the difference at p <.05 between each profile on each of the BREQ-3 subscales (1 = high identified/intrinsic, 2 = high combined autonomous, 3 = moderate mixed motivation, 4 = moderate to high combined). E.g., for high identified/intrinsic and the amotivated profile '1<3' means that profile 1 has a mean score smaller than profile 3 on amotivation and it is statistically significant at p <.05. * The mean difference is significant at the 0.05 level. ** The mean difference is significant at the 0.001 level.*

3.2.6 Motivational profile membership participant characteristics

Table 16 outlines the demographic characteristics of each of the membership to each profile in the general population sample. All profiles were predominately female, profile 4 (amotivated) being comprised of 98% females. A Chi2 test found no significant differences between profiles in relation to gender X2 (6, N=295) = 11.657, p=.070. The mean age of individuals in each profile in the general population are listed, profile 4 (amotivated) being comprised of the highest age (M=38.50, SD=12.92) profile 1 (high identified mixed) being comprised of the lowest age (M=33.95, SD=11.48). A one-way ANOVA for differences between profiles on age found no statistically significant difference F(3,295) = 1.91, p=.117. The most common ethnicity for all profiles was white/Caucasian. A Chi2 test was conducted to test the difference of ethnic groups between profiles, no significant differences were found X2(15,N=295) = 11.480, p=.718.

In all profiles the most reported highest educational attainment was a Bachelor's degree, comprised of 48.5% (n=47) in profile 1, 30.6% (n=30) in profile 2, 27% (n=20) in profile 3 and 29.2% (n=7) and profile 4. A Kruskal-Wallis was conducted to test the differences between profiles in relation to educational attainment, a statistically significant difference was found H (3) = 13.570, p=.004. However, multiple comparisons tests only found four statistically significant differences. A negative difference was found between profile 1 and 4 whereby profile 4 had a higher number of lower educational achievements (p<.001). A negative difference was found between profile 2 and 4 whereby profile 4 has a larger number of participants with a lower educational achievement than profile 2 (P<.001). All profiles had an average BMI between 25-29 kg/m^2, classified as overweight. BMI (kg/m^2) was highest in profile 4 (M=28.40, SD=8.41) and lowest in profile 1 (M=25.39, SD=5.91). A one-way ANOVA was conducted and found no significant differences between profiles on BMI F(3,295)=2.269, p=.081.

Table 16. Demographic information (gender, age, ethnicity, educational attainment, BMI, PA level categories) between profiles for the general population

Covariate	Profile 1: high identified mixed (N=98)	Profile 2: high combined autonomous (N=99)	Profile 3: low to moderate motivation (N=74)	Profile 4: amotivated (N=24)
Female, % (N)	84 (82)	68.7 (68)	76.7 (56)	95.5 (23)
Male, % (N)	15(15)	30.3 (30)	21.9 (16)	4.2 (1)
Gender fluid, % (N)	0.8 (1)	1(1)	1(1)	0
Age (years), mean (SD)	33.95 (11.48)	37.56 (12.52)	35.70 (10.19)	38.50 (12.92)
Caucasian, % (N)	86.7(85)	87.9 (87)	87.8 (65)	100 (24)
University degree, % (N)	48.5 (47)	30.6 (30)	27 (20)	29.2 (7)
BMI (kg/m^2), mean (SD)	25.39 (5.91)	25.55 (6.77)	27.40 (7.54)	28.40 (8.41)
Sufficiently active N (%)	83 (84.7)	96 (97)	40 (54.1)	4 (16.7)
Moderately active N (%)	11 (11.2)	3 (3)	19 (25.7)	3 (12.5)
Insufficiently active/sedentary N (%)	4 (4.1)	0 (0)	15 (20.3)	17 (70.8)

Table 17 outlines the demographic characteristics of each of the membership for each profile in the community sample. Similarly to the general population, all profiles were predominately female. Profile 2 (high combined autonomous) having the smallest number of female members (86%). A Chi2 test revealed no significant differences between profiles on gender. Mean ages are listed, profile 1 (high identified mixed) being comprised of the highest age (M=47.46, SD=10.96) and profile 3 (moderate mixed) being comprised of the lowest age (M=44.96, SD=8.75). A one-way ANOVA test revealed no statistically significant difference between profiles in relation to age. The most reported ethnicity for all profiles was white/Caucasian. No statistically significant difference was found in a Chi2 test between profiles in relation to ethnicity. In all profiles the most reported highest educational attainment was a Bachelor's degree. A Kruskal-Wallis test revealed no statistically significant difference between profiles in terms of highest educational achievement. Profiles 1, 2 and 4 had an average BMI over 30 kg/m^2, being classified as obese. BMI was highest in profile 3 (M=36.17, SD=1.72) and lowest in profile 2 (M=29.87, SD=2.02). Profile 2 would be classed as overweight and profile 3 obese. A one-way ANOVA revealed no statistically significant difference between profiles.

Table 17. Demographic information (gender and age) between profiles in the community sample

Covariate	Profile 1: high identified/intrinsic (N=48)	Profile 2: high combined autonomous (N=32)	Profile 3: moderate mixed motivation (N=29)	Profile 4: low overall motivation (N=19)
Female, N (%)	44 (92)	27 (86)	28 (96)	18 (99)
Male N (%)	4 (8)	5 (14%)	1 (4)	1 (1)
Age (years), mean (SD)	47.46 (10.96)	46.21 (10.69)	44.96 (8.75)	47.27 (10.87)
BMI (kg/m^2) mean (SD)	31.04 (1.35)	29.87 (2.02)	36.17 (1.72)	33.47 (2.54)
White/Caucasian % (N)	97.9 (46)	90.9 (30)	100 (28)	94.4 (17)
Bachelor's degree % (N)	33 (16)	39.9 (13)	28.6 (8)	33 (6)
Sufficiently active N (%)	37 (77.1)	28 (84.8)	22 (78.6)	12 (66.7)
Moderately active N (%)	5 (10.4)	2 (6.1)	1 (3.6)	2 (11.1)
Insufficiently active/sedentary N (%)	6 (12.5)	3 (9.1)	5 (17.9)	4 (22.2)

3.2.7 Moderation of physical activity and habits by motivational profiles

3.2.7a Descriptive statistics and inferential analysis

In the general population sample, profile 1 (Median=49, IQR=45.22,54.70), profile 2 (Median=57, IQR=55.97,64.82) and profile 3 (median=26, IQR=22.64,36.45) were sufficiently active, whereas profile 4 (median=6, IQR=5.91,16.92) was insufficiently active. Physical activity levels also differed between profiles. A Kruskal-Wallis test revealed a statistically significant difference in leisure activity scores (PA level) across the four motivational profiles H(3, N=295) = 101.15, p<.001, whereby profile 2 scored highest on physical activity level and were classed as sufficiently active whereas profile 4 scored lowest and are classed as insufficiently active. A Mann-Whitney U test revealed no statistically significant difference within profiles on PA levels, between profile 4 and 3 (p=.012) and 1 and 2 (p=.050). There was a significant difference between 4 and 1 (p<.0001), 4 and 2 (p<.0001), 3 and 1 (p<.0001), 3 and 2 (p<.0001). The median leisure activity score for profile 1 was 49.00 (IQR=45.22, 54.70) and for profile 3 26 (IQR= 25.64, 36.45), both being sufficiently active. In the general population sample, ANOVA results found statistically significant differences between profiles and habit scores F(3, 291) = 38.39, p<.001, whereby habit scores were highest in profile 2: high combined autonomous (*M* =3.16,SD=0.90) and lowest in profile 4: amotivated (*M* = 1.36,SD=0.55). The Tukey-Kramer post hoc tests demonstrated the between profile differences of habit scores displayed in table 18.

All participants in the community sample reported physical activity levels that are classed as sufficiently active, profile 2 reported the highest physical activity levels (median = 49.00 IQR=39.70,58.35) whilst profile 4 reported the lowest (median = 31.00, IQR=22.44,42.79). Profile 1 (median = 42.50 IQR=37.20,51.84) and 3 (median = 34.00, IQR=28.07,45.22) reported similar levels. A Kruskal-Wallis test revealed a statistically significant difference in leisure activity scores (PA level) across the four motivational profiles H(3, N=129) = 33.24, p<.001. A Mann Whitney U test revealed no statistically significant differences within groups on PA levels. ANOVA results found significant differences in habit score between motivational profiles whereby the difference in habit scores in each of the motivational profiles were statistically significant (*F*(3,125,) = 12.98, *p*<.001). Habit scores were highest in

profile 2: high combined autonomous (*M* = 2.92,SD=0.90) and lowest in profile 4: amotivated (*M* = 2.46,SD=0.88). Tukey-Kramer post-hoc tests indicate the between profile differences of habit and physical activity scores, displayed in table 18.

Table 18. Descriptive statistics (means (SD) for habits and (medians (IQR) for physical activity levels in profiles 1-4.

General population	Profile 1 (N = 98)	Profile 2 (N = 99)	Profile 3 (N = 74)	Profile 4 (N = 24)	*p* value	Post hoc differences
Habits	2.56 (0.93)	3.16 (0.90)	2.01 (0.91)	1.36 (0.55)	<.0001	1<2; 1>3,4; 2>1,3,4; 3<1,2; 3>4; 4<1,2,3
Median (IQR) Weekly Leisure activity score	49.00 (45.22, 54.70)	57.00 (55.97, 64.82)	26.00 (25.64, 36.45)	6.00 (5.91, 16.92)	<.0001	4-3, 4-1**, 4-2**, 3-1**, 3-2**, 1-2
Community sample	Profile 1 (N = 59)	Profile 2 (N = 31)	Profile 3 (N = 25)	Profile 4 (N = 14)		
Habits	2.64 (1.02)	2.92 (0.90)	2.70 (0.80)	2.46 (0.88)	<.0001	1>3,4; 2>3,4; 3<1,2; 4<1,2
Medians (IQR) for weekly leisure activity score	42.50 (37.20, 51.84)	49.00 (39.71, 51.84)	34.00 (28.06, 45.22)	31.00 (22.44, 42.79)	<.0001	4-3, 4-1, 4-2, 3-1, 3-2, 1-2

Note: Tukey-Kramer post-hoc tested the difference at p <.05 between each profile on habits (General population: 1 = high identified, 2 = high combined autonomous, 3 = low to moderate motivation, 4 = amotivated. Community sample: 1 = high identified/intrinsic, 2 = high combined autonomous, 3 = moderate mixed motivation, 4 = low overall motivation). E.g., for general population for profile 1 and habits score, 1<2 means that profile 1 has a mean score smaller than profile 2 and it is statistically significant at p<.05. Only significant differences are included in the table.
Kruskal Wallis to test the difference between profiles on leisure activity scores.
Mann-Whitney U post hoc tested the difference for leisure activity scores (adjusted significance for multiple comparisons). New accepted significant = 0.0083.

3.2.8 Moderation Analysis

3.2.8a General population

Results from the moderation analysis in the general population indicated that the overall model was statistically significant (R^2 = 58.63, F(7,287) = 21.47, *p*<.001) and 58% of the relationship between physical activity and habits can be explained by motivational profiles. The direct relationship between physical activity and habits was positive and significant (SE = .0037, β 0.0092, *p*=0.013), even though the effect was small the results display that physical activity levels predict habit strength, meaning for every one unit increase in the PA score, there was a corresponding increase of 0.0092 in habit score.

When compared to the reference category (profile 1, high identified), there were mixed results in relation to motivational profiles and effect on habit. Profile 2 (high combined autonomous) positively affected habit, and these results were significant (SE = .324, β =.726, p=.025). The difference in habit strength between profile 1 (high identified) and profile 3(low to moderate) was significant (SE = 264, β=-.576, p=.029), and had a negative effect such that profile 3 had a lower habit score than profile 1, as displayed in table 19. The difference in habit strength between profile 1 and profile 4 (amotivated) was significant (SE = 311, β=-1.060, p<.0008). There was a negative effect whereby profile 4 had a lower habit score than profile 1.

Interaction results found no significant moderating effects; when measuring the moderating effect of motivational profiles 1:high identified (SE = 005,β -.004, p=.499), 2:high combined autonomous (SE = 006, β=.007, p=.24) and 4:amotivated (SE = .014, β=.019, p=.169) on the relationship between physical activity and habits when compared to motivational profile 1:high identified, as shown in table 19. The test of highest order unconditional interactions shows the R^2 change as a result of the interaction was significant R^2(3, 287) = .027, *p* =.009.

Table 19. Moderating effect of motivational profiles on physical activity and habits in general population.

Model	Coefficient	*SE*	*t*	*P* value
Physical activity	.0092	.0037	2.497	**.0131**
W1[1]	.7264	.3236	2.245	**.0255**
W2[2]	-.5765	.2635	-2.188	**.0299**
W3[3]	-1.0602	.3113	-3.405	**.0008**
Physical activity x W1	-.0036	.0054	-.677	.4993
Physical activity x W2	.0067	.0057	1.181	.2383
Physical activity x W3	.0196	.0142	1.377	.1695

[1] W1 is the first moderation variable and shows profile 2 as a moderator when compared to the reference category (profile 1); *[2] W2 is the second moderator variable and shows profile 3 as a moderator when compared to reference category;*

[3] W3 is the third moderator variable and shows profile 4 as a moderator when compared to reference category.

3.2.8b Community sample

In the community sample, overall the model was not significant R^2 =.17, F(7,119) = .52, *p*<.815. Physical activity level therefore did not have a significant effect on habit (SE = .008, **β** -.0023, p=.785). Using profile 1: high identified/intrinsic as a reference category, profile 2:high combined autonomous (SE = 631,**β** -.109, p=.864), profile 3: moderate mixed (SE = .548, **β** -.072, p=895) and profile 4: low overall motivation (SE = .552, **β** -.530, p=.338) did not significantly predict habit.

Interaction results found no significant moderating effect of motivational profile 2 (SE = .011, β=.0072, p=.527), motivational profile 3 (SE = .012, β=.0032, p=.798) and motivational profile 4 (SE = .016, β = .0139, p=.399) on the relationship between physical activity and habits when compared to the reference category, as shown in table 20. It can be concluded that, in this sample, motivational profiles do not moderate the relationship between physical activity and habits in the test of highest order unconditional interaction, there was a non-significant result R^2 (3, 120) = .029, *p* = .229.

Table 20. Results from the moderation analysis of motivational profiles on physical activity and habits in the community sample.

Model	Coefficient	*SE*	*t*	*P* value
Physical activity	-.0023	.0083	-.2730	.785
W1[1]	-.1087	.6316	-.1721	.864
W2[2]	-.0729	.5484	-.1329	.895
W3[3]	-.5308	.5521	-.9614	.338
Physical activity x W1	.0072	.0114	.6342	.527
Physical activity x W2	.0032	.0124	.2561	.798
Physical activity x W3	.0139	.0164	.8455	.399

[1] Profile 2 when compared to reference profile 1; [2] profile 3 when compared to reference category 1; [3] profile 4 when compared to reference category 1.

3.3 Discussion

3.3.1 Overview

The third part of this chapter aims to discuss the quantitative findings in the previous section, whereby the results of research question 1 and 2 were presented. The first research question of this project: to what extent do motivational profiles of an adult general population and a community exercise group differ? The second research question: can motivational profiles moderate the relationship between physical activity and habits? This is one of the first studies to assess the motivational profiles in a general population sample and a community exercise sample and the first to assess the moderating effect of motivational profiles on PA and habits. Four distinct motivational profiles emerged in both samples, these are discussed below and in relation to the findings in the systematic review chapter. A combined profile and a high autonomous motivation profile emerged in both samples and were distinct in many of the studies in the systematic review, suggesting some evidence for universality of profiles. Secondly, moderation results differed between samples highlighting the specific group differences in PA habit strength.

3.3.2 Physical activity levels

When comparing the two groups, PA levels were relatively similar. 75.6% of the general population sample and 77.5% of the community sample were categorised as sufficiently active, meaning around two thirds of both groups are gaining substantial benefits from PA. However, 12.2% in the general population and 14% in the community sample scored low on PA levels and were categorised as insufficiently active, meaning they are likely gaining less than substantial benefits from PA. It is estimated that around one third of the adult population are insufficiently active in England (Lifestyles Team, 2020), which would support the PA level results of the general population sample. In relation to the community sample, of the 14% (n=18), their low PA level is unlikely to be a reflection of the community group, it may be that when completing the self-report survey these participants were new members and currently engaged in little PA activity. In addition, there is always the issue of reporting bias in self-reporting PA levels, some individuals over report or under report their activity, which should be taken into consideration. In relation to the actual scope of this study, the

psychological mechanisms (motivation and habits) associated with PA levels are of a higher importance and are discussed below.

3.3.3 Motivational profiles

The aim of research question one was to firstly identify the distinct PA motivational profiles evident in two different populations of interest and secondly to compare and contrast profile results in relation to participant characteristics (age, gender, ethnicity, educational attainment) and PA levels, drawing on the systematic review findings in chapter 2. This is not the first study to compare group differences in relation to motivation profiles but to our knowledge, this is the first to compare the profiles from a general adult population sample and members of a community exercise initiative.

Four motivational profiles emerged, in the general population sample: profile 1, high identified mixed (n=98), profile 2, high combined autonomous (n=99), profile 3, low to moderation motivation (n=74) and profile 4, amotivated (n=24), all of which varied in level of PA. In the general population, in profile 1, 85% were sufficiently active and 4% were inactive. In profile 2, 97% were sufficiently active and 0% were inactive. In profile 3, 54% were sufficiently active and 20% were inactive. In profile 4, 17% were sufficiently active and 71% were inactive. In the community sample: profile 1, high identified/intrinsic (n=49), profile 2, high combined autonomous (n=33), profile 3, moderate mixed (n=29) and profile 4, low overall motivation (n=19). In profile 1, 77% were sufficiently active and 13% were inactive. In profile 2, 85% were sufficiently active and 9% were inactive. In profile 3, 79% were sufficiently active and 18% were inactive. In profile 4, 67% were sufficiently active and 22% were inactive.

As expected, a profile high in autonomous motives and low in controlled motives emerged in the community exercise sample (profile 1: high identified/intrinsic profile), however this profile did not demonstrate the highest PA levels but on average, individuals in this profile were sufficiently active and gaining substantial benefits from PA. In addition, a profile high in autonomous motivation and low in controlled in the general population sample emerged, however, this profile (profile 1: high identified mixed: high in identified, moderate in

intrinsic, integrated and introjected and low in external and amotivation) also scored moderately on introjected regulation, a controlling motive. This profile did not demonstrate the highest physical activity levels but as with the community sample, on average people were sufficiently active. Due to the cross-sectional nature of this study, it is difficult to interpret whether membership of this profile would be predictive of sustained long-term engagement of sufficient PA levels. These results are in support of previous findings whereby profiles high in autonomous motivation and low in controlling motivation exist and are associated with sufficient levels of PA (Castonguay and Miquelon, 2018; Ostendorf et al., 2021). Ostendorf (2021) conducted an 18-month behaviour weight loss program with 6 months of supervised and 6 months of unsupervised exercise. Participants in the high autonomous profile were more likely to sustain PA when support was removed in comparison to the profile with moderate scores on motivational regulations, suggesting that profiles high in autonomous motivation and low in controlling motives are protective of PA adherence (Ostendorf et al., 2021). However, their participants were assessed in an intervention which is difficult to extrapolate to real life settings. The 6 months of supervised exercise was marketed to participants as a weight loss program, which is controlling in nature and it may be that individuals in real-life settings, being physically active for reasons associated with the high autonomous profiles will sustain sufficient levels of PA overtime with or without a supervised intervention. Future studies should continue to explore motivational profiles and PA levels from a long-term perspective to understand the trajectory of sustained behaviour. It is well-established that autonomous motivation is more predictive of long-term PA participation, which is important when considering how these findings might implicate behaviour change interventions. In the above example, whereby Ostendorf and colleagues (Ostendorf et al., 2021) measured motivational profiles in a weight loss intervention, their own limitations of the study were that the study was controlling in nature. To design and implicate successful behaviour change interventions, practitioners should aim to make conditions as real-life as possible. For example, a replication of BeStrong in a behaviour change intervention whereby a number of different psychological mechanisms that support behaviour change (e.g., action planning, self and/or group monitoring, intrinsic rewards to name a few) would be advantageous. By using a multitude of behaviour change techniques, such as promoting social support, self and group monitoring, feedback, education and readily available information on health behaviour,

which is seen in Bestrong, to increase high quality motivation for physical activity in more real life settings, a more accurate understanding of how motivational profiles influence engagement can be measured, specifically during the eb and flow of life (e.g., stressful life changes such as job or financial insecurity) where physical activity priority can be reduced.

In relation to profile size, as predicted the high identified/intrinsic profile in the community exercise sample had the highest participant membership. More distinctively, the profiles in reference exhibited high scores of identified regulation (high identified mixed in the general population and high identified/intrinsic in community exercise) and low controlling motives, however, in the community exercise sample this was accompanied by high intrinsic regulation. Identified regulation is by definition motivation driven by personal value and highly linked with sustained exercise participation (Wilson et al., 2004; Zamarripa et al., 2018). In the community sample, the programme involves weekly educational talks that increases members knowledge about the benefits of a physically active lifestyle which has likely resulted in strong personal importance of exercise, explaining the high levels of identified regulation. Indeed, the nature of the community driven exercise initiative is likely to be conducive of high levels of enjoyment and pleasure alongside facilitating value and personal importance. In comparison to the general population sample, the specific environment and type of exercise participants performed was not measured, but it is expected that current members of an exercise initiative may have higher levels of intrinsic regulation. The community exercise group carry out weekly exercise classes that are purposely designed to be enjoyable and a manageable level of challenge. Such purposeful designing means members are likely to exercise because they find it fun and pleasurable. In addition, the psychological needs of participants were not measured but the nature of a community exercise organisation are predicted to align with satisfying basic psychological needs of autonomy, competence and relatedness (Gallé et al., 2019). Research suggests that intrinsic regulation can be promoted by emphasising the process of exercise, emphasising choice over modes of exercise (e.g., with or without resistance) and intensity (choice between high and low impact exercises), promoting social connections and regular social events (Vlachopoulos and Karageorghis, 2005), all of which the community exercise infiltrate through their service. Whilst these practices are adopted, it is likely that members find the process pleasurable and enjoyable, which explains high intrinsic regulation. The satisfaction

of the psychological needs could therefore explain why two profiles emerged with high autonomous motives, and in particular a profile high in identified and intrinsic motivation. A second explanation as to why a profile high in identified and intrinsic emerged in the community exercise sample and not the general population sample, from a contextual standpoint, may represent an additive relationship whereby self-determined types of external motivation are thought to play an additive role with intrinsic motivation. (Vlachopoulos and Karageorghis, 2005). This means that the combination of identified and intrinsic has corresponded with even higher levels of positive motivational consequences on behaviour, such as high physical activity levels. Previous research has found an interplay between identified regulation and intrinsic motivation whereby higher levels of identified regulation corresponded with high levels of enjoyment (Vlachopoulos and Karageorghis, 2005; Thøgersen-Ntoumani and Ntoumanis, 2006). Whilst this study adopted a more person-centred approach, it is clear that simultaneously, high levels of identified and moderate to high intrinsic regulation are associated with high physical activity levels.

In the general population sample, the profile high in identified regulation was associated with sufficient PA levels, meaning participants were on average active. This corroborates previous findings whereby identified regulation was the strongest predictor of positive motivational consequences, such as high PA level (engagement and intensity), intentions to continue, increased effort and importance placed on exercising in university students (Wilson et al., 2004). The current study did not assess such motivational consequences except PA levels; however, the findings do offer insight into the strong role high identified regulation may play on PA levels and sustained behaviour. The current study adopting a person-centred approach, highlights the need to consider motivational regulations as coexisting entities as opposed to independent variables, as motivational profiles reveal more information than analysis on single variables. In the context of the current study, active participants in the high identified mixed profile may be sufficiently active due to scoring low on external motives and not just because of being highly motivated for identified reasons. Congruent with previous motivational profile research, high autonomous profiles characterised by high identified and intrinsic regulation, moderate integrated and low external regulation have been found, as discussed in chapter 2 (Friederichs et al., 2015; Miquelon et al., 2017; Shen et al., 2019) A sample of 2473 adults (Friederichs et al., 2015)

who also displayed highest PA levels. In addition, Miquelon, Chamberland and Castonguay (2017), in a general population sample found that the high self-determined profile (characterised by high intrinsic and identified regulation and low introjected and external) was associated with highest PA levels.

Both samples scored low on external regulation in all four profiles which was a surprising finding but could be explained by several reasons. Firstly, low external regulation in the high identified mixed profile and high combined autonomous (general population) and high identified/intrinsic and high combined (community sample) may represent the stage of PA internalisation. External regulation is commonly associated with exercise adoption and less associated with maintenance (Teixeira et al., 2012) whereas autonomous motives are closely associated with adherence. Profiles high in autonomous motivation and low in external regulation in both samples may be an indication that they are more regular exercisers or exercise maintainers, though the cross-sectional nature of the study discourages us from being certain, the higher physical activity levels in these profiles could also indicate sustained participation, though this is speculation. Matsumoto and Takenaka (2004) analysed the motivational profiles of adults in relation to the stage of exercise behaviour change they were associated with; individuals in profiles high in self-determined motivation and low in non-self-determined motives were in the maintenance stage. Indeed, those in the moderate motivation profile (characterised by scoring moderately on all regulations) were in the preparation stage which represents the middle stage of behaviour change. Whilst this study did not test for stages of exercise behaviour, it is comprehendible that the differentiation between profiles may represent the stage of exercise behaviour change participants are in.

When considering the general population sample, the results are not necessarily in support of previous literature and may need alternative explanations; when differentiating between the two profiles with lower physical activity levels, the low to moderate motivation profile is characterised by a moderate score on identified regulation which could mean that participants within this profile have internalised exercise to some degree and are not necessarily driven by tangible rewards or external factors, explaining the low external regulation. Identified regulation is linked with sustained exercise participation (Rodgers et

al., 2010; Teixeira et al., 2012) and although this profile was not associated with the highest physical activity levels, the behaviour is moderately valuable to participants, suggesting that the internalisation process has started. The results do not show the full motivational trajectory, but the findings might indicate that moderate to high autonomous motives are unlikely to co-exist with moderate to high external regulation, supporting the controlling vs autonomy confliction (Vansteenkiste et al., 2009). It was predicted that profiles low in autonomous motives would be associated with the lowest physical activity levels, which was supported in both samples.

In addition, latent profile analysis further adds to the literature in terms of understanding how motives interact. It was hypothesised that profiles scoring low in autonomous motives would score high in external and introjected regulation, as SDT presumes controlling and autonomous motives are opposing constructs (Chemolli and Gagné, 2014) though this was not the case in either sample. The relationship between autonomous and controlling motives, when studying motives singularly, suggests that opposing dimensions cannot coexist, thus assuming that high quality motivation is protective of the emergence of low-quality motivation, or that low quality motivation hinders the ability to experience high quality motivation (Scott Rigby et al., 1992). The notion of a continuum also presumes that there is a chronological transition from low to high quality motivation, which may well be the case, but the results of the current study do suggest that high autonomous motives can exist with moderate to high controlling motives, particularly in the community exercise sample.

Meta-analysis research on student motivation found that external motives, thus behaviour driven by the desire to obtain a tangible reward or avoid punishment was negatively associated with persistence and performance and predicted decreased well-being (Howard, Bureau, et al., 2021). Therefore, the low external scores alongside high autonomous motives are plausible. In terms of the low external motives scores in profiles with low physical activity, this may also be an indication of the early stage of exercise behaviour change individuals represent. High external and controlling motives are not associated with low physical activity, in fact many individuals tend to adopt physical activity for controlling reasons (Ingledew et al., 1998; Teixeira et al., 2012; Kinnafick et al., 2014). However, the

profiles with low physical activity levels represent individuals with low overall motivation (amotivated in the general population sample and low overall motivation in the community sample) indicating they may be at the precontemplation stage (Ingledew et al., 1998). In the general population sample, physical activity levels in the amotivated sample were insufficient in relation to the recommended amount meaning they are classed as inactive (Bull et al., 2020). This is unsurprising as individuals in this profile scored moderately on amotivated items, thus highlighting their insufficient drive to be physically active, which translates to their low physical activity levels. In the community sample, the profile with low overall motivation presented sufficient levels of physical activity which could suggest that members in this profile experience low levels of self-determined and controlling motives but continue their participation as a routinely commitment that was not measured on the BREQ3 scale. It can be assumed, that individuals in this profile are more vulnerable to drop out or decreased activity if membership in this profile remained.

In support of the systematic review findings, a combined profile characterised by high autonomous motives and high introjected regulation existed in both samples, possibly reflecting a universal motivational profile. In addition, in both samples the combined profile was associated with the highest physical activity levels. Introjection regulation is categorised as a controlling motive and not associated with sustained participation (Ingledew and Markland, 2008; Scioli-Salter et al., 2014). More recent understanding of introjected regulation has suggested that there are two separate components that make up introjection, being avoidance and approach (Assor et al., 2009; More and Phillips, 2021). This study used BREQ-3 which measures introjection as an avoidance component (e.g., “I feel guilty when I don’t exercise”) making it difficult to make direct distinctions between avoidant and approach components. Avoidance introjection is thought to prompt engagement in physical activity to avoid a negatively affected outcome (Elliot, 2006) whereas approach introjection is to gain a positive outcome such as personal pride. In addition, distinctions have been made between whether or not the avoidance and approach introjections are oriented towards the self-versus others (More and Phillips, 2021). When comparing the two populations in this study, it could be expected that individuals in the community-based group may elicit higher feelings of approach introjection and lower avoidance. A person can theoretically feel pride in their own actions (self-oriented, introjected approach) and can

also be motivated to feel pride in their own actions because of how those actions seem to others in the group (other oriented, introjected approach). This characterisation may be specifically important for introjected regulation as it is characterised as only "somewhat controlled" by Self-Determination theorists (Ryan and Deci, 2000a; More and Phillips, 2021). However, this was not measured using BREQ-3, as this measure does not capture the full range of constructs and is perhaps why there has been inconsistent findings on introjection in the literature. It is important that the full motivational range for physical activity engagement is understood and represented in research. More internalised forms of extrinsic motivation (I.e., introjected regulation) may result in positive outcomes as motivation becomes more self-endorsed and external factors driving the behaviour are taken on board as personally valued and meaningful (Gillison et al., 2009). Introjected regulation also represents the first step in the adaptive process of the internalisation of the behaviour, and it may play a key role in how these participants have first come to adopt exercise. High introjected regulation in the combined profile may work as a protective factor for adherence as enjoying exercise overall may not be experienced on specific occasions and involvement in the activities may be more related to obtaining approval from peers or increasing self-worth (Hurst et al., 2017), particularly in the community sample. On occasions where members of the community sample may not have chosen to be active, high introjected regulation may influence their decision through the obligation of other group members and in these scenarios, introjection is advantageous for exercise participation. Indeed, although intrinsic motivation is the most self-determined type of regulation, and as such, is strongly associated with behavioural persistence, it is suggested that it may not be sufficient to sustain behaviour when competing with the practical demands of adult life (Gillison et al., 2009; Teixeira et al., 2012; Miquelon and Castonguay, 2017).

The combined profile in both samples associated with high physical activity levels is corroborated by previous findings on physical activity motivation profiles (Stephan et al., 2010; Ferrand et al., 2012; Zhong and Wang, 2019; Friel and Garber, 2020). Friel and Garber (2020) explored the motivation profiles of adults and objectively measured physical activity levels using activity trackers. They reported that profiles high in introjected regulation in combination with high autonomous motives scored above average on physical activity levels. Due to the controlling nature of introjected regulation and therefore the conflicting

controlled and autonomous motives, these profiles may represent less chance of adhering to physical activity in the future (Ryan and Deci, 2000b). This suggests that different behaviour change strategies may be needed to ensure engagement in physical activity is adhered to. Zhong and Wang (2019) measured the physical activity motivation profiles amongst relatively sedentary office workers and found a combined profile with high introjected, also exhibiting highest physical activity levels. Their justification for such findings is based around culture, whereby it is possible that the Chinese participants in their sample reported high levels of introjection with autonomous motives as a fear of a negative result such as a negative reaction from peers. This may be plausible but does not explain our findings drawn from a western sample and previous findings in with samples in France (Stephan et al., 2010; Ferrand et al., 2012) and the USA (Friel and Garber, 2020) also western samples. Indeed, the findings in this review suggest that although introjected is maladaptive for long-term maintenance as a singular motive, when combined with autonomous motives, may be adaptive for exercise participation. The results also suggest that although individuals may benefit in regard to physical activity behaviour, from simultaneously displaying high levels of autonomous and introjected motives, they are less likely to become regular exercisers (Hopkins & Divine, 2023; Friel and Garber, 2020). In this sense, introjection may serve as an important progressive process of internalisation but ultimately, individuals should be predominately autonomously motivated and display a self-determined profile to ensure sustained participation.

It was important to test whether specific demographic characteristics differed between profiles and to ensure confounding factors were adjusted for. As displayed in table 13 for the general population and table 14 for the community sample, neither age nor gender were significantly different between profiles in both samples. In both samples, there was an unequal female to male ratio with the general population sample comprising of 71% females and the community sample 91% female. In the general population sample, participants were recruited by Prolific Academic and as a platform, many of their participants recruited are female (around 85%). Whilst it is not always necessary to have balanced samples, in relation to gender to test interactions (Dickinson et al., 2012), it is unclear whether the lack of a significant statistical finding is due to the overproportionate number of females in the overall sample or because gender differences between profiles did not exist in this sample. I

speculate the former; in the high combined autonomous profile in the general population sample, the percentage of males (30.3%) were more than double the percentage of males in the remaining three profiles. Indeed, in the community sample, more than double the number of males were in the combined profile (14%) than the remaining three profiles. Whilst ANOVA results did not rear a statistically significant finding, this can be somewhat supported by previous findings whereby Ostendorf (2021) found that men were more likely to be classified in a moderate combined profile, though due to their small sample of men, could not make an interpretation of the results. However, when referring to the systematic review findings, Friel and Garber (2020) report a combined profile comprised of 78% females which is not in support of the current study. A combined profile is characterised by high introjected and high autonomous motivation. When considering the literature, high introjected regulation in PA behaviour is typically linked with females, as females tend to report experiencing internal conflicting thoughts and guilt, less so than males (Hurst et al., 2017). Introjected regulation as a single regulation is predictive of higher likelihood of attrition due to the controlling element and unlikely to result in long term maintenance (Scioli-Salter et al., 2014). However, when combined with more autonomous motives that facilitate sustained engagement, as seen in the combined cluster, is associated with sufficient levels of PA and predictive of long-term engagement. It may be that gender differences between profiles are less important, rather the finding that highlights the most optimal motivational profiles and how PA promotion strategies can be facilitated so more individuals are fitting within the most optimal profiles.

Research has shown that individual characteristics such as sex, education level, age and marital status impact PA in different ways (Mullahy and Robert, 2010). For example, as the Social Ecological Model explains, PA engagement is dependent on multiple factors that range from individual characteristics to social and physical environmental variables (Lee and Park, 2021). In the general population sample, there were differences between profiles and PA levels depending on educational level, and lower educational attainment was higher in profile 3 (moderate autonomous) and profile 4 (amotivated), but it is unclear whether lower level of educational attainment causes membership of lower quality motivational profiles. Frederichs (2015) found that individuals from the autonomously motivated profiles were more highly educated than the other profiles. It may be that some social and physical environments mean PA is less accessible for certain demographic groupings of lower

educational attainment, thus resulting in lower quality motivation to be active, and it is the responsibility of health policy makers to ensure wider promotion of PA occurs and is specific to demographic groups. For example, for full-time working adults with children, incorporating PA into their workday might be more manageable and sustainable than committing to after work activities whereby time constraints are more likely to result in disengagement (Kinnafick, Thøgersen-Ntoumani and Duda, 2014). The efficacy of Bestrong works for a specific cohort of individuals, mainly middle to older aged females, but may not be effective for others, in which case wider promotional strategies are needed. In the case of time constraints for busy working parents, there needs to be a shift in promotion strategies or intervention designing that focuses too much on weight loss or aesthetic goals to encouraging more movement overall, which may involve busy working parents incorporating some form of physical activity in where they are able to fit (for example, schools could encourage parents to park further from the school to walk in). Indeed, educating the public on the many forms of physical activity are also important, to remove the lack of understanding and feeling restricted and avoiding being active altogether.

BMI between profiles differed depending on the sample which is supported by two studies in the systematic review findings; in the general population sample, BMI was highest in low quality motivational profiles 3 (moderate autonomous) and 4 (amotivated), which is corroborated by previous findings (Friederichs et al., 2015; Emm-Collison et al., 2020). It may be that individuals with higher BMI engage in less PA and are more amotivated as a result, in contrast with people with a healthier BMI that are more autonomously motivated to be active, which is in support of previous findings (Ersöz et al., 2016; Emm-Collison et al., 2020). Indeed, this is linked to the above where individuals who are less active, with a higher BMI may feel restricted or lack knowledge as to the many ways they are able to incorporate physical activity into their lives without, of which they can, over time build upon and increase. Encouraging and supporting the transition from being amotivated to exercise to autonomously motivated should be a high priority of health bodies and stakeholders. Higher levels of PA might create a motivational spill over in other weight control behaviours such as healthier diet (Mata et al., 2009). In the community sample, higher BMI was also associated with lower quality motivational profiles and is in support of previous findings. This could be explained by the particular cohort of individuals in the community sample,

whereby many of the members joined Bestrong to improve their physical health and aim to gain a healthier BMI. It would therefore be expected that individuals in the higher quality motivational profiles have likely benefitted from engaging in PA and have a lower BMI than those in the lower quality motivation profiles and engaging in less PA. The results highlight a need to further investigate the association between motivational profiles, PA and BMI.

3.3.4 Moderation analysis of motivational profile on PA and habits

The aim of research question 2 was to test whether motivational profiles moderate the relationship between PA and habits, comparing the general population sample to the community sample. In the general population sample, PA significantly predicted habit strength, whereby higher PA levels predicted stronger habits, though the effect size was small. In the community sample, PA did not significantly predict habit strength. In the general population sample, the high identified mixed profile and the high combined autonomous profile had significantly stronger physical activity habits and the moderate motivation and amotivated profiles had significantly weaker physical activity habits. In the community sample, there were no significant effects between motivational profiles and physical activity habits. In both samples, motivational profiles did not moderate the relationship between physical activity and habits meaning the impact PA levels have on habit strength is unlikely to be caused by motivational profile.

3.3.5 PA and habit relationship

As stated, PA predicted habits in the general population sample only, which somewhat corroborates previous findings that higher physical activity levels are associated with stronger habits (Kaushal and Rhodes, 2015; Van Bree et al., 2017; Fournier et al., 2017; Hopkins et al., 2022), though the exact direction is still unknown. A systematic review assessing the relationship between habit and physical activity behaviour found evidence for both directions (habit effecting PA and PA effecting habit) (Feil et al., 2021). As discussed in chapter 1, Gardner (2015) suggests that the relationship between habit and behaviour may not be directional, but instead bidirectional whereby the process of habit formation is determined by PA as higher PA engagement (thus higher behavioural repetition) will result in

stronger cue-context associations resulting in automaticity if the behaviour is consistently enacted. However, PA is also determined by habit, when behavioural automaticity is achieved, and the PA behaviour is automatically triggered when experiencing the context specific cue. This would be plausible when explaining the disparity between the general population and community sample in the current study, as PA did not predict habit in the community sample. There are several possible explanations for the group differences, firstly, due to the proposed bidirectional relationship between PA and habits, it may be that in the community sample where habits were moderately strong on average, PA is no longer a significant predictor of habit and habits are a predictor of PA. In this moderation analysis, habit was the outcome variable and PA was the predictor variable and their relationship was not assessed bi-directionally. Gardner (2015) alludes to the idea that when reaching behavioural automaticity, it is no longer the behaviour that is strengthening the habit, rather it is the strength of the habit that is causing the behaviour to be actioned. Lally (2010) states that the development of habits is asymptotic whereby there is a point that habit strength reaches whereby afterwards the growth is only minimal and if physical activity is being enacted outside of conscious awareness it is unlikely to be occurring as a direct effect of physical activity level, but rather as occurring because of the learned impulse to act. It is estimated that time taken to reach asymptote curvature in exercise behaviour is 91 days (Lally et al., 2010) and participants from the community sample were ranging from new members to members of several years, it is likely that on average, many of the respondents have reached the asymptotic curve limit.

Similarly, a second explanation may be more closely linked to the community program itself, the physical activity initiative may have effectively contributed to the development of habits in the community sample; in Gardner and Lally's (2018) framework they state that behavioural repetition is important during the habit formation process. It may be that members of the community group consistently attend because of the range of services included in their membership as well as exercise (educational talks, group discussions, nutritional information) and this behavioural repetition has resulted in moderate PA habits and automaticity. Self-regulatory strategies (such as planning and self-monitoring) is conducive for the habit formation process which therefore results in these intentional actions becoming habitual (Gardner and Lally, 2018). In comparison to the general

population sample, where habits on average were weaker, it may be that this sample are still going through the habit formation process, whereby physical activity level is more likely to directly predict habit strength, as automaticity has not been reached. Whilst it is unclear in what context the general population exercise and whether or not they engage in group-based activity, it is plausible to assume that when comparing to the community sample, habit strength is likely stronger for reasons to do with repetition and frequency developing automaticity over time. The community sample incorporate specific methods and means of the programme which facilitate frequency and repetition (e.g., strong culture, social support, educational workshops, community feel) which would be difficult for a member of the general population, for example, attending a commercial gym alone, to achieve. In relation to designing behaviour change interventions, it may be the delivery method of the community sample that reinforces their behaviour and promotes habit formation and to design successful behaviour interventions, more real-life, community-based groups that draw on the principles of habit formation processes would be most effective. Interventions may be more beneficial by incorporating processes that reinforce behaviour change such as timely reminders to exercise or repeating the behaviour in a consistent setting (such as the community sample), this may increase the likelihood of planned behaviour enactment, though this goes beyond the scope of this study.

3.3.6 Profiles and PA habits

In the general population sample, the high identified mixed profile and high combined autonomous profile positively affected physical activity habits, whereby habits in these profiles were moderately strong. To our knowledge, this is the first study to assess the relationship between motivational profiles and physical activity habits meaning the only previous literature comparable is studies assessing single motivational regulations. In this sample, the high identified mixed profile was characterised by individuals who strongly engage in PA because of enjoyment and pleasure (intrinsic regulation) and because it is of personal importance and value (identified regulation) and moderately as a means of relieving internal conflicts (introjected regulation). The high combined autonomous profile was characterised by individuals who engage in physical activity for a number of motives such as personal importance (identified), enjoyment (intrinsic), coherent with their sense of

self (integrated) and moderately as a means of relieving guilt (introjected). Given that more self-determined, high-quality motivation is linked to higher habit strength (Hopkins et al., 2022), it is plausible that PA habits were stronger in these profiles. Gardner and Lally (2013) suggest that intrinsically motivated PA reinforces the relationship between past performance and habit strength but also strengthens habit irrespective of past behaviour. This suggests that in the general population sample, PA habit strength may have been facilitated by membership in the high identified mixed profile and the high combined profile, by reinforcing repetition and frequency of PA behaviour. In addition, the high combined autonomous profile, characterised by high intrinsic, integrated and identified and moderate introjected regulation had the highest PA levels and a habit score of 3 (a score of 2.8 is thought to have reached behavioural automaticity). This profile in particular is likely to be predictive of maintainable and repeatable PA behaviour, though it is unclear whether the combination of high autonomous motives in this profile have facilitated the formation of the PA habit, or it represents participants that have reached a stable level of PA habit strength. When comparing to the results of the community sample, we speculate that the two profiles high in autonomous motivation in the general population sample, in particular the high combined profile, have facilitated forming PA habits and perhaps autonomous motivation acts as a mechanism for PA habit development, to a certain point until behavioural automaticity is reached and motivational regulations are less important for enactment in comparison to automaticity of behaviour. This would corroborate previous findings that suggest that strong habits are a mechanism for maintenance (Gardner et al., 2014; Phillips and Gardner, 2016). This is an important distinction for maintaining PA behaviour, as motivational profiles are thought to be dynamic and not static, therefore individuals may transition into profiles depending on motivational support/thwarting of needs (Vansteenkiste et al., 2009). If PA habits are strong or have at least reached automaticity, it is likely that the behaviour will be enacted irrespective of motivational profile membership, though this would need to be investigated on a longitudinal trajectory.

In the community sample, there was no significant positive effect of any motivational profile on physical activity habits. Physical activity habits were moderately strong in all four motivational profiles meaning when compared to the reference category (high identified/intrinsic), there was no significant difference in relation to habit score. These findings are important when comparing to the general population sample, as habit strength

was moderate in all profiles, even in the low motivation profile which is not in support of previous findings. The literature on physical activity habits typically shows that autonomous forms of motivational regulations (intrinsic, identified, integrated) are associated with stronger PA habits (Gardner and Lally, 2013; Hopkins et al., 2022) whereas less self-determined forms of motivation (external and introjected regulation) are not associated with moderate or strong physical activity habits. One possible explanation for this finding reinforces the idea that motivational profiles high in autonomous motivation may facilitate habit formation but when PA behaviour has reached a stable level of habit strength, people may fluctuate between profiles depending on psychological need thwarting/supporting. It may be that individuals in the community sample have reached stable levels of PA habit strength, meaning behaviour is frequently reinforced even when motivation is low, which will be discussed more below. On average, PA did differ between profiles but participants in the community sample were sufficiently active in all motivational profiles, though more importantly, none of the participants in this sample reported weak PA habits, which explains the lack of a significant relationship between profiles and habits.

3.3.7 Moderation analysis

In the general population, the low to moderate motivation profile, characterised by moderately exercising for personal importance (identified) and scoring low on the remaining motivates and the amotivated profile, characterised by a complete lack of interest in exercising (amotivation) negatively affected physical activity habits. These findings were expected and corroborate previous studies on low quality, or a lack of autonomously motivated PA are associated with weak habits (Hopkins et al., 2022). Given that habits are developed when consistently performed in the same context (Lally et al., 2010), and low-quality motivational profiles are predictive of low PA and disengagement (Friederichs et al., 2015; Lindwall et al., 2017; Altintas et al., 2018), as demonstrated in the chapter 2, membership of such profiles are likely to exhibit weak PA habits. Individuals in these profiles are the at-risk populations that are unlikely to develop sufficiently strong habits to sustain PA behaviour and in order to kick-start the habit formation process, it would be advantageous to promote high quality motivation that will rear engagement (Duncan et al., 2010; Silva et al., 2010). These results further support the idea that motivational profiles are important for

the formation of habits, specifically high quality (high autonomous) profiles whereby the behaviour is fully internalised and enacted for reasons congruent to the self or experienced as enjoyable and pleasurable (Lindwall et al., 2017), because they are most likely to be consistently repeated.

Hypothesis 2 was not supported in the community sample; habit strength was not significantly affected by motivation profiles. One possible explanation for the disparity in results between both samples is the reported habit strength. In the community sample, all four motivational profile exhibited moderately strong PA habits, even in profiles with low quality motivation. This result was surprising, but we speculate that as PA is enacted in the same stable environment in the community sample, it may be that habits have strengthened by the multiple sub-actions that are involved in attending (i.e., arriving at Bestrong, meeting other members, listening to educational talk, engaging in group exercise session). As mentioned previously, the moderate habits in all four profiles, irrespective of motivational profile quality, maybe a result of strong behavioural automaticity of attending Bestrong and less about the PA, which is enacted as a result of attending. Though it should be mentioned that participants in the lower quality profiles are more at risk of behaviour disengagement. When a person is exposed to the contextual cue there is an urge to engage in the habitual behaviour, however, the strength of the learned response and any supportive or unsupportive influences will impact behaviour engagement. For example, fatigue or thwarting of psychological needs on a certain day may lead to some deliberation (Lally and Gardner, 2013). Deliberation and enactment will be influenced by habit strength; when comparing both samples, deliberation for individuals in the lower quality profiles in the general population sample would likely lead to no enactment. Deliberation for individuals in the lower quality profiles in the community sample would be somewhat protected by the moderate strength habit and the countering influences would have less of an impact, but low autonomous motivation may result in some conscious decision making. From a practical perspective, it may be that PA promotion attempts should incorporate the same features of the community initiative (localised, community driven, group-based activity) to drive the increase in PA levels and facilitate the development of strong PA habits. Whilst it is attractive to consumers to promote the extrinsic incentives of PA groups, perhaps embedding a culture

of PA promotion that is autonomy driven will engage individuals and most importantly, facilitate engagement.

The influence PA level has on habit strength may not be determined or dependent on motivational profile membership. This finding can be supported by what is previously mentioned above, whereby the bi-directional relationship between PA level and habits is complex but it is likely that motivational profiles, particularly profiles high in autonomous motivation, operate by facilitating PA habit formation but are not the deliberating factor that determines whether PA influences habit. This is a novel addition to the literature as the moderating effect of motivational profiles on PA habits has not been tested before. We speculate that the distinction between a PA habit forming, and habit automaticity is determined by different functions; as habit forming requires conscious repeated exposure and behavioural enactment in the same context (Gardner and Lally, 2018) whereas once habits are developed to a moderate or strong strength the behaviour is actioned without conscious awareness (Gardner and Rebar, 2019). Motivational profile membership may only be influential in forming the habit, whereby more autonomous profiles likely facilitate the habit formation process by increasing frequency of engagement (Friederichs et al., 2015). Therefore, no moderating effect is clear, but the results do offer an important addition to the field. As discussed, it is recommended that future behaviour change interventions should aim to optimise high quality motivation for individuals to 'fit' into high quality profiles whilst simultaneously drawing on the principles of habit formation to further increase their likelihood of PA engagement.

3.3.8 Strengths and limitations

A strength of this study is the relatively large sample size, particularly in the general population, and the low percentage of missing data. It can be assumed that there is a smaller margin of error in results and a greater precision of findings. This is advantageous because this is the first study to assess the moderating relationship of motivational profiles on PA habits and it can be assumed that the results reliably add to the literature. In addition, the study used a person-centred approach when calculating motivational profiles, more specifically a latent profile analysis (LPA). LPA is associated with a better understanding of

heterogeneity that exists in the data because individuals are assigned to profiles based on membership probabilities that are directly estimated from the model (Spurk et al., 2020). A model-based approach is thought to be more arbitrary and rigorous, thus contributing to more reliable results. In addition, the moderation analysis is another high rigorous statistical test that strengthened the study, as it allowed to test for the influence of a third variable (motivational profiles) on the relationship between PA and habits, rather than testing a causal link between PA and habits, the moderation tests for when or under what condition the effect occurs. Therefore, gaining a fuller picture and improving causal inference.

Despite the strengths, this study has several limitations. Due to the COVID-19 pandemic, it was necessary for the study method to undergo several changes. Firstly, due to an inability to collect data during the pandemic, the study design was changed from longitudinal to cross-sectional, meaning data was only collected at one time point. Such designs preclude analysis of the influence of moderating variables (i.e., motivational profiles) on the PA-habit relationship over time. Indeed, it should be encouraged to examine the longitudinal, predictive role of motivational profiles in the PA-habit relationship. Motivational profiles have been measured over several timepoints (Howard, Morin, et al., 2021) and due to the dynamic nature of motivation, people tend to transition between different profiles over time. It is not assumed that motivational profiles are stagnant rather that several different factors influence the transition between profiles, which could be explored in future research, particularly in relation to PA habits.

This study relied on self-report measures, which can be subject to error and bias. Due to the pandemic, it was not possible to collect objective measures of PA level and self-report was deemed necessary. It is possible that the use of self-reported PA may have biased the association between motivational profile and PA in a socially desirable way, such that participants aligned their self-reported levels of PA with their response to the motivation for exercise questions. It is also possible that participants either under-reported or over reported their PA levels, it is common for individuals to over report PA levels in self-report measures (Colley et al., 2018). The measure that was used (Godin-Leisure time PA measure) is thought to control the risk of error (Ainsworth et al., 2012) due to the number of different parameters in the questionnaire (type, frequency, number of days). Future studies would

benefit from exploring the association between motivational profile and device-measured PA in a larger sample. A second limitation relates to the respective measures used for motivational regulations (BREQ-3), whilst this measure has been validated, it fails to consider the distinction between two different types of introjected regulation, namely avoidant and approach introjection (More and Phillips, 2021). This is a relatively new distinction, but results have found a marginal difference in PA behaviour (levels and engagement) between these types of introjection and it was not possible to dissect the approach or avoidant association of introjected regulation in the current study. Future measures should consider introjection as two variables as opposed to singular. In relation to the sample, 81% were female and 90% were white/Caucasian. A sample predominately female may not be generalisable to the whole population or other demographic groups. Gender bias can influence the understanding of the results and the ability to extrapolate findings to a wider sample. However, the large number of females might be advantageous for informing the design of PA promotion strategies that appeal to females.

Chapter 4: A qualitative exploration on how members of a community-driven exercise initiative experience motivation and the facilitators or barriers to PA engagement.

Chapter 4: Qualitative study

4.1 Overview

This chapter presents the methods, results and discussion for the qualitative study. I will firstly include information on the chosen design, research paradigm, sampling and participants, data collection and analysis and study rigour. I will then navigate the various ethical considerations necessary for this project. In terms of the results, the main themes and subthemes that emerged from the interview data will be described and then discussed to contextualize the themes in relation to existing literature and relevant theory. It is important to note, throughout the thesis so far, this sample of interest have been referred to as the community exercise sample. For clarity in this chapter, the name of the exercise initiative (Bestrong) will be used to reflect the in-depth focus on this population of interest. Participant characteristics (age, gender) are described first. Six distinct themes emerged

from the data; theme 1 (the social capital of BeStrong) has 2 subthemes (culture of Bestrong and promoting engagement with other members and creating supportive networks). Theme 2 (physical and psychological improvement) has 2 subthemes (weight loss and improving physical and mental health). Theme 3 (rewarding outcomes) has 2 subthemes (enjoyment and pleasure and sense of accomplishment from challenge). Theme 4 (situational barriers to being physically active) has 2 subthemes (COVID-19 restrictions and time). Theme 5 (personal barriers to being physically active) has 2 subthemes (stress and life events and self and mind battle). Theme 6 (processes to overcome barriers to being physically active) has 2 subthemes (mind-set shift to prioritisation and making exercise habitual).

The objective of this qualitative study was to understand what motivates members of Bestrong to be physically active and to identify the key contributing factors that drive members to continuously attend Bestrong. Bestrong is a particularly unique population of interest when considering exercise motivation, this group have a very low drop-out rate meaning their methods for promoting long term exercise maintenance is successful. Whilst the previous chapter analysed the quantitative data on Bestrong, it was necessary to gather qualitative data that is rich and descriptive and contributing to knowledge on this population of interest that does not currently exist.

4.2 Methods

The methods section covers the qualitative methodology, research design and theoretical underpinning of this study. Then a description of the sample used, including methods of recruitment. Next this section covers a description of the interviews purpose and questioning, and the methods used to analyse the interview data. Lastly, an overview of rigour and ethics within this study.

4.2.1 Qualitative methodology

Qualitative research is a field of inquiry and providing a universal definition can be challenging due to the numerous traditions, methods and methodologies that it entails. Qualitative research involves many different approaches and methods that share several commonalities but are ultimately different in the features they present (Aspers and Corte, 2019). Many individuals define qualitative research in different ways meaning the

interpretation and conducting of qualitative research presents itself in a multitude of ways (Anderson, 2010). For example, the philosophical approach (e.g., ethnography) chosen will influence the way the research is conducted, whilst being further shaped by paradigms (e.g., interpretivist) that the researcher brings to the study (Cairney and St Denny, 2015). A crucial component of qualitative research that resonates through the current study is the focus on lived experiences and interpreting meaning (Sparkes and Smith, 2009). Qualitative research is heavily reliant on descriptive data (as opposed to numerical in quantitative) and interpretation and meaning are drawn out by the research team, thus interpreting phenomena regarding what it means to the people under study and the meanings people bring to them (Sparkes & Smith, 2009). There are various reasons why a qualitative approach was chosen alongside a quantitative approach to conduct this project, the first being that it allowed a more detailed interpretation of the research topic and of Bestrong by adding the rich, descriptive data to the numerical, information-based data. Secondly, the nature of self-report data collection is often void of understanding the full picture, whereby a person's response maybe impacted situationally, but as a researcher their score is analysed as it is. The benefit of qualitative research in this thesis is the explanatory factor whereby members of Bestrong interviewed can convey how and why their experiences occur, which is particularly informative when studying determinants that impact human behaviour, such as motivation and habit formation. In doing so, the qualitative component of this project allowed an exploration into how motivation and habits tend to fluctuate which is reliant on social context.

4.2.2 Research design

The selection of an appropriate approach to answer a study's research questions is crucial part of the research process (Teherani et al., 2015); consequently, there is a requirement that researchers can clearly articulate and defend their selection and there is a myriad of qualitative approaches to research. For example, a phenomenological approach is concerned with understanding and describing a phenomenon through lived experiences whereas a grounded theory approach is more concerned with theory development whereby social processes are studied in context and explained through the developmental theory (Starks and Trinidad, 2007). However, a researcher finds a question, or a topic belongs within a

qualitative paradigm but does not necessarily correspond with the appropriate methods. This was partially true with the current project, whereby using a mix of methods is often challenging as qualitative and quantitative are often thought of as completely conflicting approaches. Furthermore, it was important to ensure the qualitative design was conducive to answering the research questions that underpinned this study. The research design adopted for the qualitative part of the project was a descriptive research design (Kim et al., 2017).

Qualitative descriptive research (Kim et al., 2017) seeks to provide a rich description of the experience depicted in easily understood language and aims to provide a comprehensive summary of events experienced by a group of individuals (Sullivan-Bolyai et al., 2005). The researcher seeks to discover and understand a phenomenon, a process, or the perspectives and worldviews of the people involved but does not seek to explain a phenomenon (Vickie A. L and Clinton E. L, 2012). Whilst traditional approaches such as phenomenology, grounded theory and ethnography are also descriptive approaches by nature, they tend to explain a phenomenon and therefore are not entirely descriptive (Starks and Trinidad, 2007). In addition, a descriptive approach is less interpretive as it does not require a highly abstract extension of the data. Lastly, a qualitative descriptive approach tends to draw from a naturalistic inquiry and is less theoretically based than other approaches, however, it is possible that a descriptive approach will hold overtones of other approaches, such as phenomenology. One main element evident with qualitative description studies are learning from the participants and their descriptions (Sullivan-Bolyai et al., 2005). Qualitative description research adopts a naturalistic approach, which creates an understanding of a phenomenon through accessing the meanings participants attribute to them (Doyle et al., 2020). The qualitative description approach assumes that many interpretations of reality exist and that what is offered is a subjective interpretation strengthened and supported by reference to quotes from participants (Bradshaw et al., 2017). Within the qualitative description approach, the phenomenon of interest is explored with participants in a specific situation and using a specific conceptual framework (Parse, 2001) with the research question related to the meaning of the experience. For example, in the context of this study, members from a community exercise initiative (BeStrong) were purposefully selected to discuss their experiences of motivation and the processes that they take to develop habits.

Regarding the conceptual framework, interview questions were open ended but were ultimately based on the theoretical framework of SDT that underpins this study. As SDT informed the design of this study, we thought it would be necessary to ensure the questions asked in the interviews and the topics studied were a depiction of the theory informing the study. Whilst it was important that the SDT did not become dominant in the execution of the study, when designing the interview guide, the questions certainly resonated with the SDT. The participants are a purposive or purposeful sample who have the requisite knowledge and experience of the phenomena being researched, therefore recruiting members from the same community-based initiative was necessary as all participants were describing the same experienced phenomenon but likely interpreting their experience in different ways. The interactions of a given social unit are investigated and the "participant group is selected from the population the researcher wishes to engage in the study" (Parse, 2001, p. 59). A rationale for the use of a descriptive approach to is to provide straightforward descriptions of experiences and perceptions (Kim et al., 2017). A qualitative descriptive design was deemed most appropriate because it most closely works with quantitative data and appeals to the mixed method design whereby descriptive qualitative data provides analysis and interpretation of the data-near self-report responses that provides a representative interpretation (Doyle et al., 2020). In addition, a descriptive design has clear potential for mixed method triangulation and has utility in the population of interest as it could provide the "how" and "why" of experiencing motivation and habit formation when a member of a community exercise initiative being, that the quantitative component of this project could not provide.

4.2.3 Theoretical underpinning

The relationship between research methods and paradigms often contested. There are at least three primary applications of theory in qualitative research: (1) theory of research paradigm and method (Glesne, 2011), (2) theory building because of data collection (French, 2010), and (3) theory as a framework to guide the study. Theory within qualitative research relate to the theories that ground a methodological approach (e.g., phenomenology, ethnography, narrative) or the epistemological paradigms that guide a study (e.g., post positivist, constructivist, critical). Other scholars have articulated the inextricable presence

of theory in the process of obtaining knowledge, describing facts as theory-laden (Guba and Lincoln, 1994), and noting the influence of a theoretical lens to arrive at observation statements. Theoretical frameworks provide four dimensions of insight for qualitative research that include: (1) provide focus and organization to the study, (2) expose and obstruct meaning, (3) connect the study to existing scholarship and terms, and (4) identify strengths and weaknesses. As has been demonstrated above, researchers have differed in their views of how theory should be incorporated in qualitative research and particularly when using a qualitative descriptive approach, which lies within the naturalistic approach, is less theory driven and more interested in process, meaning and understanding of a phenomenon as opposed to interpreting with theory. Qualitative descriptive approaches follow a predominately inductive approach whereby it is suitable for heavy description and concept development, however, due to the multiple methods nature of the project, data analysis was abductive, involving a process of moving between induction (e.g., explanations and ideas that stem from the data) and deduction (e.g., using priori theory to understand patterns in the data). In this context and to answer the fourth research question, the qualitative and quantitative methods supplement one another by providing a rich, straight description of the phenomena, rooted in the survey and interview data.

4.2.4 Sampling and participants

Once I had gained ethical approval, recruitment from BeStrong began. The specific sampling technique adopted is dependent on the type, nature, methods and purpose of a research project (Cairney and St Denny, 2015). However, for the qualitative component, participants were a purposive sample (Kim et al., 2017) based on their membership with BeStrong. Purposive sampling refers to selecting research participants that will ensure research aims are addressed and who have knowledge and experience of the phenomenon under scrutiny. Traditionally, there is no gold standard for sample size in qualitative research and it is encouraged that data collection continues until data saturation is reached, which differs depending on the research design and the size of the population (Fusch and Ness, 2015). Data saturation is reached when there is enough information to replicate the study, when the ability to obtain additional new information has been attained, and when further coding is no longer feasible (Fusch and Ness, 2015). Participants volunteered to be involved in a

semi-structured interview after completing the online questionnaire, though were taken from a purposely selected sample as being members of BeStrong. 19 participants were interviewed once, 3 participants were male and 16 were female. Age of participants ranged from 24 years to 66 (M = 48.68, SD = 10.92). There was no inclusion or exclusion criteria for the interviews, as all participants will have passed the inclusion criteria to complete the survey.

4.3 Data collection

4.3.1 Semi-structured interviews

Semi-structured interviews were used to collect data from participants for several reasons and are particularly advantageous in mixed-method designs. Firstly, the semi-structured interviews allowed the researcher to ask pre-determined questions meaning the researcher can guide the interview to stay relatively on topic and having more control than completely unstructured interviews. Whilst unstructured (in-depth) interviews are beneficial in some research projects, in this case there needed to be some form of structure and control over the topics discussed. Secondly, semi-structured interviews specifically ask open-ended questions and probing follow up questions, meaning the data collected is rich and in-depth. This is particularly beneficial in the context of this study whereby the qualitative data is important to compare and contrast with the quantitative survey data, which is numerical and lacks depth. Interviews were originally proposed to take place at a quiet room located at or near BeStrong base. However, due to the current COVID-19 pandemic and the strict regulations set out by the government, a contingency plan was devised, and a decision was made to conduct interviews online, via Zoom. The reason for this is for the protection of both the participants and the researcher, and so the advised social distancing guidelines from the government were adhered to Conducting interviews online were advantageous for participants during the pandemic as it meant they were able to comfortably conform to the restrictions, similarly, they were more freely and geographically available due to interviews being conducted at their home. Some scholars have inferred that online interviews allow participants to feel more comfortable and open if conducted behind a screen and in a familiar environment (Nehls et al., 2014). Disadvantages of online interviews include the

potential for disruption if connection is lost, fortunately this did not occur in any of the interviews conducted. In addition, it is difficult to recognise non-verbal cues when conducting interviews online and may be less authentic than face-to-face interaction (Nehls et al., 2014).

Interview guides were semi-structured and consisted of 7 main open-ended questions, these questions were developed based on questions from the online survey but adapted to resonate with participant's feelings and experiences. For example, questions in the survey required participants to rate their agreeableness to statements related to motivational regulations, guided by SDT. These questions were therefore adapted in the interview to ask, "why do you engage in physical activity", aiming to instil conversation about any of the five motivational regulations (external, introjected, identified, integrated an intrinsic) and several probing follow up questions were devised, such as "what do you like/dislike about exercising?", which may encourage conversation on the abovementioned regulations and amotivation. This allowed participants to speak openly about their physical activity experiences and describe their physical activity motivation which could be compared to the six motivational regulations described in the SDT, however, in some instances not all 7 questions were asked as the conversation naturally covered the question in some form and the researcher instead probed for more detail.

The first interview topic explored their overall experience with Bestrong, probing for the length and type of membership and the types of activity they engage in. The second topic covered their reasons for signing up to Bestrong, probing for their initial attraction to the service and how it differed from any other fitness initiative. The third topic explored how active they were before joining Bestrong and their relationship towards exercise that led them to the service. The fourth topic was surrounding the COVID-19 pandemic and whether they encountered any difficulties or changes to their physical activity levels as a result. The fifth topic broadly asked participants why they engage in physical activity but then specifically probed for their likes and dislikes towards exercise and the benefits they experience, which was specifically informed by SDT. The next topic explored any barriers that may impact their physical activity levels, such as internal barriers (confidence, body image) or external barriers (time, finance) and how they go about overcoming such barriers. Lastly,

the final topic explored how members go about fitting exercise into their lifestyle and exercising regularly.

Prompts and probes were also tailored to encourage further discussion of concepts and attempts to capture each participant's unique experience. Interviews began with myself, the researcher, introducing myself and explaining my role and interest in their participation in the interview. This was an essential part of each interview, and I ensured I thoroughly explained my background and research interest, to build rapport and create a comfortable environment. I then explained the ethical considerations and ensured participants they could stop or finish the interview at any point, briefly explained the structure of the interview in regard to interview topics and then asked for permission to record the interview. Interviews took place concurrently as survey responses were distributed and finished when data saturation had been met which was decided by the researcher. There was no particular timeframe in participants memberships that survey distribution or interviews took place, all current active members had access to both the survey and could volunteer for interviews. Interview length ranged from 25 minutes to 75 minutes but averaged at 55 minutes. All participants granted permission to record. Recordings were automatically, with 80% accuracy, transcribed by Zoom.

4.3.2 Data analysis

To make a decision on the analytical approach to use, an understanding of the data was necessary. The data set is large (19 participants) and therefore the approach needed to balance both depth and breadth, a framework analysis was deemed most appropriate.
A well-established analysis method in qualitative research, Braun and Clarkes thematic analysis (2006), aims to withstand any specific epistemology, a framework analysis adopts a more pragmatic approach. For the data collected in this study, a framework analysis was a more appropriate fit than thematic analysis for a number of reasons; firstly, F.A emphasises both a priori and emergent data driven themes to guide the framework, which certainly aligns with the data. There are pre-defined theoretical areas to be explored (SDT) but the unexpected results were also open for discovery. Framework analysis was purposely

designed to manage relatively larger data sets by using software such as NVivo which was important when there aren't many researchers working on the data.
There are four types of research questions framework analysis is typically used to address, these are contextual, diagnostic, evaluative and strategic (Parkinson et al., 2016). The current projects research question fits in with the "contextual" category as the interest alluded to the nature of participant's experiences of physical activity (contextual) and what the effectiveness of a community initiative is and their experiencing of habitual processes. Also being aware that the research is cross-sectional and will draw on elements from the larger data set of other research questions. As framework analysis is an approach that can be used for these different types of research questions, I was attracted by its flexibility, and felt that the relevance of the approach was by no means limited to applied policy research (Goldsmith, 2021).

NVivo (Bazeley & Jackson 2013) was decided upon as an appropriate software and is fully integrated with framework analysis which increased the appeal of using the analysis method. There are two NVivo software packages available however I used the stand-alone package and had an agreed protocol whereby any changes to the project were made on the project 'master copy', and copies of the project were regularly merged, and the master copy was backed up weekly on my university computer.

Framework analysis has 7 stages (transcription, familiarisation with the interview, coding, developing a working analytical framework, applying the analytical framework, charting data into the framework matrix and interpreting the data).

The aim of the first few stages of framework analysis is to 'get to know' the data, from individual interviews to its overall 'feel', which is common in many qualitative methods. Firstly, the audio recording and verbatim transcription of each interview is needed. As interviews were conducted online, the audio used was a video recording and as interviews were recorded on Zoom, audio was automatically transcribed to around 80% accuracy, meaning it was necessary to listen to the audio whilst checking the transcribed documents were 100% accurate. After the audio was transcribed, it was important to be familiar with the data and get a feel for the story within each interview. Whilst it wasn't necessary for the

researcher to know each interview by every minute detail at this stage, there was a need to achieve some sort of holistic sense of what was going on (Ritchie & Spencer, 1994, p. 179). This involved listening to the interviews, reading transcripts and making notes of the emerging concepts in the data. For framework analysis, it is not necessary to review all the material during the early stages (Srivastava & Thomson 2009), particularly when there are large amounts of data at hand, as this will happen at later stages in the data analytic process. Familiarisation was a huge advantage in this study as the data set was larger than anticipated with one researcher working on this stage, it was especially important to know the data before attempting any coding. Listening to the interviews resulted in gathering a sense of what participants were experiencing in relation to their physical activity journey, as well as understanding the emotion within the interviews. After listening to the audio, transcripts were carefully studied from the beginning, noting and discussing anything that seemed of potential interest, as well as any initial impressions that potentially reflected the research question.

The next stage involved coding, reading each transcript and applying a label (or 'code') that represents what they have interpreted, or feel is important, again not too dissimilar from thematic analysis. This involved the researcher identifying anything that is relevant from a range of perspectives. For example, reference was made to participant values and beliefs (e.g., beliefs about community driven initiatives), feelings and emotions (e.g., apprehension, frustration, pleasure), authentic things (e.g., anecdotal scenarios or behaviours). Coding is thought to be an important part of analysis as it means the data can be compared to other aspects of the data in a more systematic way (Gale et al., 2013). In order to ensure the coding stage was organised, all transcripts were reviewing in NVivo, which is considered a more conservative and systematic tool for qualitative data analysis (Furber, 2010). NVivo was an effective way of storing and organising the data with ease of accessibility during the interpretation.

The next stage involved developing the parts of the framework in a more systematic way by attempting to organise the codes further into a more meaningful manor. This stage involved a lot of back and forth editing and was very much a progressive stage. Ritchie and Spencer (1994) suggest that the process of developing framework categories is informed both by a

priori concerns as well as emergent issues arising from the earlier step of familiarisation. This therefore focuses the framework around the research questions and is tailored to what exactly the topic is aiming to explore. Though it was important to keep in mind that when developing the framework categories, the focus was on managing and organising the dataset, and the interpretation was to come later. Developing the framework was time consuming as the process involves many trial and error attempts of a number of different versions of frameworks before settling on a final one. For example, the first attempt at code identification on all transcripts revealed around 100 codes and the attempt to group them together seemed impossible. Therefore, it was more feasible to test out categories of codes on a proportion of the data rather than all 19 transcripts and always being open to revising the categories. codes were given a number in NVivo, and transcripts were coded using numbers so codes were not written out each time and were easily referred to. The framework categories identified needed to be mouldable and rigid rather than fixed.
Next, data charting was carried out where the data is rearranged to create some sort of order, whilst ensuring original meaningful aspects of the data are retained. Charting was conducted using framework matrices; whilst ensuring the analytical framework was followed, reference to interesting and important quotes were added. The final stage involves interpreting the data, however, throughout the analysis process impressions and ideas were noted which became beneficial during this final stage. Due to the descriptive method adopted, this stage mainly focused on identifying characteristics of and differences between the data and mapping connections of each interview and the experiences of each participant.

4.3.3 Rigour

As with any research design, ensuring the rigor or trustworthiness of findings from a qualitative descriptive study is important. There are four key criteria of rigour: credibility, dependability, confirmability and transferability. Credibility refers to the recognition of participants experiences contained in the study, which often involves reviewing individual's transcripts (Frost et al., 2014). The researcher practiced credibility when thoroughly reviewing the transcripts and looking for similarities within and across participants. Such interpretations were debriefed to more experienced qualitative researchers within the team

and all quotations in the report were participant's words. The second criteria described is transferability, which is the ability to transfer findings from one group to another; the study established transferability as there was an in-depth description of the population being studied at the beginning of the report which describes the demographics. Thirdly, dependability is described as the reliability whereby another researcher can follow the same methodological process and achieve the same results. This was achieved by ensuring a detailed description of the research methods were included. Lastly, confirmability describes how a researcher should be reflective and maintain self-criticism in how the research went and offering potential future insights (Shenton, 2004).

4.3.4 Researcher positionality

Research positionality refers to the characterisations of the researcher and potential factors that the research brings to the research process (Massoud, 2022) and therefore it influences both how research is conducted, its outcomes, and results (Rowe, 2014). It is common in research that the researcher's experiences might shape their approach to research, the more fixed aspects may predispose someone towards a particular point or point of view, however, that does not mean that these automatically lead to particular view or perspectives (Holmes, 2020). The researcher studied a MSc in Sport and Exercise Psychology meaning there was a personal interest in the topic and forethought around understanding more about physical activity motivation was likely guided by their prior knowledge from their studies. In addition, being someone who is active like themselves and have their own experiences of physical activity motivation and understanding of what factors may facilitate and impede motivation, meaning it would have been difficult for the researcher to approach this research project completely impartial and specifically when conducting interviews. In addition, the researcher spent some time with the members of Bestrong and the co-founders, not so much to immerse themselves into the culture and impact the data but to feel as though they were contributing something back for their time. The researcher does not feel that this caused any change in the data and feel it only improved the rapport between respondent and researcher, thus resulting in strong data being collected. One important consideration that informed the positionality of this research project was to remain reflexive throughout the project, specifically before, during and after interviewing

participants but certainly when analysing and interpreting the data too. Reflexivity starts by identifying any preconceptions brought into the project by the researcher (Holmes, 2020), understanding the previous personal and professional (i.e., academic studies) experiences, pre-study beliefs about how things are and what is to be investigated and motivation for exploring the topic. Reflectivity was discussed briefly in the previous section on rigour, however, in the context of positionality, it was critical to remain self-aware that a researcher's positionality is not fixed and may change over time, specifically in the four years of a PhD research project. This was certainly the case meaning it was essential to remain reflexive throughout. For example, to ensure the qualitative interviews were not impacted by the researcher's prior assumptions and knowledge, it was imperative to create a semi-structured interview guide, where the questions and probes/prompts were carefully written to ensure the questions resonate with the purpose of the research only, these were also confirmed with the researchers' supervisors. The interview guide was also piloted by the researcher with the researcher's supervisor and they both remained reflexive to ensure the interviews would be guided, not led, by the researcher in accordance with the questions on the guide.

4.3.5 Ethical considerations

The study was granted ethical approval from the Faculty of Biological Sciences Ethics Committee (REF: BIOSCI 19-033). Informed consent was essential prior to participants completing the survey and included a short description of the participant information sheet. Participants were made aware that they are free to withdraw their participation at any stage throughout the research, without any consequences.

Anonymity was protected during surveys as all responses were anonymous and no personal information was required, therefore responses were analysed using case numbers. Participants were given the option to leave their email addresses at the end of the survey for participation in interviews and gave permission to be contacted by the researcher. Participants had the opportunity to include their email addresses to be entered into a prize draw, again with their permission to be contacted.

Participant's real names were disclosed and after each interview finished, anonymity of their names and identities continued and used in description and reporting of the results. All data collected from the cohort of participants (questionnaire responses, interview tapes, transcripts) will be kept on a password protected computer inside the researcher's office, of which only the research team had access to. The data will be destroyed after 10 years.

4.4 Results

Overview: this section aims to describe the six broad themes evident in the data captured in this qualitative study. Several commonalities emerged when analysing the data, more specifically, the social capital of Bestrong (T1), physical and psychological improvement (T2), rewarding outcomes (T3), situational (T4) and personal (T5) barriers to being physically active and processes used to overcome barriers to being physically active (T6).

4.4.1 Participant characteristics

In total, 19 participants expressed willingness to participate in an interview. All participants were current members of BeStrong at the time of the interview, though membership length varied. Sixteen participants were female three were male. The average age of participants was 48 and aged ranged between 24 and 65.

4.4.2 Theme 1: Social capital of Bestrong

Many participants described the importance of Bestrong as an environment with a culture that encapsulates a strong sense of community and social interaction and support, all of which is cultivated in their social capital. A social capital is the network of relationships in a particular community or society which enable that specific community to work effectively (Bourdieu, 1986). Bestrong has successfully built a network of individuals with very similar beliefs and values meaning their approach to physical activity aligns with the culture of Bestrong.

4.4.2.a Culture of BeStrong

Participants discussed the various ways a culture of support had been cultivated in Bestrong's approach to lifestyle change. Most participants talked about their reasons for

exercising being heavily influenced by the social aspects of BeStrong, whereby participants met at least once a week and engaged in exercise (classes and organised walks) together which is embedded in the culture. Participants felt that BeStrong, as an organisation, promoted a culture of support and care through consistently offering group-based activities and opportunities to chat (e.g., when arriving at Bestrong, during the educational talks, during the organised walk events), fostering a supportive and person-centred approach. Overall, the culture of Bestrong was described as positive; this is driven by Bestrong founders who are viewed as relatable, having lived experience of changing their eating habits and adopting a more physically active lifestyle. This subtheme emerged as a key reason that facilitated participant's engagement in Bestrong and physical activity. Participant 6 described the trust they felt for BeStrong as a not-for-profit organisation and the holistic approach they offered.

Ppt6: "I find their support is unbelievable. Its immense and not just one sided for weight loss or exercise. It's a full combined approach and that's what I love about it. And my background, particularly health wise hasn't been great. I had many instances of spinal problems early on in my life… I just trust them [BeStrong] and I think you build up trust with people who are extremely genuine people who care about all their members on whatever level. And think that helps and rather than somebody who is a big business and just there to make money. You get the feeling that Rick and Rachel [Bestrong founders] really care about their members".

4.4.2b Promoting engagement with other members and creating supportive networks

Participants expressed the importance of the group and the relationships they made at Bestrong for sustaining their engagement in regular physical activity. Some participants explained that they signed up to Bestrong to meet people and since they made friends through the service. One participant explained they are used to their own company but finds socialising with others a strong motivator.

Participant 1 described the distinction between attending BeStrong for exercising and to satisfy their need of socialising.

Ppt1: “it [Bestrong] is my social life as well, I have almost made a persona out of being a runner and I think it kind of is part of my personality now… I’m not a naturally social person… I sort of forced myself to be sociable because I know it's good for me, but I’m naturally quiet and enjoy my own company and can be a bit of a hermit so going to something like Bestrong is a clash as it's really good motivator… making it a social event because at its most basic level running with people who are talking with you and creating conversation are offering distraction, running is secondary because you, you having a social interaction with somebody and that becomes your focus and it's like oh good I’ve run the three miles”

For Participant 7, exercise was seen as beneficial because of the organisation of group events and activities.

Ppt7: “I love the Community aspect that it [Bestrong] gives you. And the activities outside of class at the organized monthly walks. You get to know people and the other events that they put on, so I like that side of it. That's [social interaction] really is good for me”.
Participants described opportunities where they not only met new people but also engaged in new and different conversations in a supportive context. These interactions were viewed as beneficial for more than just exercising. Social interactions during exercise allowed participants to discuss their problems, feelings and emotions with other members. Participants described their interactions as involving a counselling element, strengthening relationships and knowing they will support you. Many participants described the group as non-judgemental whereby other members would positively encourage and applaud achievements, even when members had not reached their goals, such as overeating or missing an exercise class. Many members compared this dynamic to previous weight loss groups that were unsuccessful for them and didn’t provide social support and care, such as Slimming World and Weight Watches. These were described as controlling and toxic, which many either lost weight and gained it back again or did not successfully achieve any of their goals. There was a general similarity amongst all participant’s whereby sustained engagement is achieved when the environment is supportive, welcoming, trusting and caring.

Participant 1 explained the counselling element of Bestrong whereby members discussed the importance of having the opportunity to express how they felt.

Ppt1: “It's almost going to make it sound like a counselling group and it's not but the natural payoff of putting yourself in a social environment regularly for a few weeks and remembering what you've chatted about and people asking how you are doing this week is huge. There is a counselling element here, you can offload… it's not just going along, you have a chat with people, you get to know people and they support you. They’re all likeminded people and are very kind and welcoming so it's a nice thing to do as well”
Participant 7 and 8 compared their experience in be Strong with Slimming World and Weight Watches and the judgemental or non-supportive environment.

Ppt7: “I didn't look forward to going to slimming world it was judgmental, I was sort of chastised a little bit if I’d put weight on”

Ppt8: “You'd sit around and talk about who's lost weight who's put on who stayed the same and what they've done and why they've done that, and I didn't like that, because it was almost like victimizing or victimizing you for putting on weight that week and I dreaded it, so I felt sick before and during it”

4.4.3 Theme 2: Physical and psychological improvement
The second theme that was clear in many of the interviews was the topic of exercising for weight/fat loss, which was not surprising given that many of the participants had admitted to struggling with their weight in the past and had many failed attempts at losing weight or were self-proclaimed ‘Yo-Yo dieters’. This theme covers two sub themes: first, the subtheme of weight loss describes the importance of losing weight to achieve specific goals and find physical activity easier to enact. Secondly, a subtheme of improving physical and mental health more broadly represents how physical activity is impactful on multiple aspects of health.

4.4.3a Weight loss

Many participants expressed the importance of exercise for weight loss and body shape goals, particularly among those participants who expressed that they were overweight. Most individuals described their attendance at BeStrong as being important for weight loss as opposed to just exercise. Some participants were initially interested in losing weight and then overtime their motives changed, as a result of meeting weight loss goals and the positive benefits experienced (enjoyment, sense of community). In addition, losing weight enabled participants to feel like exercise (such as running) was easier.

Participant 6 explained that they signed up to BeStrong to lose weight.
Ppt6: “yeah I wanted to lose weight and I was struggling, and I didn't know what it was and after all the usual medical tests and there was no medical reason why I wasn't losing weight and so that's why I wanted to go really”

Participant 14 similarly signed up with her husband with weight loss goals.
Ppt14: “[the reason I exercise is] to lose weight, so that I can run more easily, so it was physical activity that David got me into it, because what happens is, I mean maybe you're not at this stage, I have got clothes from different times of my life and I don't tend to throw them away so I’ve got my thinner clothes I’ve got my medium sized clothes and I’ve got my huge clothes, you know, and all the rest of it and they're all really nice, and so the hard thing is that when I get to a different weight category”

Participant 2 emphasised the importance of weight loss when signing up to Bestrong but overtime this motive has become less important in comparison to health-related goals.
Ppt2: “The first part of going to Bestrong was about losing weight and that was my number one concern so I had an awareness that I was making it easier on myself if I could lose weight, so I had a weight loss goal… things are different now and I think I want to be healthy, I want to live a longer life, I want to be able to enjoy my grandchildren, I want to be the flexible lady who is able to do things”

4.4.3b Improving physical and mental health

Many participants expressed the need to feel healthy and to experience the beneficial effects exercise can have on physical health. Feeling healthy was particularly important for

retired participants who valued being physically able in order to live a longer life. Physical activity was also deemed important to participants for making life tasks and actions easier to enact, such as hands on activities in work. Increasing physical fitness and strength was seen as beneficial outside exercise classes. Some participants joined BeStrong with the goal of becoming healthier and remaining healthy.

Participant 2 expressed the importance of being physically healthy in relation to family.
Ppt2: “things are different now and, and I think I want to be healthy now I want to live a longer life, I want to be able to enjoy my grandchildren, I want to be known as the flexible lady not too old to be able to do things”
Participant 6 was aware their health was important in order to be around longer for their grandchildren.

Ppt6: “yeah, yet I say you just want to get to a weight, so you look fit you look healthier, but we've got three grandkids as well, you want to be around for them, for you know a bit longer”

Participant 7 described the health-related impact exercise has, such as life longevity and wellbeing.

Ppt7: “[I exercise because] it's a wellbeing feeling it's knowing that you know my blood pressure has dropped and knowing my cholesterol levels have dropped and, knowing that you know, by doing what I’m doing and stopping doing what I was doing is probably going to prolong my life and make me healthier”

In addition to physical health, many participants expressed that an important reason for exercising regularly is to maintain or improve mental health. Whilst some participants engage in exercise outside of BeStrong classes, the drive for engaging in these activities are the same. When comparing to periods of reduced or no physical activity, the mental health impact experienced in relation to mood and energy are vast.
Participant 8 explained that for them, exercising is crucial to maintain mental health. Ppt8: “because I struggle very badly with mental health and if I don’t exercise to me, it affects me,

exercise is the best antidepressant you can ask, so I started doing swift [indoor bike] alongside at the start of April 2020 and I loved it that much I'd be doing 500 to 900 kilometres a month"

Participant 9 described the benefits of being active on their mental health and how it's important to push themselves to keep exercising.

Ppt9: "it [exercising] really does help me with my mental health, and I do notice if I do take a couple of weeks off for whatever reason, I can definitely tell my mood goes down, I'm more snappy and have less energy, I just don't feel as upbeat so it definitely affects my mood and you find that even in the winter months when you look outside and it's dark and you think I don't want to go tonight, I really don't want to I'm not in the mood I'm tired I've worked all day but then you go and when I come out, I always feel so much better, I can really, really tell the difference and then I'm so pleased that I've pushed myself to go out in the bad weather and do it"

4.4.4 Theme 3: rewarding outcomes

Overview: The third theme that was evident in the data was the rewarding component that was driving intention to engage in physical activity. Enjoyment and pleasure are commonly experienced when exercising at Bestrong, both in members who are new to the programme and members with a longer standing membership. Workout classes are promoted as fun and complete autonomy is given to members with level of difficulty. Secondly, members often gain a sense of accomplishment when reaching goals linked to performance and ability.

4.4.4.a Enjoyment and pleasure

An important physical activity motive discussed by most of the participants is sheer enjoyment; the different mode of activity arranged by BeStrong (group classes, organised wellness walks) are all enjoyable and pleasurable for participants, which reinforces the repetition of the behaviour. Many enjoyed the classes because they are designed for any level of fitness and can be altered in relation to injury, meaning perceived competence of exercising is high in participants. Exercise being fun and enjoyable is important for sustained

engagement and when comparing to previous exercise attempts where there was no enjoyment, participants dropped out or reduced engagement. Enjoyment seemed to be evident from the beginning of membership as there is autonomy in type of activity and the time or day to participate. In addition, BeStrong have strong affiliation with running communities in the local area, meaning many of the members joined BeStrong to then trial running with the couch to 5k scheme, resulting in more challenging runs. Some participants have encouraged other members to take up running and complete challenges which further highlights the strong sense of community.

Participant 2 described their enjoyment of exercise.
Ppt2: “any other exercise I do because I quite enjoy it and I do generally quite enjoy physical activity, I always played sports at school and everything, so I’ve obviously got some sort of natural affinity towards exercise and both to do the ones I enjoy”

Participant 4 similarly described the sheer enjoyment, particularly in group settings. Ppt4: “I do enjoy it yeah I enjoy the group participation yeah cuz were all we're all at different levels, so it doesn't matter so if someone is really super good or a novice there's no shame you just get on with it yeah to the best of your ability”

Participant 2 explained that enjoying an exercise directly impacts their tendency to engage or avoid the activity.
Ppt2: “And the ones that I liked the trainer or I liked the exercise became part of my routine, I tried to build them into my regular routine and the ones that I didn't enjoy, one was boxing I hated that I don't like anything to do with fighting, totally not my personality I knew not to sign up for any sort of fighting ones with a certain trainer I didn't like so, then I go around the different gyms so I purposely went to look for the exercises that are naturally enjoy to do”

Participant 14 agreed that enjoying exercise is crucial to remove the pressure and force to go.

Ppt14: “the most important part is finding something that you enjoy because if you enjoy it, you're going to stick to it, so you know there's no point forcing yourself to go to the gym that you're not comfortable in and you don't want to go there”

Participant 11 described physical activity as pleasurable, directly comparing to a segment of their life whereby exercising was inaccessible due to time constraints.
Ppt11: “It was always time management, when I was working when I had a family there's so many things going on, whereas now I make time for me and that's why it's pleasurable”
Participant 6 described exercise as being important for manifesting positive feelings about themselves that go beyond weight loss, as this is a short-lived rewarding component whereas improving oneself from within has a longer lasting feeling of reward.
Ppt6: “Yes, it is yes [pleasurable], you see your weight loss and once you've got to the weight that you are well that's fine and you get a buzz from that and because I lost two and a half stone and that's great yeah fine what we do and I felt great but that feeling only lasts for so long so without the exercise the sort of the euphoria I feel when I’ve done and completed exercise, I wouldn't still be going because you've already achieved your weight loss goal but with the exercise that helps me not only feel like I am bettering myself but helps me maintain the weight as well”

4.4.4.b Sense of accomplishment from being challenged

Many participants highlighted the importance of challenge and accomplishments as a reason for engaging in physical activity. Many find accomplishing goals and challenges contributed to self-improvement and increased perceived competence. Some participants admitted they were proud of their journey so far and have achieved fitness goals they never expected to. A sense of achievement and accomplishment results in sustained engagement. Participant 3 explained the feeling of accomplishment experienced when they continuously improve which was rewarding.

Ppt3: “I keep doing it because I think I can see that if you keep working at it, you can get any improvements out of it, and you know from where I started to where I am now, well I’m not as good as I was now like 18 months ago but I’m still okay, I think, and I got to that reasonably quick level just by working hard and trying to improve so and I think it kind of

identifies really that you in a way that you are a master of your own destiny" Participant 6 explained that the challenges Bestrong organise encouraged a sense of achievement and engagement.

Ppt6: "I think it's working towards something new and that journey through that challenge and helping you to keep fit, at my age you need to keep everything going and keeping within your BMI and all the challenges help you to achieve that as well"
Participant 10 described the feeling of accomplishment that they have not experienced before.

Ppt10: "I've never really been the type of person who would ever really lift weights or anything like that, but actually I enjoy it and it's a sense of accomplishment that and I've never really had with exercise before"
Participant 7 described the sense of achievement they feel when they have adhered to their exercise schedule, even with deliberation.

Ppt7: "I always find it difficult to drag myself to do something, but once I've done it it's that sense of achievement, even if it's even if it's a you know, not a race, even if it's In January I've been getting up at half past five walking to the gym and swimming"

4.4.5 Theme 4: Situational barriers to being physically active
Overview: Theme 4 describes the situational barriers that participants believe impede their drive and ability to be active, some of these barriers were circumstantial and out of their control (e.g., COVID-19 restrictions) whilst others were described as more within their control (E.g., time).

4.4.5.a COVID-19 restrictions
Every participant described some form of obstruction in their exercise journey as a result of the COVID-19 restrictions. Some participants worked through the pandemic in various roles, including those in the NHS so their physical activity levels when restrictions were in place massively reduced. Some participants, particularly in the beginning of COVID-19 were

furloughed from their work, meaning by default were being less active without the commute to work or being active during the workday. Participants disclosed that during the COVID-19 restrictions, the weather impacted their motivation to engage in physical activity and in the winter months, characterised by less sunlight hours, members did not have any drive to be physically active. A few factors were involved that may have contributed to this; members explained that being controlled and restricted by COVID-19 regulations resulted in disengagement in activity. A disruption in routine and accessibility to BeStrong meant participants needed to find other means of exercising, though many were restricted to walking or home workouts. BeStrong transitioned to conducting online workouts during the beginning of the pandemic as a replacement for in-person weekly classes.
Participant 4 described their experience of the COVID-19 pandemic and working for the NHS meant their routine influenced their exercise schedule.

Ppt4: “because I worked all the way through and I worked for the NHS, so It was a little bit of walking but not much, so yeah the pandemic, really, really put the mockers on everything”
Participant 6 similarly described how the restrictions disrupted her routine to exercise.
Ppt6: “even when I was in my last role, I used to finish a lot later I used to get changed at work and go straight there from work and so yeah you know the restrictions that they have imposed stopped anything really”

Participant 9 described the pandemic restrictions directly impacting their motivation to exercise, being particularly impactful in the winter months.

Ppt9: “but then the second lockdown came along, and I think it was like September, we were going into winter, and I just could not motivate myself to do it, my husband did he carried on with it right the way through. But I just couldn't I couldn’t, and I think the space we didn't really have the space in the lounge the garden on the sunny summer nights that was fine, but I found that two of us in the living room, it was just, it just didn't work, for a long time I didn't do any exercise”.

Although most participants described the pandemic as being obstructing of their ability and motivation to engage in Bestrong and be physically active, some explained that the COVID19

pandemic was beneficial and helped their diet and exercise routine as there was less temptation at social events to eat calorie dense foods and were able to commit to their weight loss goals much easier. One participant explained that he encouraged other members of BeStrong to keep active during the pandemic and took on a leadership role in doing this, highlighting the sense of community.

4.4.5.b Time

Time was described as a common barrier to being physically active, which was expressed in different contexts all specific to participant's lives. Participants with young children explained the difficulty in fitting exercise into their schedule when they had other responsibilities. In addition, being busy with full time work and child responsibilities left some participants feeling de-motivated, whereby their energy levels were depleted. This meant they were only able to exercise as and when they found the time.

Participant 12 explained the difficulty in fitting exercise in as a parent.

Ppt12: "Bit by bit I'm watching the food and, at the moment my exercise is just a walk at lunchtime, because when I get home sorting out William who's my son you know, homework and tea's, cleaning and things like that so I've not got the motivation"

4.4.6 Theme 5: personal barriers to being physically active

Overview: whilst situational barriers were discussed in theme 4, it was clear in the data that many participants had specific personal barriers that often interrupted their motivation to be active. Firstly, stress and life events often means that self-care in the form of physical activity are not prioritised. Secondly, personal barriers often stemmed from their own insecurities and reluctancy to be active e.g., from lack of confidence, resulting in avoidance.

4.4.6.a Consequences of stress and life events

Stress was expressed as a common barrier in a few participants, explaining that stressful life events (such as jobs, finance) directly impacted on motivation and drive to exercise, often being labelled as a non-priority. Participants explained that in some instances when stress levels were high, they had difficulty in being active even when they intended to and were aware of the beneficial impact post-exercise. One participant used other low energy

strategies to relax and cope such as taking the time to sit down, as opposed to exercising. Similarly, some participants were aware that they had avoidance tendencies, instead of exercising when stressed which they admit helps, they sometimes avoided this and stayed home instead, which resulted in experiences of guilt. One participant explained that due to stress, they attended BeStrong but did not feel fully committed and endorsed in their membership and the group. This disconnection is described as being related to stress from work and a result of COVID-19.

Participant 6 described that exercise was not something to prioritise when they were tired and found other ways to cope with this.

Ppt6: “when I had a little bit of free time, the last thing I wanted to do was to go an exercise class and make myself far more tired than I was already, and so I think that had a massive impact on exercise and also, I think you when you get to that particular state [lack of drive to go] you can't be bothered when you've got five minutes or half an hour to go for a walk you just want to sit down and try and clear your head or maybe have a cup of tea, or you don't necessarily want to be getting your boots on and going out for a walk”

Participant 8 explained that they were aware that exercise alleviated experience of stress, but they often found it difficult to action.

Ppt8: “I have a rubbish day I feel a bit stressed after work and I’ll let the stress consume me so rather than thinking getting out for a run that'll help my head and get rid of the stress I let the stress kind of start emanating more and more inside me and then I’ll just sit on the sofa and I’ll think I’m not leaving now I’ve had enough I’m going to get my pyjamas on and I’m not going to move and I don't care and then it later on I’d be like I felt better if I go now so that that has happened a number times because it's easy to not run because it's not my favourite”

Participant 14 explained they have a negative association with certain types of exercise due to being informed about the death of a family member when exercising. The participant explained that yoga was the exercise they most commonly engaged in but now the activity is triggering for them. Whilst this scenario is uncommon, it highlights that tragic life events can impact a person’s motivation to engage in physical activity.

Ppt14: “Who would anyway, that meant that that I probably think that's what stopped me doing the online yoga because it was like oh my god I’m not going to go because the last time I did I had a knock at the window telling me what happened, so if I go again what else what other disasters could happen, which is ridiculous I know”

4.4.6.b Self and mind battle

A barrier that many participants explained they struggled with was internal conflict as a barrier to exercise. A few participants explained that their self-perceptions, perceived competence or appearance impacted on their engagement in activity. Appearance and feeling unconfident in how they looked, for example when exercising, led to disengagement in some participants, whilst also creating a negative association with exercising. Some participants explained that they unconsciously compared their abilities to that of others, which reduced their perceived competence. All of the participants who described body image and self-esteem insecurities and problems were female and some described such difficulties as having emanated from their past. Some participants described that the level of uncomfortableness they experience when exercising reduces the level of enjoyment which in turn impacts engagement. One participant was conscious of specific times of the year whereby exercising was not a priority, such as Christmas, and their diet often changed too. They explained that they felt a sense of self-sabotage because they were aware they would like to transition back into their healthier eating and exercising routine but found it very difficult.

Participant 2 explained that they experienced internal conflict that impacted their engagement.

Ppt2: “Right now, a reasonably few, to be honest, me is probably the biggest barrier my head whether I tell myself, I want to engage or whether I tell myself I don’t want to engage and sometimes that can be quite a battle but right now is to say, I purposefully set up milestones within the group that keep me engaged with them so I can’t drop out”

Participant 10 explained their resistance to engaging in certain types of physical activity because of their appearance.

Ppt10: “Again it's another mental health thing but yeah not really wanting to join in with things and because other people will see how tired you get or you know, like everyone says

oh, you know with your knees really bad, you should go swimming but the idea like I do love swimming but the idea of going to a public pool and going swimming this size it's not going to happen, because it makes me feel like inordinately uncomfortable”

Participant 13 similarly described that exercising freely involved a level of comfort in exercise clothes which is difficult to gain.
Ppt13: “it is all to do with image and looking and not looking and wearing lycra when you have a body like mine, perhaps not the best look and it is all to do with not just the look of it, but the comfort level of it, and you know finding a sports bra that fits and finding one that you can pull over your head and what have you and tuck everything into you know and it's just it becomes a little bit of a drain and the effort to go shopping for clothes like that, when it's not something you want to do anyway comes a big effort and then you look at them and they're huge and you just think you would rather that you didn't you know didn't buy them in that size, which is the whole point of going”

Participant 14 described their tendency to avoid exercise due to comparing their own capabilities with that of others, which impacts their engagement.
Ppt14: “I probably wouldn't go, because I think they're going to be too much faster than me, and so I would talk myself out of going, which is, which is bad, and I am a bit worried, so that by the time my leg is healed I’m pointing to it like you can see It, but that's what I’m doing with this hand which obviously you can’t see I am a bit worried about that, because then everyone else will have moved on and I won’t have done so being left behind”
Participant 9 explained that they experience aches and pains when they perceive themselves as weighing more than they would like, which impacts the enjoyment of exercise. Ppt9: “My weight, I think because like I said earlier about the running, I think it's I’m too heavy at the minute and that's why I don't enjoy it because, after I’ve run, I’m just aching everywhere and that's got to be down to the weight and carry too much weight for my size I’m only five feet”

4.4.7 Theme 6: processes used to overcome barriers to being physically active
Overview: Theme 6 evolved as an extension of theme 5 whereby ways to overcome the situational and personal barriers to being physically active were discussed. The first

subtheme, mindset shift to prioritisation, was evident in many participants which represented a common value at BeStrong whereby physical activity should be made a priority for self-care rather than a chore. Secondly, the final question asked during each interview was “what processes are involved in exercising regularly” and all of the participants, to some extent, considered the importance of making exercise habitual or second nature.

4.4.7.a Mind-set shift to prioritisation

Many participants explained that they struggled being physically active due to time constraints with juggling work and childcare responsibilities. Some participants described time to be inexcusable and that exercising should be a priority, as looking after your health is important. They suggested that internalising the importance of being active and learning to prioritise is crucial for sustained engagement, rather than demonising physical activity as something that must be done. Some participants explained that learning to prioritise exercise was tough, particularly among those who had families who were reliant on them.

Participant 6 explained that to avoid PA deliberation and increase likelihood of engagement a person must internalise the importance of being active.

Ppt6: “So I think it's important to set yourself time to exercise and realize how important it is, because unless you realize the importance, then it's very quick to say oh well, I was only going swimming, or I was only going for a walk and if you take out the day or something it's hard to slot it back in again”

Participant 9 explained the importance of fitting PA into her daily routine alongside other essential tasks such as making dinner.

Ppt9: “I think I just learned when I did that first program I just learned that you can't use the excuse of I haven't got time, you know, everybody's got 15 minutes or half an hour so it's just sort of embedding it in, making it a priority, now that I have to do it, that it’s part of the day, you know I work, prep the tea before we go to exercise, and then we go to exercise it's just the routine now it's just built into our routine”

Participant 9 explained that the priority of fitting PA into their lifestyle was never high but now they ensure there is the time.

Ppt9: “I think it was just the fact that people always have excuses as to why they were too busy to do it, you know I used to say while the kids were little, and you know they've got their activities and they come first and I haven't got time to be doing things like that, but then once I signed up to Bestrong it just showed that it didn't really impact much on the home life, nobody starved, you know all the clothes were washed and ironed, and they got to school and I still managed to do it and, at the end of that six months, you think oh yeah well yeah I’ve got time to do it, you have it's just a mindset”

Participant 11 explained that post-retirement they were able to prioritise exercise whereas when they were working time management was a difficulty.

Ppt11 “I wouldn't have time to do it before, when I was working as I had a very heavy schedule, but once I’ve retired and I’m doing this, I think it's great you meet lots of interesting people… It was always time management, when I was working when I had a family there's so many things going on, whereas now I make time for me and that's why it's pleasurable”.

Whilst time is a common barrier, some participants expressed that there is always the time, but other psychological barriers take over, such as lack of drive to prioritise exercising. Retired participants explained that finding the time to be physically active when working full time before retirement was difficult and was often a lower priority. Since being retired, participants explained that they have to prioritise time for themselves including attending BeStrong and being physically active. After retiring, participants prioritised exercise more and engaged in activity for health-related reasons.

Many participants expressed the importance of a practiced mindset shift, particularly to cope with internal conflicts. They explained that the ethos of BeStrong is to give members the tools to create a healthy lifestyle, in relation to exercise and nutrition and aligning their mindset in order to practice the strategies is crucial. For example, reducing self-pressure and allowing deviations from exercise and nutrition plans to happen, as other responsibilities sometimes take over. By introducing a sense of autonomy rather than feeling controlled,

participants explain that the behaviour (being physically active) will just become a part of the routine.

Participant 4 explained that before Bestrong they did not consciously think about the unhealthy lifestyle habits that were progressing whereas now they were aware of the tools they learned.

Ppt4: “I don't know I think it's a bit like neuro linguistic programming… the challenge is changing your mindset from not thinking about being unhealthy and sleepwalking into obesity into a mindset of exercising and eating healthy and putting into practice the tools that you're given with Bestrong”

In addition, one participant stated that a change in mindset occurs as you identify with others, being in a safe environment to discuss triumphs. Also, they discussed the struggles that play a crucial part in attendance and highlights the reasons for being motivated in theme 1.

Participant 10 described the importance of talking about struggles as well as triumphs as a group, which increased feelings of relatability and promoted mindset change.

Ppt10: “the other places that I’ve been to like weight watchers and slimming world and stuff they have people that don't really talk about the struggles and only talk about the triumphs and actually like your triumph and isn't really going to help me, in the nicest possible way, like the fact that you, lived on spring water for a week isn’t going to work whereas, you know talking about what I found really difficult this week, and this is what I’ve ended up doing and everyone's like yeah do you know what I’ve had weeks like that this is what you need to do, or like don't be disheartened, carry on draw a line under it, these discussions really change your mindset”

4.4.7.b Making exercise habitual

Many participants explained that in order to manage barriers that impede exercise, embedding PA into a consistent routine was crucial. Members of BeStrong on average attended a session at least once a week, at the same time and location as the schedule rarely changes. This was deemed advantageous for consistency and embedding the behaviour into their routine.

Participant 11 described an experience whereby repeating the exercise behaviour consistently for a period of time resulted in the behaviour feeling second nature and easier to maintain. Participant 11 described that even when exercise felt second nature there was still a conscious element that was involved to action the behaviour, if they do not have any desire to exercise, there is deliberation, and it is difficult to maintain consistency.
Ppt11: “if you can do this for so long and stick at it, then you know you can do another week of it and then before you know where you are its second nature absolutely, I see it now anyway… that's the habit formation that once you've been doing it for a while, because it will, you stick to it, but you have to want to do it I think, but not all the time I’m not obsessed with it, but I know the certain things I like to do, I like the HIIT class I like to get my steps in either between 15 and 20,000 a day… there are things that I like to do… so I plan those out and then, if we go walking on the coast or you know together that weekend that sort of extra that's a an extra thing really”

Participant 12 consistently exercised on her work lunch break, often with a colleague to cope with the barriers of time constraints. This participant and her colleague had similar goals for implementing exercise into their routine (increase fitness and weight loss), but this activity became an important part of their day and described this behaviour as being habitual.
Ppt12: “it's walking at lunchtime and I go out for a walk with my secretary, she's going on holiday and she wants to get fit as well, or just slim down as well, and so work it's always busy but I will always be out there, I’ll go for a walk and I do a mile circuit and we do it, sometimes we're with different people different days, but every day, I was out there it didn't matter how busy I was unless something was going completely wrong, I will be out walking, it's a habit now we've both got into the habit at lunchtime”

Participant 3 described the importance of routine and consistent attendance, exercise and importantly, being a member of exercise groups is so ingrained and consistent in his routine, that it would be highly noticeable by other members if he did not attend. He expressed that he associates specific timings on a specific day with exercise and going to running club feels like second nature. Participant 3 explained that being consistent is also a way to avoid experiencing previous emotions about himself; he previously perceived himself as “flaky” or

inconsistent at the beginning of his exercise journey, which had negative connotations, because he found it challenging to maintain the behaviour.

Ppt3: “I just keep going because, and I think well every day is a school day and, first of all, and it's just part of a weekly routine now… my weekly routine you know involves going to Bestrong, at least once a week, you know sometimes 2,3,4 times a week and that's the week kind of done really, so you know it's like Wednesday night tonight is the club run for the Blackburn roadrunner so I’ll be there at seven o'clock and if I didn't go it would be a very, very, very bizarre situation and so it is that routine and it does just feel second nature, if I don't go tonight, it will feel completely bizarre if I’m not there and I think there's a part of my brain that will revert back to the feeling of feeling a bit flaky you know, whereas if I go tonight it's another box ticked off that's another night I’ve not been flaky because I’ve done enough and turned up”

Participant 9 found it important to remain consistent to avoid interrupting her consistent routine and finding it challenging resuming the routine. She described that if she experienced a gap in her exercise routine, for a period of several weeks, it snowballed into a much longer time frame.

Ppt9: “yeah especially Bestrong, because I have been going to that class so long that yeah, it's my Tuesday and Thursday night, saying that I do, I go to Bestrong because it's just second nature… I don't want to fall in the trap that I have done before, that I take two weeks off that leads to four weeks off that leads to six months off You know, and I do think that I’m always thinking to get back I need to get back on it”.

Many participants discussed the role of habit formation and the processes involved in creating strong habits, both PA and eating habits. Participant 11 described PA as a strict part of their routine, comparing exercise to everyday behaviours such as brushing their teeth. Exercising is also a behaviour that is encouraged and embedded into their children’s routine and viewing exercise as an essential daily habit is modelled to their children, comparing the behaviour to brushing their teeth.

Ppt 11: “see this as physical exercise going out for a walk it's part of my day and I think if people could get their head around that you know you brush your teeth, you use the bathroom you go for a walk, I think it should be… and with my children, I think we all do pretty well so that that its part of their day that they have some time to the outside life” Participant 13 described the difficulty in strengthening exercise habits alone and highlighted the advantage of BeStrong and the relationship with the community that made the process easier. They explained that the habit of exercising was inextricably connected to the community group shared by all members.

Ppt13: “you just need to attach a habit to something else and try and make a 1% difference and that's what I decided I would try and do and but it's never easy to do on your own so despite the fact that my family are very supportive it's not easy to do on your own, so I wanted to try and try and do something with a community where the group with some other people who are like minded”

Some participants found organisation and planning to be effective tools to strengthen their exercise habits; participant 5 uses a booking system to ensure they have scheduled in their exercise and to increase likelihood of attendance, as the classes can be fully booked without notice. They also have specific days for exercise activities meaning they can stay accountable, and this organisation is an enjoyable process.

Ppt5: “Obviously, I have Bestrong on a Tuesday I’ve got my membership and the clubicise on a Thursday I booked for next week, when I get there tonight, I’ll book for the following week so if you just know because there's limited nodes covered there's limited spaces, if you don't book you don't get to go because I’ve seen it fill up quite quickly so yeah it's just forward planning, this is what you do on a Thursday… I enjoy it anyway and I use the Bestrong app for logging my water and food and my activity, so I use that”.

In addition, participant 6 describe how she wrote her exercise plans in her diary and described being strict with enacting the behaviour when it is scheduled in. She described that coping with the barrier of time constraints is made easier when there is an awareness of the importance of exercising. Whilst this might be personal to participant 6, they explain

that valuing exercise results in sustaining the behaviour, as opposed to avoiding it. Ppt6: “We put it in the diary and once it's in the diary unless it's something urgent then that's what happens because my husband, he exercises he goes out for walks and things, longer walks than I can manage and once that's in the diary it almost always happens… I mean that's a motivational tool and I share that with the group and quite a lot of people since then did the same thing”.

Participant 8 followed a similar approach whereby a daily planner was situated in her household kitchen and used to schedule exercise activities for the week. This tool is particularly useful to cope with circumstantial barriers that interrupted exercise such as bad weather, as having the exercise physically written down as a reminder increases the likelihood that the plan will be followed through.

Ppt8: “We like to have in the kitchen a planner for the week we write down what each of us is doing on what day so we know we're doing it together, or we know that we're doing it separately and it's just a constant reminder there of this is what you should be doing, but what you need to be doing tonight to achieve what you want to achieve and it takes time because, obviously, once you get out of the habit of doing it and, particularly in the offseason it's so easy to go into a lazier routine because it's cold it's dark it's not nice weather we're in obviously you've got things planned and all that this month I’ve got to do this and I’ve got to be you know it kind of gives you that focus and that that need to put the habits in place, because you know You will achieve what you want to achieve”

4.4.8 Discussion

Overview: the final section of chapter 4 aims to discuss and interpret the six themes described above with supporting evidence and relating back to the function of Bestrong. Finally, this section discusses the strengths and limitations of this study and offers some future directions to consider.

This study highlighted six broad themes that represent the factors that both facilitate and debilitate physical activity engagement at Bestrong: social capital; physical and psychological

improvement; rewarding outcomes; situational barriers; personal barriers; processes used to overcome barriers. Themes one, two and three reflect the key motivating factors that drive Bestrong member's engagement and attendance, while themes four and five describe the barriers that can disrupt their engagement and lastly theme six describes the processes members adopt to cope with the barriers. This study identifies features of Bestrong that could be included in community-based interventions aiming to promote long-term sustained physical activity, which were not found in the quantitative findings.

Both the cultural and social environment of Bestrong was identified as contributing to member's engagement and motivation to continuously attend Bestrong. Organisational culture is defined by the shared beliefs, expectations and practices that inform the actions of members (Kumar, 2016) and a strong culture is inherently linked to higher performance. In relation to reasons for engagement, embedding a strong culture that aligns with the goals and aspirations of its members (e.g., health improvement, socialising) elicits a reason for members to continuously engage with the initiative. As outlined by participant six, the founders of Bestrong have created a combined approach that appeals to both diet and exercise but have also created a culture whereby members have trust in the initiative, thus influencing motives to engage. Research into culture and the fitness industry and physical activity interventions is limited; several studies have reported that the success of physical activity programmes is facilitated by a culture of acceptance and open-mindedness, prioritising a culture of health that supports physical activity opportunities (Brinkley, Freeman, McDermott & Munir, 2017) and encouragement and shared values (Sendall et al., 2016). MacIntosh and Doherty (2008) found that the organisational culture within private fitness clubs was focused on corporate values, which directly impacted member's satisfaction and tendency to remain members, suggesting that an organisational culture plays a critical role in member retention. More recently, Bailey, Benson & Bruner (2017) investigated the organisational culture of CrossFit, a group-based exercise affiliation that fosters a culture of physical activity through structured, varied exercise sessions in a group-based setting. Their qualitative study found that the organisational culture is rooted in a strong sense of community that extended beyond the gym and shared experiences, pride in their workouts and inclusivity. In this study, all members shared a common goal of improving health and well-being, which pertains to the culture that BeStrong cultivates. The culture

that is cultivated at BeStrong is likely to be predictive of their low attrition rates as organisations with a strong culture are likely to sustain success over time (Buchanan and Mccalman, 2019) and the strong psychological sense of community and support established at Bestrong has a positive influence on retention.

The findings are also supported by the literature in relation to the role social interaction plays in physical activity engagement (Sharpe, 2003; Killingback et al., 2017; Gallé et al., 2019; Lai et al., 2020). The importance of social interaction and exercise is in support of the social capital theory (Bourdieu, 1986) which states that within social relationships of people that share the same goals, they often come together as a group at a community level to share resources and information in a collaborative sense. The social capital theory has been researched in the physical activity literature with support that social capital positively influences motivation and engagement in exercise (Chen et al., 2019; Baladastian et al., 2021). More specifically, social capital is thought to influence engagement through provisions of behaviour-targeted social support. BeStrong members seemed to describe their experience of PA as the key defining components of social capital, a collaboration at a community level that share goals and resources. A limitation with theory is in the context of physical activity is that many individuals do prefer to exercise alone and promotion efforts that target social capital might not be effective at an individual level for this reason. However, enhancing the social capital of inactive individuals may help increase physical activity overtime and efforts to drive a social capital could result in marginal improvements in physical activity levels for many individuals that are motivated by social connection. Social support is an extremely influential and motivating factor that drives physical activity engagement (Carron et al., 1996; Stapleton et al., 2015; Dam and Rhind, 2020; Elshahat et al., 2021). SDT states that the psychological need of relatedness should be satisfied for a person to grow, develop and be most productive (Markland and Tobin, 2010). Many of the participants described the supportive element is crucial for sustained engagement, even when motivation was low, which is supportive of the social support literature. Companionship and emotional support have been identified as the primary types of desired social support for exercise behaviours (Stapleton et al., 2015) and the key elements of community-based initiatives such as BeStrong, is emphasising social interactions, including group-based exercise, group discussion sessions and organised wellness walks. Research on

older adults suggests that social support is crucial for physical activity engagement (Lindsay Smith et al., 2017) and whilst older adults may have different reasons for engaging in physical activity in general, the role of connection and support is the same. Indeed, community-based exercise programmes that utilise social support are associated with sustaining exercise behaviours in older adults, particularly through factors relating to the individual, the instructor (e.g., trust, humanised), design of programme (e.g., location, affordability) and social features that support a sense of belonging (Killingback et al., 2017), which is in support of the features mentioned by the participants in the current study. Factors that have impeded the success of community interventions include being undervalued, lack of communication between members, poor relationship between community and organisation (Cooper et al., 2021). If connection and support from others is a facilitator of physical activity engagement, practitioners and stakeholders should aim to encourage physical activity with group-based activity, which might be more sustainable than advertising external incentives. Examples of community-based social support interventions are evident in the literature, such as walking groups, exercise buddy systems and planning schemes (Cleland et al., 2012; Hanson and Jones, 2015; Hinton et al., 2017). The disadvantage of community-based interventions is the level of attrition when the intervention is removed or completed, which does not serve to tackle physical inactivity levels long term. This research-to-practice gap, whereby there is a lack of translation of successful interventions in controlled conditions into real-world contexts, outlines a significant challenge for public health and community engaged researchers and practitioners attempting to implement effective and sustainable interventions for population health. Drawing on the benefits of real-life successful community initiatives, such as BeStrong is advantageous for informing practitioners and is lacking in the literature.

In addition to the culture and social environment, many participants were highly motivated to exercise in order to alter their physical appearance, most commonly for fat loss. Weight loss and body composition changes are common controlling motives for the initiation of physical activity (Ingledew and Markland, 2008; Scioli-Salter et al., 2014; Klain et al., 2015). Controlling motives such as weight loss are advantageous for adoption because the inherent focus on the tangible goal of losing weight is usually motivating and increases intention to action the behaviour. However, controlling motives are not associated with long-term

engagement and are associated with maladaptive outcomes (Sicilia et al., 2018). The reason for this is proposed by SDT theorists which state that engaging in exercise to gain rewards or avoid punishment is short-lived in nature and once a person achieves a reward set for themselves (e.g., a weight loss goal) the continuation with the behaviour, unless internalisation has begun, is reduced as the exercise is not self-regulated (ThøgersenNtoumani and Ntoumanis, 2006; Emm-Collison et al., 2019). In addition, for many inactive individuals, they lack sufficient interest in exercise and do not value it enough to make it a priority but adopting exercise for weight loss has a rewarding contingency that is likely noticed quicker (Teixeira et al., 2012). Therefore, the adoption of exercise for reasons consistent with weight loss or improving appearance are a means to an end and often thought of as “having to” rather than “wanting to”. Participants in this context discussed being somewhat motivated for externally controlling reasons such as weight loss but they also displayed a high degree of internalisation suggesting that maintained physical activity behaviour is likely to be continuously enacted for self-determined reasons and controlling reasons such as those associated with their appearance. It may be that once a behaviour has undergone internalisation and the behaviour is enacted for reasons within the self (such as social support and strong identification as displayed by participants), a person can be motivated for controlling reasons that do not result in maladaptive consequences on maintenance.

Participants also discussed the huge benefits physical activity has on both physical and mental health, while this information is not novel, members of Bestrong describe being motivated to attend continuously because of the associated health benefits. The literature on the beneficial effects of PA on physical and mental health and wellbeing is well established (Fox, 1999; Hanson and Jones, 2015; Anderson and Durstine, 2019; Dunne et al., 2021); more specifically, participation in large physical activity events such as UK parkrun have a positive impact on mental wellbeing, an event that fosters the psychological needs of relatedness, competence and autonomy (Dunne et al., 2021). In addition, a systematic review on walking group interventions found that walking groups have wide ranging health benefits and are effective for adherence (Hanson and Jones, 2015). In the current research context, BeStrong have affiliations with running groups and have weekly organised walks and the results from the data are in support of studies, whereby participants state that being

active increases aspects of physical health and mental wellbeing. They describe the key drivers of engagement are associated with the positive benefits on health and wellbeing. A key problem with addressing the high levels of inactivity in the UK is the lack of awareness and education surrounding the beneficial impact of physical activity on health and wellbeing. Many individuals are likely aware that being active is a health behaviour but many individuals, particularly with chronic illness, may be unaware of the physical and mental improvements that incorporating activity into their lives may have. This unawareness of the benefits likely contributes to amotivation as a lack of interest in a behaviour is linked to not taking action (Faries, 2016). Indeed, many individuals intend to change or maintain a behaviour but will not follow through with their intention, as explained in the intention-behaviour gap (Mullan et al., 2021). In relation to health promotion, it would be beneficial to embed an understanding of the physical and mental wellbeing benefits of being active that appeals to a whole population. Bestrong in particular are a unique service as they offer a number of educational formats to memberships. Members receive weekly educational and research-driven videos and in-person talks including group discussions on topics ranging from diet, physical activity, mental health and other psychological processes. Therefore, the results presented in this qualitative exploration are novel.

The third theme to emerge from the data describes the rewarding outcomes experienced by members of Bestrong that also facilitate their engagement and attendance. Finding exercise inherently enjoyable is a deeply evolved motive that is associated with long-term engagement (Rodgers et al., 2010; Teixeira et al., 2012; Geller et al., 2018; Rodrigues et al., 2019), however, research into SDT and physical activity suggests that people can enjoy a behaviour but still not persist at them and avoid them, as there are factors that facilitate and undermine intrinsically motivated behaviour (Standage and Ryan, 2020). For example, the satisfaction of basic psychological needs will facilitate intrinsic motivation which can be seen in the data as participants express that group participation increases enjoyment (relatedness), the lack of judgement from others when they exercise at different levels (competence) and the freedom to find an activity they enjoy (autonomy). These findings are in support of previous research which state that enjoyment facilitates behaviour when psychological needs are satisfied (Teixeira et al., 2021; Leisterer and Gramlich, 2021) and appear to facilitate engagement in the context of the community exercise group.

Participants expressed a number of factors that facilitated their enjoyment for exercise, such as being fond of the trainers, choosing exercises they find pleasurable and including other peers. In relation to previous research, social support is also an important determinant of physical activity behaviour in exercise maintainers (Geller et al., 2018) further supporting that community driven or group-based exercise initiatives facilitate engagement by promoting enjoyment and pleasure. In relation to pleasure, experiencing pleasure in health behaviours and particularly physical activity is an integral part of sustaining the behaviour. Whilst pleasure is commonly associated with negative and destructive of health behaviours such as seeking pleasure from nicotine or (over)eating, pleasure can be experienced when exercising which very much contributes to health (Phoenix and Orr, 2014). Pleasure in sport and exercise has been well explored; the ethnography of bodybuilders in the UK found the bodily pleasures experiences with anaerobic exercise, though these are short lived but do encourage bodybuilders to continuously repeat the exercising the experience the same pleasure (Monaghan, 2001). In addition, subjective experience of physical activity in older adults found that older adults experience different nodes of pleasure (Phoenix and Orr, 2014). For example, some described a pleasure of habitual action which was not necessarily from the enactment of physical activity itself, rather they found the repetition and routine of physical activity pleasurable because there was a sense of purpose and structure. As opposed to, the sensual pleasure described when being physically active, such as the touch of wind when walking or the touch of water when swimming. In the context of this study, participant eleven describes a more personable pleasure, whereby pleasure is experienced as a result of the luxury of making time for themselves, as if pleasure is the by-product. However, participant six experiences goal achievement pleasure. The results highlight the variety and complexity of pleasure and is largely not a singular or one-dimensional construct in relation to physical activity.

As participants suggest, engaging in exercise that a person finds enjoyable even as a novice is crucial and a person should avoid forcing a specific form of activity upon themselves, to avoid attrition. This is supported by research (Kinnafick et al., 2014) whereby individuals that did not adhere to the 10-week walking intervention for reasons that ultimately impacted their experience of pleasure and enjoyment. For example, the non-adherers viewed the intervention as an inconvenience thus perceiving it as low importance. This highlights that

health professionals attempting to increase population activity levels must factor in the facilitating and undermining factors that affect a person's intrinsic motivation towards exercise. There also remains the problem that some inactive populations may not view any form of exercise as inherently pleasurable, interesting or enjoyable and it is the duty of the health promoting organisations to ensure a range of different forms of activity are accessible to promote autonomy and that more community-based initiates are readily available.
Some participants described being highly motivated to attend Bestrong and exercise to feel accomplished and challenged. In the literature, being motivated to achieve a tangible goal is described an extrinsic motive and in the PA literature, extrinsic motives impede long term engagement. In sports, extrinsic rewards are central as athletes from novice to elite receive rewards for winning and avoid losing. However, many sports involve a certain degree of self-determined motivation such as pleasure, enjoyment and skill improvement which is likely the determinant of long-term sport engagement. PA and sport engagement are inherently different and the literature surrounding reasons for engagement and importantly, long term engagement suggest that exercise needs to be internalised and exhibit a high level of self-determination (Teixeira et al., 2012; Fortier et al., 2012; Teixeira et al., 2015) However, in similarity, both sport and exercise are motivated by challenge and accomplishing goals. In the context of this study, many participants described their reasons for engagement as being influenced by being challenged and achievement. In support of previous literature, the motives for engagement in UK parkrun included providing opportunities for competence testing challenges (e.g. improving times, running the whole distance, or reaching milestones of 50 or 100 runs) (Dunne et al., 2021). In addition, this sense of achievement may have contributed to the development of their exercise identity as perceptions of commitment and improvement are direct contributors to changes in exercise identity (Caddick and Smith, 2014). These competence-based goals are in accordance with the self-efficacy theory (Bandura, 1977; McAuley and Blissmer, 2000) which suggests that interventions need to help individuals set goals, self-monitor behaviour, and use social support to maintain a challenging behaviour such as exercise. This directly supports the data from the current study, as participants explain that their sense of achievement is parallel to their continuous engagement.

Situational barriers emerged as a key debilitating factor for members of Bestrong to attend or possess the drive to engage in physical activity. The literature on COVID-19 globally suggests that the restrictions imposed impacted physical activity levels (Nienhuis and Lesser, 2020; Roche et al., 2022; Jiao et al., 2022; Mata et al., 2022). A systematic review of 66 studies found that physical activity significantly reduced during lockdown. Restrictions that required people to stay at home and limit or stop the use of exercise facilities caused a reduction in activity (Roche et al., 2022), therefore, COVID-19 is described as a key barrier to physical activity. Research has identified the specific impact of COVID-19 restrictions on activity levels between demographic groups and found that women found the public health restrictions to be a stronger barrier to exercise than men (Nienhuis and Lesser, 2020). In addition, COVID-19 restrictions were cited as a huge detriment on independence and ability to be active in older adults (Jiao et al., 2022) whereas some adolescents reported COVID-19 as a facilitator as it presented opportunities to take part in activities not done previously, like physical activity (Ng et al., 2020). The findings above suggest that the COVID-19 restrictions may have been beneficial for health and well-being for some individuals, which partially supports the current literature.

In the current study, the sample population were predominately female middle-aged adults and all members attended Bestrong at least once a week meaning it is plausible why the COVID-19 restrictions were described as a key barrier to exercise. In the context of Bestrong, the pandemic removed any opportunity for social interaction and physical activity which many members relied on for improvements in physical and mental health. The removal of routine, interaction with other members and physical exercise negatively impacted their drive to engage in other forms of activity, such as online formats. As Bestrong is a community initiative, the closure of such programmes will have been a jointly felt impact and have impacted multiple avenues in their lives. Many participants relied on Bestrong to engage in physical activity, and it seems the closure had a direct impact on their interest in being active away from Bestrong, suggesting their motivation may branch out further than physical activity as an activity and rather their motivation possibly stems to the whole attendance and membership (e.g., food diary, weekly meet ups, educational talks). Although most participants described the pandemic as being obstructing of their ability and motivation to engage in Bestrong and be physically active, some explained that the COVID19

pandemic was beneficial and helped their diet and exercise routine as there was less temptation at social events to eat calorie dense foods and were able to commit to their weight loss goals much easier. One participant explained that he encouraged other members of BeStrong to keep active during the pandemic and took on a leadership role in doing this, highlighting the sense of community.

The findings above suggest that the COVID-19 restrictions may have been beneficial for health and well-being for some individuals, which partially supports the current literature. Ng and colleagues (2020) found that in one quarter of their adolescent sample, the COVID19 restrictions facilitated physical activity as it presented opportunities to take part in activities not done previously. Whilst a majority of studies suggest that lockdown restrictions had a negative impact on their activity levels, it is important to address the factors that resulted in a positive impact on activity. For some, the COVID-19 restrictions required people to focus purely on their health and wellbeing and removed the temptation of food and inactivity when socialising pre-pandemic. This perhaps reflects the nuance between autonomous and controlling environments, as this participant gained freedom from tempting environments during lockdown in comparison to pre-lockdown where they felt coerced into making less healthy choices. It may be that lockdown provided a re-evaluation of embedding healthy lifestyle choices into their routine, though this should be explored further. On the other hand, participant 17 adopted a leadership role by encouraging other members to remain active. This further demonstrates the importance of social support, which is embedded in the culture of Bestrong and actioned not just by the founders but by the members.

In addition, time is described as one of the fundamental barriers to being physically active (Sequeira et al., 2011; Hoare et al., 2017; Koh et al., 2022), particularly in women (Peng et al., 2023) as they continue to perform a large proportion of household tasks and childcare responsibilities despite the increase of women in the workplace (Moreno and Johnston, 2014). As this sample was predominately female, it is unsurprising that a common barrier to being active was time. Participant 12 describes the multiple daily tasks as a mother that restricts their motivation to go out and exercise in the evening and this is a common theme within the literature, whereby mothers feel they do not have the time to exercise because of child rearing responsibilities (The national agency for sport, 2008; Moreno and Johnston, 2014; Peng et al., 2023). This barrier is less associated with males and reflects the differences in physical activity promotion efforts that is required between genders. Ansari

and Lovell (2009) found that in a sample of younger women in London, time constraints due to parenthood affected exercise participation the most, with only 35% of women that were active before childbirth, being active after having children. This is in support of the current study whereby some members of Bestrong describe time as a key barrier to exercise regularly, which is magnified with child rearing responsibilities. In order to consider time barriers to physical activity, multi-level, progressive promotion efforts are needed that aim to embed some form of activity into people's lives that are maintainable and feasible for busy schedules. In addition, it is essential to use gentle behaviour change approaches as opposed to quick fix or short-term programs that many do not sustain.

The literature on physical activity levels in retired aged individuals is mixed; some research has found that female older adults perceive significantly greater barriers to exercise than a sample of younger females, thus impacting physical activity levels (Ansari and Lovell, 2009). However, systematic review research suggests that the transition to retirement results in an increase in leisure-time physical activity (Barnett et al., 2012). It is clear that retirement can impact a person's susceptibility to be active, in terms of facilitating their motivation to engage in exercise or creating more barriers and apprehension towards exercise. The findings in the current study highlight the different lifestyle challenges faced by women within different age brackets and that specific physical activity promotion strategies should target gender and in particular, in different life stages. Bestrong have a varied member's age range from early 20-year-olds to 70+ and tailor their services to appeal to all their members. For example, evening activity sessions are hosted at different locations within the local area, at times that suit many individuals, from early to late evening. In addition, Bestrong include midday exercise opportunities for their retired or shift working members. Such tailoring of physical activity services should be more widespread and accessible in local areas for populations that find it difficult to be active due to time constraints.

In addition to situational barriers, many participants described personal barriers that often influence their drive to engage in physical activity. A majority of the literature states that the experience of stress (in work and personal life) impedes efforts to being physically active (Stults-Kolehmainen and Sinha, 2014; Schultchen et al., 2019; Hasan et al., 2023). Nahid (2023) found that 42% of 400 adults in Bangladesh reported stress as a major barrier to

being active, despite their knowledge of the stress relieving benefits exercise has. In addition, higher stress in a cohort of university students were directly related to a reduction in physical activity (Schultchen et al., 2019). Physical activity is well documented as being a protective factor against experiencing stress, and the beneficial effects of regular exercise in preventing chronic stress (Tsatsoulis and Fountoulakis, 2006; Hamer, 2012). However, in the current study, participants understood the benefits of exercising when stressed but still found it difficult to engage, suggesting that whilst physical activity promotion efforts should focus on activity when stress is high, to break the cycle of stress leading to inactivity, it may be that other realms of stress alleviation is incorporated around physical activity. For example, Bestrong cultivated an environment of connection and support, and weekly sessions were not just focused on physical activity. Research suggests that exercising with others is thought to increase the stress-reducing benefits of exercise (Plante et al., 2001), therefore, driving the development of community-based initiatives, such as Bestrong, where members build a sense of connection with others with a built-in exercise session, could be beneficial when stress is high. The social support component of Bestrong's service largely plays a part in why the organisation has low attrition rates. It is perhaps necessary that in order to prevent stress negatively impacting physical activity levels, attempts should be made to widen opportunities for connection and social support in a physical activity environment. For example, creating structured green spaces with socialisation opportunities (Fan et al., 2011). In addition, to keep encouraging the importance of regular physical activity, which is thought to reduce a person's sensitivity to stress (Tsatsoulis and Fountoulakis, 2006).

A second personal barrier was more closely related to their sense of self and perceived appearance. A majority of the literature states that the experience of stress (in work and personal life) impedes efforts to being physically active (Stults-Kolehmainen and Sinha, 2014; Schultchen et al., 2019; Hasan et al., 2023). Nahid (2023) found that 42% of 400 adults in Bangladesh reported stress as a major barrier to being active, despite their knowledge of the stress relieving benefits exercise has. In addition, higher stress in a cohort of university students were directly related to a reduction in physical activity (Schultchen et al., 2019). Physical activity is well documented as being a protective factor against experiencing stress, and the beneficial effects of regular exercise in preventing chronic stress (Tsatsoulis and

Fountoulakis, 2006; Hamer, 2012). However, in the current study, participants understood the benefits of exercising when stressed but still found it difficult to engage, suggesting that whilst physical activity promotion efforts should focus on activity when stress is high, to break the cycle of stress leading to inactivity, it may be that other realms of stress alleviation is incorporated around physical activity. For example, Bestrong cultivated an environment of connection and support, and weekly sessions were not just focused on physical activity. Research suggests that exercising with others is thought to increase the stress-reducing benefits of exercise (Plante et al., 2001), therefore, driving the development of community-based initiatives, such as Bestrong, where members build a sense of connection with others with a built-in exercise session, could be beneficial when stress is high. The social support component of Bestrong's service largely plays a part in why the organisation has low attrition rates. It is perhaps necessary that in order to prevent stress negatively impacting physical activity levels, attempts should be made to widen opportunities for connection and social support in a physical activity environment. For example, creating structured green spaces with socialisation opportunities (Fan et al., 2011). In addition, to keep encouraging the importance of regular physical activity, which is thought to reduce a person's sensitivity to stress (Tsatsoulis and Fountoulakis, 2006).

The final theme emerged as participants described the coping mechanisms used to overcome barriers and the associated processes they adhere to. PA time constraints are multi-factorial (Brunet et al., 2013) and time use varies based on a person's circumstances. For example, full time working mothers are often confronted with significant constraints on their time to be physically active (Emm-Collison et al., 2019) which reduces as children grow older or when adults have reduced hours or are retired. However, it may be that coping with time constraints and prioritising PA are mutually exclusive, as participant 6 describes, allocating time to be physically active needs to be considered a necessity for health and internalising a personal importance of being active may facilitate PA behaviour (Duncan et al., 2010). Studies have shown that practicing PA for identified motivations, whereby personal importance of the behaviour is cultivated, is associated with high engagement and adherence (Ingledew and Markland, 2008; Teixeira et al., 2012). Unfortunately, for inactive individuals or novice exercisers, particularly those with time demanding lives, internalising the importance of PA behaviour may not occur at adoption and these particular groups may

need extra support or could be at risk of disengagement. In addition, many PA promotion attempts engage individuals through controlling strategies that create a norm of “needing” to exercise as opposed to “wanting” to exercise (Teixeira et al., 2012). PA priority is therefore likely to begin by establishing personal goals and examining techniques that ensure PA can be embedded into a person’s lifestyle, just as any other health promoting behaviours are embedded into a person’s lifestyle, such as taking medication. In order to cultivate personal importance, particularly for individuals with time constraints, it may be that incorporating PA into family time such as increasing family walks or playing active games instead of sedentary activities will promote a stronger significance of being physically active. However, some participants adopted the nuance of a mind-set shift; participant 4 explained that Bestrong provided strategies to maintain a more positive mind-set that enabled them to be active and make healthier eating choices. Some research distinguishes between mind-sets applied to fitness, in particular growth beliefs and a growth mind-set which involves a large degree of self-control (Orvidas et al., 2018). For example, initiating time to exercise or eat healthily, inhibiting the temptation to skip an exercise class or eat convenience food and continuing this behaviour despite barriers that may impact efforts. A growth mind-set is a belief that human behaviour is malleable and will actively approach challenges as opposed to avoiding situations that are uncertain (Dweck S., 2015). Individuals that practice a growth mind-set will see failure as an opportunity to learn and this was demonstrated by participant 10 who explained that learning about other member’s struggles was a chance to resonate with others and relate to their own experience. In relation to PA, growth-oriented mind-sets are associated with higher exercise frequency and increased self-efficacy (Orvidas et al., 2018) meaning fostering a growth mind-set is likely to engage individuals and encourage frequency over time. Given that one of the personal barriers that emerged as a sub-theme was a *self and mind battle* whereby participants felt their perceived competence was often impacted by their own negative interpretations of their ability and physical appearance, Bestrong creating tools and strategies for members to challenge their mind-set and practice a more growth-oriented belief is going to have a positive impact in their approach to attending and being active.

In addition to prioritising exercise, many participants described the importance of making exercise habitual. Being consistent in their routine was described as being beneficial for

stability and continuation of the behaviour, which supports the idea that habitual actions are cue specific, for example events (locations, people), activities or timings (Verplanken, 2018). It is likely that members have developed multiple specific contextual cues when attending Bestrong (the same location, people and timing each week) which have reinforced the strength of the habitual action. Whilst habit strength has not been quantified in this qualitative study, it does appear that some participants engage in PA outside of conscious awareness which denotes strong habits. Participant 11 described an automaticity component of PA behaviour whereby being active was embedded within their daily routine, making comparisons to more simple everyday behaviours such as brushing your teeth. This is in support of the habit literature, when individuals have built strong PA habits over time, the behaviour is described as occurring outside of conscious awareness and less deliberation or intention is needed for the behaviour to happen (Lally et al., 2011; Rebar et al., 2014). Some habit research suggests that once habits reach a strength and have developed automaticity, PA facilitators such as autonomous motivation, may not be as important at driving PA behaviour as if habits were moderate or had not reached automaticity (Hopkins et al., 2022). In the current study, participants who described PA as being ingrained in their routine have probably developed strong PA habits, which is context dependant (Bestrong), and the behaviour requires less cognitive deliberation. For example, whilst not specific to Bestrong attendance, participant 12 describes a strong habit for walking during lunchtime and even when intentions are low or debilitating factors such as busyness of work occur, they consistently engage in this behaviour. This is helpful for individuals seeking to increase PA but with concern of the difficulty and may persuade people that the behaviour will become easier to enact. A second process that may be useful for habit strengthening is considering the behaviour to be a necessary activity, just as washing or cleaning your teeth and modelling this behaviour onto other family members to increase normative function. The behaviour change literature suggests that repeating PA behaviours in consistent settings increases automaticity which can then be modelled at an individual or interpersonal level (Lally et al., 2010). Participant 10 demonstrated that it was equally as important to embed PA into their children's daily routine to ensure the whole family unit reinforce the PA behaviour.

Lastly, participant 13 chooses to perform PA at certain times and in certain situations (at Bestrong) to increase likelihood that the behaviour will be stable and reinforced, as exposure to situational prompts (e.g., other members of Bestrong) increases the predictability of PA. Whilst this is an important function for habit formation, it is likely to be problematic if exposure to these prompts happened to cease, such as during a holiday (Lally et al., 2010), whereby individuals may need extra support in engaging again on return. Research suggests that health behaviours often fail to be enacted even when they intend to do so, known as the intention behaviour gap (Sheeran, 2002; Mullan et al., 2021). A technique used to manage this gap is action planning, whereby individuals use different modes of planning to specify where, when and how a behaviour will be enacted (De Bruijn et al., 2012). In this example, participant 5 books onto a specific PA class a week in advance, often occurring at the same time each week, to ensure this behaviour is enacted. In addition, participants 6 and 8 write down their plan to exercise which helps bridge the gap between intending to exercise and facilitate the action. Research has suggested that incorporating behaviour change techniques such as barrier management and action planning are successful at facilitating PA behaviour (Bélanger-Gravel et al., 2011). There is a lack of understanding of the benefits of the most effective techniques in relation to planning for PA behaviour and interventions do not tend to be designed to specifically assess the contribution of planning. Whilst it is evident that some participants in the current study effectively use different methods of planning to ensure PA is enacted, each technique adopted is individualised. Perhaps PA promotion attempts should promote variety and decision making as it may be insufficient to prompt single types of behaviour change techniques alone. In order to bridge the gap between intention and behaviour enactment, action planning is an effective technique, though without a plan that is pre-specified the overall efficacy is reduced (Kwasnicka et al., 2016).

4.4.9a Strengths and limitations

There are a number of strengths associated with this qualitative exploration. Firstly, the data collected was rich and in-depth, due to the semi-structured nature of the questions, interesting concepts were explored that ultimately resulted in a well-rounded understanding of participants experience with physical activity. The research question aimed to understand

participants experience of motivation, which we feel were addressed in all six distinct themes. We were able to gather rich and detailed insights into what facilitates and impedes physical activity behaviour within the community sample, which was not possible from the quantitative data alone. In addition, this study is novel and the six distinct themes that emerged have not been studied within this population of interest. The essence of qualitative research means making sense of the data and building a meaningful picture. I feel the six distinct themes reveal a full picture of the multi-factorial reasons individuals within a community group engage in physical activity whilst recognising the many challenges faced when embedding such a complex behaviour into their life. The fifth and sixth theme are novel and offer very specific coping strategies that are used when such challenges are experienced. Whilst the data clearly represents the subjective interpretation of this community exercise sample, the findings are informative and may be used to improve other community settings that perhaps struggle with attrition or lack of progress. Whilst some of the barriers presented in theme 4 are not unique to this study, they represent the need to use the findings in an applied way and addressing the barriers listed, that were in support of previous research, is crucial. Lastly, as described in the methods chapter, there is no gold standard for sample size in qualitative research, however, this study reached data saturation at participant 19, which is a relatively strong sample size, given it was predicted 12-15 participants would be satisfactory. Recruiting 19 participants allowed for a strong and rich data set whilst ensuring all participants could describe their own subjective experience as individuals.

Despite the strengths, there are some limitations to address. Firstly, it is possible that there was an element of self-selection bias, as members of the community sample volunteered be interviewed after completing the survey. This can be a larger problem in quantitative research as it impacts the external validity of the findings, however, within this context, the data is representative of the community sample at large and did not aim to be generalisable to whole population samples. Whilst it is possible that the self-selection of participants caused a bias, it still remains that the themes that emerged are representative of Bestrong. A second limitation, which was out of the researcher's control, was the method of data collection. Due to the COVID-19 and the strict restrictions at the point of data collection, it was necessary to conduct interviews online via Zoom. This was advantageous for several

reasons (i.e., no need to travel, ease of recording and transcribing, reduced burden of time). However, being a researcher with experience of both face to face and online semi structured interviewing, there are some limitations of the online format. Firstly, many participants arranged interviews in their home, often late in the evening meaning there were more distractions (e.g., family responsibilities, internet problems) that may have been controlled for if interviews were conducted in a quiet room at the Bestrong site (as originally proposed). Secondly, in-person interviews allow for a stronger ability to build rapport and understanding body language. However, during the time the interviews were being conducted, there were very strict government restrictions in place due to the pandemic meaning participants were grateful for the prioritisation of conducting interviews online and this likely created ease and contributed to building rapport. Lastly, a weakness of this study could be the lack of novel findings in comparison to the quantitative data, however this is certainly justified. As mentioned, the purpose of qualitative research is not to gather data that is generalisable to the whole population because that diminishes any sense of individual differences, instead the purpose is to understand the perspectives and subjective interpretation of a small population of interest, to understand social processes. Therefore, the data certainly extends and informs that of the quantitative data from the community sample in chapters 4 and 5, but more so, the distinct themes provide a well-rounded story of the complex processes (reasons for, barriers to and coping methods) of physical activity behaviour in this particular group. These results could be used to address the challenges listed with a rich and detailed interpretation, which is not always possible to gain from quantitative findings.

4.4.9b Conclusion

Theme 1 (the social capital of BeStrong) has 2 subthemes (culture of Bestrong and promoting engagement with other members and creating supportive networks). Theme 2 (physical and psychological improvement) has 2 subthemes (weight loss and improving physical and mental health). Theme 3 (rewarding outcomes) has 2 subthemes (enjoyment and pleasure and sense of accomplishment from challenge). Theme 4 (situational barriers to being physically active) has 2 subthemes (COVID-19 restrictions and time). Theme 5 (personal barriers to being physically active) has 2 subthemes (stress and life events and self

and mind battle). Theme 6 (processes to overcome barriers to being physically active) has 2 subthemes (mind-set shift to prioritisation and making exercise habitual). The findings offer an in-depth understanding of the psychological processes that facilitate not just physical activity behaviour, but membership of the community group, which is of high importance to many of the participants. The sense of social support infiltrates through each theme and the strong sense of belonging that is embedded in this community group is a key motivator.

5.0 Chapter 5 General discussion and conclusion

5.1 Chapter overview

This chapter aims to conclude the findings of this thesis by providing a brief overview of the findings, discuss the methodological implications of the studies and discuss the practical implications in terms of physical activity promotion. There were three overall aims of this thesis; firstly, to conduct a systematic literature review on the topic of physical activity motivational profiles in order to gain an in depth understanding of the current climate of research and the key empirical gaps. Secondly, the thesis aimed to identify the PA motivational profiles in two different samples (an adult sample and a community exercise sample) and identify any relationships between covariates such as age, gender, ethnicity and education. Thirdly, this thesis aimed to test whether motivational profiles moderate the relationship between PA and habits, in the two separate samples. Lastly, this thesis aimed to qualitatively explore experiences of motivation for PA in a sample from a community exercise initiative. Each study contained a discussion with strengths, limitations and implications of findings in respect to that study. This chapter will provide a briefer summary of the main findings and how these findings might be used when considering future work, both practically and from a research perspective. A paragraph on the strengths and limitations of the overall study and a general conclusion will follow.

5.2 Methodological considerations for motivational profiles and physical activity research.

RQ1: What are the methods that have been used in motivational profiling and physical activity research and what does this mean for future understanding of profile membership and physical activity levels?

Motivational profile research has predominately used cross sectional methods which makes it difficult to assess the change in motivation over time. The systematic review discussed in chapter 2 showed that a large number of studies investigating physical activity motivational profiles used a cluster analysis, which is considered a bottom-up approach (finding similarities between cases) as opposed to a small number of studies using latent class analysis, which is considered a top-down approach (i.e., describes the distribution of the data based on the probability the cases are members of the classes). The majority of studies using cluster analysis for physical activity motivational profiles measured motivation as amotivation, controlling and autonomous motivation. This approach doesn't account for the entire continuum of motivational regulation (Howard & Hoffman, 2018) and this type of analysis reveals far less information about each individual profile and their co-existing relationship meaning with a variable centred approach, for example, we know that controlling and autonomous motives are not incompatible but without understanding how such variables interact collaboratively, we would not know that they are also not mutually exclusive (Heredia-Leon, Valero-Valenzuela, Gomez-Marmol & Manzano-Sanchez, 2023). We know from motivational profiling research that individuals are able to be motivated for 'opposing' reasons (i.e controlled and autonomous) simultaneously but in varying degrees, we can see from the results that a high introjected profile means individuals are highly motivated for both controlling (introjected) and autonomous reasons which operate together and have a positive impact on physical activity behaviour, though we are not sure of the impact on physical activity sustainability.

A latent profile analysis is viewed as a more conservative method because the data is analysed based on probability rather than similarities between cases, which is a much more accurate approach and with less room for error. Latent profile methods are relatively novel in comparison to the cluster analysis so when dissecting the methods and results of the studies using a latent profile analysis, taking into consideration there were only three studies in the literature review, all three studies (Altintas, Guerrien, Vivicorsi, Clement & Vallerand,

2018; Lindwall et al., 2017; Zhong & Wang, 2019) analysed all six motivational regulations and used more complex samples i.e., looked at more than one cohort of individuals with larger sample sizes. Comparing a number of different samples is important because we know from physical activity research, that activity level and particularly motivation, can differ between cohorts of individuals in different demographics (Lindwall et al., 2017). By making demographic distinctions between groups, we can develop understanding on the motives that facilitate or impede physical activity on a much more developed and detailed level. When comparing profiles based on analysis of all six motivational regulations, as in a latent profile analysis, we can compare groups based on their similar characteristics which can in turn provide internal validity on motivational frameworks such as SDT and externally validate motivational theories such as the Organisational Integration theory (Lindwall et al., 2017).

The systematic literature review in chapter 2 was a necessary part of this thesis and impacted the decision making of the method best suited for the overall research project whereby a cross-sectional design and using a latent profile analysis was deemed most appropriate. Whilst future directions for motivational profile research certainly involve considering longitudinal methods, these methods were not feasible for this research project. Adopting a cross-sectional design meant that an analysis on habits and motivational profiles were conducted, which is advantageous before conducting a design over a longer period of time. It was an important consideration to use a latent profile analysis in order to consider all six motivational regulations and a cross-sectional design was implemented due to the COVID-19 pandemic restrictions.

In terms of future understanding of motivational profiles based on the systematic literature review, the cross-sectional studies included in the chapter 2 review highlight that information on each profile type may be informative in terms of knowing whether a person is motivationally at risk, characterised by low motivation and associated with less desirable outcomes, such as low physical activity or attrition (Hagerman, Miller & Butryn, 2022). We know that cross-sectional studies do not allow us to make inferences about how a person becomes motivationally risk over time (Wang & Cheng, 2020) and this goes beyond the scope of this PhD but we do know that certain groups of individuals are more at risk of being

unable to sustain an active lifestyle when exhibiting the characteristics of certain motivational profiles (e.g., low in autonomous motives). The review in chapter 2 highlighted high levels of physical activity are dependent on a number of specific motivational regulations, not necessarily following the pattern proposed in the SDT continuum meaning SDT, or more specifically, the Organismic Integration Theory, as a theory might not be a one size fits all and slight differences between cohorts could be informative when designing PA interventions using SDT. Perhaps the adaptation of interventions should acknowledge the role of motivational profiles and the differences between cohorts, though this will be discussed further below.

While the review in chapter 2 was an important and necessary part of this thesis, there were some methodological weaknesses that ought to be discussed. Mainly, it remains unclear the causation of the relationship between profiles, for example the profiles high in self-determination may have higher physical activity levels due to being autonomously motivated or increased physical activity levels overtime may have increased autonomous motivation. In addition, due to the multidimensionality of motivation, it is unclear whether other psychological processes were involved and thus impacted PA, which influenced the motivation for the quantitative and qualitative study in this thesis.

5.3. Physical activity motivational profiles from a general adult population and a sample from a community exercise initiative.

The aim of the quantitative study in chapter 3 was, by building on the results of the systematic literature review, to assess the motivational profiles from two different samples and subsequently test whether motivational profiles impact the relationship between physical activity and habit. As discussed in chapter 1 of this thesis, the literature on physical activity motivational profiles is relatively novel. The motivational profiles in the literature and in this study were similar in nature and therefore represent some form of universality in profiles. It is well-established that autonomous motivation is more predictive of long-term PA participation, this finding is well-established from variable centred approaches (Teixeria et al., 2012) and motivational profiles research using cluster analysis (Friederichs, Bolman & Oenema, 2015). However, this study aimed to reveal the motivational profiles of two

separate groups using a latent profile analysis and including all six regulations from SDT, which is important when considering how these findings might implicate behaviour change interventions.

Four distinct profiles emerged, in the general population and the community exercise sample. While these profiles were similar in some ways, for example both samples had a profile that was high in autonomous motivation and a profile with low overall motivation, in line with the extant literature, the actual membership of these profiles differed. Firstly, the community group was more physically active overall and more than 60% of individuals in each motivational profile were deemed sufficiently active. In addition, a higher percentage of members from the community group were found to be in the high identified/intrinsic profile compared to just a third of the general population being in the high identified profile, suggesting this cohort of individuals are more likely to exercise for reasons such as enjoyment and finding exercise valuable, which in turn may predict likelihood of long-term maintenance. The results suggested that the community exercise group are less likely to be in a profile with high scores on introjected regulation and autonomous regulation combined, indicating a higher number of individuals possessing high quality motivation and exercise being internalised in an autonomous fashion. We expected the members of Bestrong to have different experiences in relation to their exercise participation compared to the general population, making them an interesting and unique population to study. This was the case for a number of reasons, firstly, Bestrong is a community-based initiative ran by two individuals from the community in which it stands in comparison to government led or larger corporation led initiatives, it is well understood that the members of Bestrong receive very personal support and guidance within their membership, which is a key contributor to their high success rate and low dropout rate. As the SDT states that exercise longevity is facilitated by autonomous motivation, Bestrong founders creating an environment that likely encourages autonomous motivation, means this population is unique in comparison to a general population sample, who may not attend a community group with such advantages. Understanding the reasons why these members participate in PA and attend Bestrong and how these reasons relate to the quality of their experience of PA is important in ensuring that organisers of community-based exercise initiatives provide a suitable offer to meet the needs of their members.

To design and implement successful behaviour change interventions, practitioners should aim to make conditions as real-life as possible. For example, a replication of the community exercise group in a behaviour change intervention whereby a number of different psychological mechanisms that support behaviour change (e.g., action planning, self-and/or group monitoring, intrinsic rewards to name a few) would be advantageous. Using a multitude of behaviour change techniques, such as promoting social support, self and group monitoring, feedback, education and readily available information on health behaviour, which is seen in Bestrong, to increase high quality motivation for physical activity in more real-life settings, a more accurate understanding of how motivational profiles influence engagement can be measured.

5.4 Do the distinct motivational profiles identified in each sample moderate the relationship between PA and habits?

In the general population, PA habit strength was highest in profile two and represented a score associated with reaching behavioural automaticity. Habit strength was weak in profile three and four in the general population sample, however, in the community sample, PA habit strength was moderately strong in all four profiles and there were no significant differences between profiles. As discussed in chapter 4, it is proposed that due to the bidirectional relationship between PA and habits, it may be that in the community sample PA is no longer a significant predictor of habit and consequently habit acts as a predictor of PA. It may be the delivery method of the community sample that reinforces their behaviour and promotes habit formation and to design successful behaviour interventions, more real-life, community-based groups that draw on the principles of habit formation processes would be most effective.

Motivation for PA is by nature, multidetermined and motivational profiles present that there are multiple reasons for being active which facilitate the behaviour, however, it is also clear that a higher quality motivational profile may facilitate the development of a PA habit, up to a certain point, but once developed, the behaviour is repeated in a more automatic fashion and the quality of motivation may be less important, again representing a bidirectional relationship. PA promotion attempts should incorporate the same features of the

community initiative (localised, community driven, group-based activity) to drive the increase in PA levels and facilitate the development of strong PA habits. Stakeholders could attempt to introduce more community-based exercise initiatives that support the transition to more adaptive motivational profiles, making such initiatives more readily available to all members of the public would be beneficial in helping normalising movement over strict exercise routines, for example.

5.5 How do members of a community-driven exercise initiative experience motivation and what are the facilitators or barriers to PA engagement?

As discussed in chapter four, a qualitative study whereby members of the community exercise initiative were interviewed to explore their experiences of motivation as members of a unique and successful community driven group. Six themes emerged from the data; social capital; physical and psychological improvement; rewarding outcomes; situational barriers; personal barriers; processes used to overcome barriers. When considering the reasons for physical activity engagement, and considering the notion of SDT, it is well-established that the reasons are multi-faceted. The qualitative results show that members of BeStrong engage in physical activity for social connection, weight loss, mental health improvement and reward seeking (e.g., enjoyment and sense of achievement). While these findings are not necessarily a novel revelation to the literature, we can consider that the environment that has been created for the members, contribute to their internal drive to continue attending, which is what governmental bodies aim to instil in the general public. Both the cultural and social environment of Bestrong was identified as contributing to member's engagement and motivation to continuously attend Bestrong and embedding a culture that mirrors the goals or purpose seeking behaviour of its members (e.g., health improvement, socialising) promotes a reason for members to continuously engage with the initiative. Many of the participants described the supportive aspect is important for sustained engagement, especially when motivation is low, which is supportive of the social support literature and the social capital theory (Bourdieu, 1986).

If connection and support from others is a facilitator of physical activity engagement, practitioners and stakeholders should aim to encourage physical activity with group-based activity, which might be more sustainable than advertising external incentives.
The disadvantage of community-based interventions is the level of attrition when the intervention is removed or completed, which does not serve to tackle physical inactivity levels long term. This research-to-practice gap, whereby there is a lack of translation of successful interventions in controlled conditions into real-world contexts, outlines a significant challenge for public health and community engaged researchers and practitioners attempting to implement effective and sustainable interventions for population health. Drawing on the benefits of real-life successful community initiatives, such as BeStrong is advantageous for informing practitioners and is lacking in the literature. In relation to health promotion, it would be beneficial to embed an understanding of the physical and mental wellbeing benefits of being active that appeals to a whole population.

When considering the findings of the qualitative study, importantly, social interaction with other members does facilitate motivation to re-attend due to sharing similar goals and collaborating as a group. Driving the importance of social connection may be advantageous for PA promotion attempts for individuals seeking to exercise with others. Social support satisfies the psychological need of relatedness and participants described their experience at Bestrong as an environment with high-quality close relationships that increase a sense of belonging. This strong sense of social support is a powerful driver for engagement.

5.6 General discussion of quantitative and qualitative findings

The quantitative and qualitative studies in this thesis stand as separate studies and we not combined in any way, however, when reflecting on the findings, we can make some similarities. Firstly, the characteristics of the high-quality motivational profiles that emerged in the community sample and could explain why there are slight differences in motivational profiles between samples. For example, the community sample scored high on intrinsic regulation (enjoyment/pleasure) in profile 1 whereas profile 1 in the general population was characterised by moderate scores on intrinsic regulation. Subthemes of enjoyment and

pleasure emerged within theme 1 in the qualitative study whereby participants explained that attending Bestrong is always fun and enjoyable, which triggers a reason for repeated engagement. Similarly, motivational profiles with high PA levels scores were characterised by high integrated and identified regulation. Within this theme, participants were motivated for challenge and accomplishment and to improve health, which was personally important (identified) and because being a member was part of their identity (integration). Reasons for engagement that described externally regulated motives (weight loss/appearance) did not support quantitative findings. Many individuals explained that having weight loss or appearance driven goals strongly influenced their engagement in PA and attendance to Bestrong, however, on average scores were low on external regulation in the BREQ-3 survey. This discrepancy highlights the advantages of using a mixed-methods approach, whereby qualitative exploration can reveal more information on quantitative findings. Results could be used to address the well-established barriers to physical activity engagement, particularly in women.

In addition, profile 3 in the general population sample was characterised by moderate identified regulation and low scores on the remaining regulations, with a relatively high percentage of participants not sufficiently active (46%) whereas in the community sample, profile 3 was characterised by moderate scores on intrinsic, integrated, identified and introjected regulations, with only 22% insufficiently active. Perhaps demonstrating that in the community sample, whilst this profile would be considered a lower quality motivation because scores are moderate compared to profiles 1 and 2, in comparison to the general population these participants are motivated for reasons that have undergone some level of internalisation (e.g., personal importance, conscious value, sense of identity, enjoyment and pleasure). All of these types of motives are reflected in the qualitative subthemes on reasons for engagement. In addition, introjected regulation (regulation contingent by self-esteem e.g. interpersonal conflict) was moderate to high in 3 of the 4 motivational profiles in the community sample, which supports the subtheme of internal conflict and guilt.

Avoidant introjected regulation e.g., guilt is often associated with negative consequences on PA behaviour (Hurst *et al.*, 2017). However, the in-depth interview data demonstrated that guilt is not always a deterrent on PA engagement and can actually be advantageous for

behavioural repetition. We speculate that whilst participants experience guilt for not attending, the guilt is often manifested as a positive enforcer which encourages participants to attend to support and spend time with their peers but in non-attendance, participants did not seem to be concerned about any negative consequences. Therefore, introjected regulation is likely beneficial when experienced with more autonomous and internalised types of motivation. Though this is speculative and would need to be explored further in future research.

When considering why individuals engage in PA it is important, for intervention or promotion designing, to consider the barriers that impede engagement or effect motivation and the ways in which people can build on coping strategies to avoid disengagement. The qualitative chapter aimed to explain the findings from a theoretical perspective and offered some insight into how the results could be applied practically. The third theme proposes ways in which members tend to cope with the barriers that impede their motivation which may be advantageous for PA promotion design e.g., helping people prioritise PA engagement, challenging internal conflicts to be more positive and the role of habits (creating, forming with others, forward thinking).

5.6 Strengths and limitations of this research

A number of strengths and limitations were listed in the prospective chapters for each study, however, there are some overarching points that relate to the whole thesis that must be mentioned. Firstly, the scope of this thesis was strengthened by the systematic literature review chapter, which aimed to review the current research on motivational profiles, a review that did not currently exist. When comparing to the vast amount of research on habits in comparison to motivational profiles it was deemed necessary to gain a thorough understanding of how this project can address the gaps. The systematic literature review was presented as a poster at an international conference in May 2023, receiving comments from experts in the field and aims to be published at a later date, which further strengths its place in this thesis. Secondly, the use of mixed methods allowed for a combination of both broad inference and in-depth inference, providing stronger confidence in the findings. The use of both methods was complimentary and while the purpose was not for either method

to explain the results of the other, the findings do work in parallel as the standardised, quantitative data is more generalisable whereas the rich subjective qualitative data allow a more insightful understanding of the complexity of physical activity motivation.

Limitations as mentioned in previous chapters are relation to the cross-sectional nature, whereby data was collected over one time point and does not reflect the dynamic nature of motivation and likelihood that while motivational profiles in function are largely universal, a person's ability to transition between profiles depending on a number of non-conscious (e.g., habits) or conscious (e.g., deliberation, intentions) processes. In addition, it would have been advantageous to interview participants multiple times over a specific time frame in order to assess any changes in motivational experience over time.

Using two different samples of interest strengthened the study but unfortunately there was a disproportionate number of females and white/Caucasian participants, potentially causing some bias in reporting and a lack of generalisability to males and other ethnic groups. This is likely why there was no significant difference between profiles on ethnicity, which is unlikely to be related to ethnicity and rather related to the disproportion of ethnicities within participants. Future research should prioritise identifying the differences between motivational profiles and ethnicity to ensure that health promotion attempts inclusive of the potential differences in what facilitates physical activity behaviour. It is well-established in the literature that some ethnic minority groups are presented as hard to reach in terms of providing access to health promoting services and are at risk of health issues related to lack of physical activity (Liu *et al.*, 2012). While it goes beyond the scope of this study, this avenue of research could ensure health promotion (i.e., physical activity promotion attempts) meet the needs of ethnic groups.

5.7 Implications for practice and future research

It is important to highlight that the findings could be first used to inform future design of intervention studies, over a significant period of time, to ensure the recommendations are

applicable. Longitudinal research measuring people's PA motivational profile membership at a number of different time points could inform understanding of whether an individuals transition between profiles is necessary to understand how motivation and habits change over time.

Assessing motivational profiles of different populations of interest, (I.e., inactive, initiates, maintainers, gender, age, ethnic background) may reveal understanding on the complexities of profile membership. Assessing PA habit strength over a period of time and assessing the casual relationship and the potential shift in the directionality by assessing habit strength in relation to profile membership over time is also a necessary addition to the literature. Lastly, qualitatively interviewing a number of the abovementioned sample populations to use rich, in-depth data to complement the quantitative inquiry.

5.8 Concluding remarks

Given the several limitations associated with this study, this research has added to the evidence relating to PA MP's; firstly, by conducting a systematic literature review which did not currently exist. The review found 12 studies on MP's that met the inclusion criteria, but some gaps were not filled which warranted this thesis. Secondly, this is not the first study to use LPA to identify the motivational profiles in two different samples, as shown in the systematic literature review chapter, but to our knowledge this is the first study to assess the relationship between motivational profiles and PA habits, specifically whether motivational profiles effect the relationship between PA and habits. Whilst no significant moderating effect was found, there were marginal differences in habit strength between groups and reflect that an initiative such as Bestrong with low attrition and high engagement are more likely to result in sustained PA behaviour and benefits from being physically active. In support of the qualitative findings, BeStrong participants are motivated to exercise due to the drive of social support/interaction, sense of identity and integration, weight loss body shape goals, physical and mental health improvement, challenge and accomplishment,

enjoyment and pleasure, pleasure, internal pressure and guilt, suggesting reasons are multifactorial and co-exist.

It is clear from the findings that a more comprehensive understanding of the causal relationship between PA and habits are needed. More specifically, the direction of the relationship between PA and habits and how/when these shifts. Given the huge benefits PA has on physical and mental wellbeing and the associated decline in life threatening illness when engaging in PA, higher quality motivational profiles that are characterised by more autonomous types of motivation are likely to result in long term sustained behaviour. In addition, motivational profiles with high autonomous motivation (more specifically identified reg and introjected) are most likely to have strong PA habits. To increase the likelihood of people maintaining PA and protecting their health, their reasons for engagement should be internalised and congruent with their sense of self.
Motivation concerns the direction and persistence of PA and is pertinent to all aspects of activation and intention, which is why it is imperative that population PA levels are not just increased i.e., more individuals are engaging in PA and gaining substantial benefits but the reasons for engagement are internalised and represent more self-determined reasons that have the best consequences for behaviour. In terms of what this means for practice, promotion strategies that engage by drawing on the principles of motivational profiles, more specifically profiles that are likely to result in sustained PA whilst taking into account the processes that may facilitate habit formation, will result in long term PA behaviour. People associated with low quality motivational profiles might need more support in transitioning to more higher quality motivational profiles which should be accounted for in the design of promotion strategies.

8.1 Appendix

Appendix 1: most recent ethical approval after amendments

Dear Natalie

BIOSCI 19-033 Amd 3 June 2022 - The dynamics of motivation for physical activity and health behaviours

NB: All approvals/comments are subject to compliance with current University of Leeds and UK Government advice regarding the Covid-19 pandemic.

We are please to inform you that your amendment to your research ethics application has been reviewed by the Faculty of Biological Sciences Research Ethics Committee (FBS REC) and we can confirm that ethics approval is granted based on the documentation received at date of this email.

Please retain this email as evidence of approval in your study file.

Please notify the committee if you intend to make any further amendments to the research as submitted and approved to date. This includes recruitment methodology; all changes must receive ethical approval prior to implementation. Please see https://ris.leeds.ac.uk/research-ethics-and-integrity/applying-for-an-amendment/ or contact the Research Ethics & Governance Administrator for further information fbsresearchethics@leeds.ac.uk if required.

Ethics approval does not infer you have the right of access to any member of staff or student or documents and the premises of the University of Leeds. Nor does it imply any right of access to the premises of any other organisation, including clinical areas. The committee takes no responsibility for you gaining access to staff, students and/or premises prior to, during or following your research activities.

Please note: You are expected to keep a record of all your approved documentation, as well as documents such as sample consent forms, risk assessments and other documents relating to the study. This should be kept in your study file, which should be readily available for audit purposes. You will be given a two week notice period if your project is to be audited.

It is our policy to remind everyone that it is your responsibility to comply with Health and Safety, Data Protection and any other legal and/or professional guidelines there may be.

I hope the study continues to go well.

Best wishes
Sou Chung
On behalf of Dr David Lewis, CHAIR, FBS REC

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Sou Sit Chung, Research Ethics Administrator, The Secretariat, University of Leeds, LS2 9NL, s.chung@leeds.ac.uk
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Appendix 2: qualitative interview guide

Welcome and study information:

Thank-you again for agreeing to help with this research. I'm just going to begin by talking a little bit about the research I am undertaking and what this means for you. My PhD aims to investigate how specific psychological mechanisms (such as motivation and habits) differ in individuals of varying physical activity levels, for example comparing novice exercisers to more experienced exercisers.

Thank-you for completing the online survey. The aim of the survey was to assess the different psychological variables involved in physical activity initiation and maintenance, variables such as motivation, habit, body image, self-efficacy, intentions were assessed.

The aim of today's discussion is to better understand your views and experiences of physical activity and any challenges you may have encountered. I am going to ask you to talk about previous physical activity levels, some of the reasons that led you to signing up to BeStrong and generally how you feel about exercise. We will then discuss a little bit about fitting physical activity into your lifestyle and if there are any challenges you face.

Everything you say during this interview is confidential and your responses will not be listened to by anyone outside of the research team. It is possible that some of the things you say will be quoted in my final thesis, however, your identity will be completely anonymised.

There are absolutely no right or wrong answers, I am just interested to learn about your experiences. If there are any questions you would rather not answer, that is absolutely fine, just let me know and we can move on. If you feel you would like to pause or stop the interview at any time, do not hesitate to say so. Please let me know if you feel uncomfortable or unwell.

Is there anything you would like to ask me before we begin?
Can I ask for your permission to record this interview? The recordings will be transcribed by myself and used for data analysis, but your identity will remain completely anonymous.

1) Firstly, to start, can you tell me a little bit about yourself and your experience with BeStrong?
   How long you've been a member, type of membership (online/in-person) – if in person how often do you visit? Classes or meetings?
   Type of PA you engage in?

2) What were some of the reasons that led you to sign up to BeStrong?
   a) Initial BeStrong attraction?
   b) Social aspect? Accessible?
   c) Health reasons
   d) Important goals?
   e) What was different to a normal gym/fitness centre?

3) Can you describe to me how active you were before joining BeStrong?
   a) What types of activities?
   b) Sports or exercise?
   c) During childhood, teens or adult life?

4) Can you explain any changes to your physical activity levels that occurred as a result of COVID-19?
   - Type of PA, motivation, less social contact, online delivery
   - Benefits of these changes
   - Challenges

5) Why do you engage in physical activity?
   a) What do you like about physical activity?
   b) Examples?
   c) Benefits of PA
   d) Do you ever feel guilty for not exercising?
   e) Have any aspects of your lifestyle encouraged PA?
      ~ explore lifestyle factors (i.e stress, mental health)
   f) Any other factors influenced engagement in PA?

Have any reasons for engaging in PA changed since you first signed up to BeStrong?

- Improved confidence
- Enjoyment? Fitness? Wellbeing??
- Changed values/attitude

6) Can you think of any barriers that might have impacted your physical activity levels?
   a) Internal barriers (i.e lack of confidence, body image, low energy)
   b) External barriers (i.e time, lack of resources, childcare, financial)
   c) Any examples?
   d) Have any of those barriers become easier to overcome? How so?
   e) Anything you have found easy about fitting PA into lifestyle?
      ~Why do you think this? (value of activity, enjoyment, appearance, fitness)

7) Now were going to shift the topic slightly, can you tell me how you go about fitting exercise into your lifestyle? What got you into the habit of exercising regularly?
   - E.g repetition, consistent setting, strict routine, go with friend, reward self?
   - What processes have you taken? Daily log, booking classes, travel with friends, routine?

   - is there anything you find or have found challenging about fitting PA into your lifestyle?
     E.g work schedule, pandemic restrictions, childcare?

   How have you learned to manage these challenges?

   Does exercise ever feel automatic or second nature? Doing it without thinking?

Go back to any points you want to discuss.

Summary, thanks, ask for questions, debrief, close.

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